CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
Karen Ross, Secretary

# 2013
# Specialty Crop Block Grant Program – Farm Bill (SCBGP-FB)
# FINAL REPORT

USDA, AMS Agreement No:
Specialty Crop Agreement No. 12-25-B-1657

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California Department of Food and Agriculture
2013 Specialty Crop Block Grant Program –Farm Bill
Final Report
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# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 1 | **Project Title:** California, Always in Season | |
|---|---|---|
| **Grant Recipient**: Buy California Marketing Agreement | **Grant Agreement No.:** SCB13001 | **Date Submitted:** December 2015 |
| **Recipient Contact:** Nicholas Matteis | **Telephone:** (916) 441-5302 | **Email:** nmatteis@agamsi.com |

## Project Summary

California has more than 25 agricultural marketing programs (Marketing Orders/Commissions) engaged in the promotion of specialty crop products. The marketing and promotional efforts of these entities independently compete in a highly diversified media environment for consumer visibility. There was a need for a promotional "umbrella" to help crosslink independent messaging of these entities to better impact consumer visibility, awareness, and increase the competitiveness of California's specialty crop industry.

This project modeled itself after Visit California's successful marketing campaign, which provided a generic statewide banner of media promotions that was leveraged by the local tourism bureaus and entities to promote their specific location/region. In the case of Buy California Marketing Agreement (BCMA), the project allowed California's agricultural marketing programs to leverage the visibility of a national media campaign to further cross promote their individual products in a competitive media market. This national media campaign focused solely on California's specialty crop industry.

This project was important and timely for California's specialty crop industry as it fulfilled a needed void in the generic marketing of specialty crop products and corresponded directly with the planning and implementation of Visit California's 2014 programming. Visit California was recently renewed as a marketing program, by assessed business in April 2013, ensuring the continued marketing of California as a tourist destination for the next six years.

Visit California has promoted the purchase and consumption of California culinary experiences as a pillar in their overall marketing campaign on California. Food and wine travel was an important and fast growing tourism segment nationally and resulted in direct sales within the food and beverage sector. BCMA promoted the purchase and consumption of California agricultural products to consumers domestically and internationally. The gained opportunity for BCMA and California's specialty crop growers was the leveraging of Visit California's global marketing budget of $42.6 million to further promote awareness and consumption of California's specialty crops.

This project created a promotional media marketing umbrella – *"California, Always in Season"* which highlighted the year-round growing season in California, its diversity of specialty crops/growing regions, as well as the food experiences that were uniquely Californian. The objective of this media campaign was to position California as the premiere destination for culinary travel as well as to increase the exposure, affinity, and sales of California grown specialty crops. This was achieved through capitalizing on the momentum of the Visit California overall media campaign ($42.6 million budget); heightened consumer interest in the food supply – where it grows, how it grows and who grows it; and provided the opportunity for California agricultural marketing orders/commissions to independently leverage the media messaging/campaign.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Activities that were completed in order to achieve the performance goals and measurable outcomes identified in the approved project proposal were as follows:

Campaign finalization: All promotion campaign details were completed by BCMA and the California Tourism Commission by November 2013.

Media Campaign Engagement with Stakeholders: Meeting campaign engagement with stakeholders was conducted from November 2013 to March 2014 on an ongoing basis. There were 30 meetings with approximately 60 attendees. These meetings were successful in identifying specialty crop organizations to involve in the project by means of identifying specialty crops and specialty crop farmers that would be featured in the print and digital media developed by the project. This includes farmers and their specialty crops to feature in the custom videos and advertorial spreads as well as specialty crops to feature on the project's custom microsite hosted on *Food & Wine* website, http://www.californiasweeps.com - now hosted on the Visit California website, http://www.visitcalifornia.com/dream365tv and the BCMA website, www.californiagrown.org.

Media Purchase – Food and Wine: The media purchase was completed by *Food & Wine* by December 2013.

Content Development – Food and Wine, Earned and Owned Media: Six custom videos were completed by *Food &Wine.* For each video, chefs were featured along with specialty crop farmers. The first three videos represent spring and summer specialty crops and the final three videos represent fall and winter specialty crops.

Custom Rich Media Unit: *Food &Wine* created a custom ad unit with four tabs to feature a different chef and/or farmer within each tab. This effort is complimented by a sweepstakes experience (non-grant funded) to encourage interest and engagement with the program. Targeted Digital Media: Targeted web-based advertisement on the *Food &Wine* website – which included a Brandblock (1x) and custom co-branding: microsite, ROS banners and E-newsletter text links.

Distribution – Food & Wine, Earned and Owned Media: Six (two-page) advertorial spreads were distributed with unique and custom content appearing in the April, May, June, September, October, November 2014 issues of *Food & Wine* Magazine (see Attached Final Report). Additionally, the six short format videos (3-4 minutes) which coincided with the print advertorial spreads in each issue of *Food & Wine* Magazine were launched on a *Food & Wine* microsite and linked to a sweepstakes experience (non-grant funded), http://www.californiasweeps.com/. The videos were filmed in Santa Barbara, Guinda, Madera, San Diego, Chico, and Monterey, California. The videos are now hosted on the Visit California and BCMA websites (see links above).

During California Restaurant Month (January 2014), Visit California incorporated the CA Grown brand into an integrated campaign and connected California's bounty of specialty crops with the famous chefs and restaurants that use these crops to make unique California dishes.

The overall scope of the project did not benefit commodities other than specialty crops.

The media program also leveraged the owned media (in-kind) of Visit California's global marketing campaign:

California Restaurant Month: Visit California incorporated the CA Grown brand into an integrated campaign and connected California's bounty of specialty crops with the famous chefs and restaurants that use these crops to make unique California dishes.

Video Content developed by Food and Wine Magazine: The video content included specialty crop agritourism and the CA Grown brand in video creation and curation strategy to generate global assets.

VisitCalifornia.com: Included integration of the CA Grown brand and agritourism features in editorial content in the *Wine & Dine* section, including inside scoops, must-sees and trip ideas. Content was translated and localized with Visit California international domains.

Social Media Posts developed by Visit California to promote agritourism in California: Facebook and Twitter (VisitCA and DineinCA) with 435,000 followers – CA Grown messaging, including farm stands, farmers, chefs and restaurants were promoted. VisitCA and DineinCA contributed in extending the project's messaging to their 435,000 followers.

California Visitors Guide produced by Visit California: The CA Grown brand was used to identify unique specialty crop agritourism opportunities across the state in the printed guide (released January 2014) with additional linking to CA Grown web content from digital extensions of the guide.

California Road Trips Guide produced by Visit California: Specialty crop agritourism trips were incorporated into different routes features in the publication (released May 2014) and online.

The media program also leveraged the earned media (in-kind) of Visit California's global marketing campaign:

Global Press Trip: Visit California assisted in seeding 2014 culinary media campaign through their global press trip which brings 6-8 top tier foreign journalists to California in fall 2013. The itinerary focused on agritourism, California chefs, and interactive food and wine experiences.

Press Familiarization Trips: Visit California organized several media trips to California. BCMA worked with Visit California to develop customized itineraries to focus on the best food and agriculture California has to offer.

Global Broadcast PR Emphasis: Collectively, Visit California's PR representatives across 14 global markets focused broadcast pitching efforts on culinary themes in the 2013/2014 fiscal year. All markets proactively pitched culinary TV shows and food/drink storylines for targeted broadcast exposure.

Media Center: Agritourism, farm stands, farmers' markets, farm to fork, food festivals and other "CA Grown" ideas were featured on Visit California's media center – a digital resource accessed by tourism operators, foreign media and other entities to support external marketing efforts.

What's New in California: Agritourism "firsts" were featured in the Visit California's quarterly release highlighting new travel and tourism related attractions, hotels, events, and more in all the regions of the Golden State. The print publication has more than 3,000 subscribers (mostly media). Content was also available within Visit California's online media center.

Media Video Newsletter: Showcased specialty crop agritourism story angles to global media through a 1-minute "California Harvest" segment in Fall 2013 media video newsletter; content highlights included farm stays, ag tours, farmers' markets, food festivals, and more. October 2013 e-distribution reached more than 2,500 media contacts around the world. This newsletter was developed by Visit California to integrate their marketing and promotions efforts to promote agritourism, in line with their culinary promotional pillar, with the content created for the "Always in Season" campaign.

Media Events: BCMA also had the opportunity to feature CA Grown specialty crop products at Visit California's signature media events. These events bring a taste of California and included displays of California produce to top tier media in key markets. The events were hosted by Visit California to promote/support agritourism and incorporated the CA Grown brand and specialty crop products as a highlight of what California had to offer by way of culinary unique agritourism experiences.

## Goals and Outcomes Achieved

Over a nine month period the BCMA campaign delivered 59,511,082 impressions sourced from Food and Wine's print, display and social media. Print media's total readership reached 46,200,000 over six print insertions. Display targeting recorded 13,055,594 impressions and social media reached 255,488.

Food and Wine's banner, rich media, and e-newsletter display placements drew 29,422 total clicks to the www.foodandwine.com/california microsite. A 0.23% campaign click-through rate was achieved - nearly three times the industry standard display benchmark 0.08%. High impact brand block placements on the Food and Wine homepage lent to a strong 0.40% click-through rate indicating strong contextual affinity to the BCMA content. Food and Wine's social audience yielded 12,205 social engagements including likes, comments, shares, favorites and mentions.

Six custom CA Grown videos accumulated 759,612 video plays from only 421,657 visits. Upon visiting the site, the auto-play video feature immediately captures user attention - leading to an efficient 180.15% visit to video engagement rate. Individual video views ranged from 80,000 to 150,000 where popular San Diego and Fresno videos each recorded approximately 150,000 video plays.

The chance to win the ultimate California foodie vacation sweepstake garnered 308,368 total applicants. Efficient behavioral targeting across Food and Wine's run of site and homepage placements converted 73% of all site traffic into a sweepstake entry. Explicit banner call-to-actions to "Enter to Win" combined with high post-click share of voice on the landing page ultimately enticed visitors to enter to win immediately upon visiting the site. Please note that no grant funding was expended to host the sweepstakes, as this was a component of the Visit California in-kind support for the project.

- Media Performance:
  - Impression Delivery (Target: 58,310,400 - impressions) (Total Impressions Delivered: 59,511,082)
  - Engagement with Custom Content (Target: 10% rate of engagement, 50,000 visits to food and wine content on VisitCalifornia.com) (Rate of Engagement achieved: 180.15% visit to video engagement rate, 421,657 visits to the Always in Season microsite. *Please note: The target was visits to VisitCalifornia.com but it was decided that the Always in Season microsite would be a better place to house the custom content.
- Earned Media Coverage:
  - # of media placements (Target: 30 - media placements) (Total media placements: 72)
  - Impressions (Target: 1.5 million impressions) (Total Impressions: 27 million impressions)
- Advertising Effectiveness:
  - Increased awareness of CA Grown Brand among target audience (Target – 25% increase from baseline) (Total increased awareness: 21%)

All goals for the reporting period were exceeded with the exception of the target set for increased awareness. Regarding brand lift specifically, people's association of California with seven culinary related topics were measured, comparing ratings among BCMA aware and unaware respondents. Those results are summarized below. Please note:

- Ratings were on a scale of 1-5, (1= Not at all, 5= Very much)
- Several categories- wineries, fine dining, California grown crops- had very high association among those with no recall of the campaign, making it more difficult to generate lift
- Following up on the point above, there is an inverse relationship between association scores and % increase- wineries have the highest levels of association with CA but the lowest % increase lift.
- Summing the scores for all seven categories shows a combined difference of 5.1 points, or a 21% brand lift. Though it doesn't quite reach the goal of 25%, the results are impressive - especially when compared to brand lift measurements in comparable 5 point rating scales for other components of the larger Visit California campaign.

| **Image of California** | **No recall of BCMA** | **Recall of BCMA** | **Difference** | **% Increase** |
|---|---|---|---|---|
| Wineries | 4.4 | 4.7 | .3 | 7% |
| Fine dining | 4.0 | 4.6 | .6 | 15% |
| California-grown crops (e.g., almonds, grapes) | 3.9 | 4.4 | .5 | 13% |
| Local cuisine | 3.7 | 4.5 | .8 | 22% |
| Farmers markets | 3.3 | 4.1 | .8 | 31% |
| Breweries | 2.9 | 3.8 | .9 | 31% |
| Farm tours | 2.7 | 3.9 | 1.2 | 44% |
| **Total** | **24.9** | **30.0** | **5.1** | **21%** |

As a brand new project the baseline data was not provided. All targets set were achieved or exceeded with the exception of the increased awareness, which was reached a total of 21% rather than the targeted 25%. However, as noted above, achieving a 21% increased awareness is impressive when compared to comparable measurements of larger programs.

## Beneficiaries

The following BCMA members benefited from the completion of the project: Kiwifruit Administrative Committee; California Association of Nurseries and Garden Centers; California Pear Advisory Board; California Asparagus Commission; California Avocado Commission; California Cut Flower Commission; California Farm Bureau Federation; Agricultural Council of California; Wine Institute, California Dried Plum Board; California Fig Advisory Board & California Fresh Fig Growers Association; American Pistachio Growers; Certified Farmers Markets of Sacramento; Pacific Coast Famers Market Association; California Certified Organic Farmers; California Olive Committee; California Cherry Board and many Company members.

Including the above mentioned BCMA member organizations and company members approximately 52 CA Grown members benefited from the accomplishments of the project. Please note that the benefit extends to all members of the BCMA member organizations and company members growers, whether they were featured directly in the content developed by the project or gained attention from social media efforts made by BCMA staff to capitalize on the social media following of Visit California and gain followers through collaborative social media posts.

The return on investment of the project was over 200%, as the total cost for the media spend was $688,500 for a total value of $1,513,667. The project resulted in 72 media placements that generated over 27 million impressions for a total of more than $3.4 million in earned media value.

## Lessons Learned

Potential improvements to the project include:

- Stronger and more diverse farmer – culinary/agritourism stories. The greatest diversity possible in specialty crops and types of culinary/agritourism experiences that can be featured would be ideal.
- More crops and farmers featured in print and video content. More diversity of crops and farmers featured would also be ideal in order to tell an enhanced story about the diversity of specialty crops grown in California and their various uses and ways to experience them.
- Added print media that targets the California consumer i.e. Sunset Magazine to compliment the Food and Wine print distribution which is to a more national audience. This would round out the reach of content to in-state and out-of-state audiences.
- Integration of digital content into both the BCMA and Visit California websites would be ideal for closer association of the audience to both organizations. The Food and Wine microsite, though effective, took the audience away from other opportunities for site visitors to explore other culinary/specialty crop focused content.

All targets set were achieved or exceeded with the exception of the increased awareness, which was reached a total of 21% rather than the targeted 25%. However, as noted above, achieving a 21% increased awareness is impressive when compared to comparable measurements of larger programs.

## Additional Information

Attached is the BCMA digital report which includes campaign highlights, stats, and print features.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 2 | **Project Title:** Removing Barriers to Commerce to Reverse Market Share Decline | |
|---|---|---|
| **Grant Recipient:** California Flower Growers Cooperative | **Grant Agreement No.:** SCB13002 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Alicia Adler | **Telephone:** (949) 584-3572 | **Email:** Alicia.m.adler@gmail.com |

## Project Summary

California produces 75%+ of U.S. cut flowers but U.S. cut flowers have dropped from 60% of U.S. wholesale sales in 1989 to 29% in 2011 as imports (mainly Colombian) grew. This keeps prices stagnant (up just 2.7% over the past decade). Further, most South American imports enter a single port of entry (Miami) and are aggregated in warehouses with which buyers deal directly. This supply chain structure allows buyers to deal efficiently with a few sellers offering wide selections rather than multiple sellers for California flowers. This project created an online marketplace allowing buyers and California farmers a single point of contact for all California varieties to ease this burden. The industry must address this to remain viable and stop further market share loss. Accordingly, the California Flower Growers Cooperative (CFGC) is supported by the California Cut Flower Commission, representing all California cut flower farmers. As a farmer-owned cooperative, any profits flow back directly to the farmers and benefit only them. CFGC membership is open to all California cut flower farmers.

This project was important and timely because it aimed to create economic opportunities for specialty crop producers through market development activities that focused on local, regional, or international markets. The goal was to enhance the ability of California cut flower farmers to compete with imports by creating a website to provide online product aggregation and a single destination for buyers to purchase all California varietals in one place. The project objective was to recover at least a modest 1% of the total U.S. market share lost to foreign imports by July 2015, which would lead to about $9.5 million in additional annual revenues to California cut flower farmers. After development and initial promotion of the website was completed, ongoing maintenance costs for the site would be modest and covered by a transaction fee to the farmers.

This project did not build upon a previously funded Specialty Crop Block Grant Program project nor has this project been submitted to or funded by another Federal or State grant program.

## Project Approach

From December 2013 through January 2014, grower and buyer input was gathered and assessed for the planning and design of the website. The website was designed, but limited input was provided by stakeholders, so further development of the website was postponed.

In January 2016, the CFGC retained a new Project Manager (PM) to ensure the remaining activities were completed by the end of the project period.

Since January 2016, the CFGC focused efforts on completing the development of the website. By April 2016, the database design for grower inventory was developed and provided to growers to provide sample data. Three CFGC member companies provided data samples to populate the website and simulate transactions for

testing. The website designer then completed development of the base transactional e-commerce code, shipping module, purchase order module, grower module and HTML5/CSS3 templates for backend code.

By June 2016, the website "went live" and CFGC leadership was trained to use and maintain the website after the grant period is over. Sales data will be tracked and reported as they are achieved.

California cut flowers are the only commodity that benefited from this project. No other commodity benefited from this project.

The website contractor developed and designed the database for grower inventory and collected sample data from selected CFGC members. They also led training webinars and "on boarded" CFGC members as they were available.

## Goals and Outcomes Achieved

The primary goal of this project was to reverse the trend of losses of California farmers' market share to imports. The performance measure that was to be used to monitor this goal was the market share percentage held by California cut flower growers. The benchmark was current California sales as estimated by the California Cut Flower Commission (CCFC); the target was to add revenues equal to 1% of the total domestic market, taken from the share currently held by imports, by the end of the project period (June 2016). The secondary goal for this project was to generate web traffic to the site and to measure flower sales initiated on the site. The performance measures for these goals were web page visits and totals sales dollars for online sales. The benchmark was zero as the site did not yet exist; the target was to generate an average 800 monthly page visits and get to $9.5 million in total annual sales by the end of the project period.

The website is functional and three CFGC members have uploaded their inventory. Unfortunately, due to delays in website development and member on boarding, the site has yet to be used to conduct flower sales. The Cooperative hopes to achieve this goal in 2017, once all members are fully registered on the site and trained.

The outcome measures for this project are long-term. To date, CFGC has successfully developed and launched their e-commerce website in 2016, but members are still uploading product information and learning how to use the site. CFGC expects initial sales to take place early 2017.

All tasks specified in the approved work plan were completed, except for the public relations and industry outreach component. This component will need to take place after the end of the grant period, and CFGC will not use grant funds to cover these costs.

CFGC did not achieve its expected measurable outcomes by the end of the grant period, due to various project delays. However, the website is developed, and sales are expected to begin early 2017

Additionally, CFGC collected flower and greens total annual sales data from the CCFC flower farmer members for 2012, which totaled $231,499,806. This benchmark will be compared to total annual sales of cut flowers in 2017, one year after the launch of the e-commerce website.

## Beneficiaries

The primary beneficiaries of this project are California's 225+ cut flower farmers; current CFGC membership represents nearly half of California's cut flower industry by dollar volume (any California flower grower may join CFGC).

California accounts for over 75% of the U.S.'s total cut flower production. Domestic farmers have lost significant share of the U.S.'s $1.24 billion cut flower market to imports (U.S. share, of which California represents 75%+, has dropped from 60% in 1989 to 29% in 2011 according to statistics provided in a presentation at the International Floriculture Expo). The over 16,000 retail florist shops across the country will benefit as they will have the convenience of a one-stop supplier for all California cut flower varietals, saving them time and logistical hassles; accordingly project supporters include florists who have committed to serve as beta testers for the new site, and more can be easily added, if needed. California's cut flower industry accounts for approximately 14,000 jobs directly (through farms and cut flower wholesalers and retailers), indirectly contributes to an additional 122,000 jobs, and had a total economic impact of $10.3 billion in California in 2007 according to an economic impact study performed by Tootelian & Associates.

## Lessons Learned

After unexpected delays due to limited availability of project leadership, the CFGC retained a grant management contractor to assist with the completion of the project and reporting by June 30, 2016. The new PM joined the CFGC's management team in January 2016. The CFGC completed the project, but has not yet achieved expected measurable outcomes due to a delay in member "on-boarding" to the website. Several members are still uploading their product information onto the website, and expect to utilize the website shortly after.

There were no unexpected outcomes or results during the life of the project.

A lesson learned for those working on e-commerce industry websites is to provide education and outreach to the cooperative membership who might participate to ensure they will efficiently provide product information in a timely manner.

## Additional Information

americanflowerfarmers.com

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| USDA Project No.: 3 | Project Title: Market Match Consortium | |
|---|---|---|
| **Grant Recipient:** Ecology Center | **Grant Agreement No.:** SCB13003 | **Date Submitted:** December 2015 |
| **Recipient Contact:** Martin Bourque | **Telephone:** (510) 812-5514 | **Email:** martin@ecologycenter.org |

## Project Summary

Direct marketing through Farmers' Markets (FMs) is a critical survival strategy for thousands of California Specialty Crop (CSC) farmers. Simultaneously, California's low-income residents suffer disproportionately from diet-related diseases from lack of CSC consumption while currently receiving $7.6B in CalFresh Benefits. The Market Match Consortium (MMC) is a statewide coalition of FM operators and organizations working to enhance the competitiveness of CSCs by driving California's 7-to-17 billion dollars in Supplemental Nutrition Assistance Program (SNAP) benefits [aka CalFresh or Electronic Benefits Transfer (EBT)] and other benefits directly to CSC growers.

The impacts of the global recession have been long lasting and have been followed by deep cuts to federal and state safety-net programs. This is now coupled with the ongoing drought in California, which significantly increases the cost of water – and thus the cost of growing and the cost of living. Farming communities and low-income communities have been particularly hard hit. These economic stressors have changed people's shopping habits and the burgeoning awareness of healthy food, and the movement towards purchasing direct from farmers, both faltered. Much of the momentum that had led to increased sales by CSC growers in California was lost during the recession. For low-income shoppers the situation was equally precarious.

The California Obesity Prevention Plan states that meals containing more fruits and vegetables cost 41% more than meals of lower nutritional quality. The higher prices are associated with lower purchasing and intake. Market Match (MM) helps low-income families bridge this food gap by increasing affordability, food access, and overall food security while simultaneously building a healthy habit of farm-direct shopping with their local CSC grower. The 2013 California MM Cluster Evaluation showed: 78.5% of CalFresh shoppers surveyed reported MM was their reason for shopping at market; 80.5% of the CSC growers reported selling more CSCs as a direct result of MM, 69% had more new customers, 72% had more repeat customers, and nearly 20% of the CSC growers were increasing their acreage to meet demand caused by MM.

The MMCs goal is to drive 1% of Cal Fresh sales, $76 million, directly to CSC growers by 2020.

From 2009-2012, the MMC was run by Roots of Change. Ecology Center (EC) assumed coordination in 2012 under 2012 Project 26: *California Farmers Market Consortium*. During the first phase of MM, each implementing subcontractor (Partner) was encouraged to find the shopper recruitment and MM delivery system that worked best for their budget and location. Great innovations were tested. Project 26 (2012) was utilized to: 1) study best-practices from the proof of concept phase; 2) expand MM to new markets and CSC growers; and 3) support the MM programs with the existing 11 Partners. The intended enhancements for this project were to: 1) grow the MMC from 11 to 17 partners at 150 FMs (up from 138) serving 1,140 CSC

growers (up from 840) to facilitate $1.2 million (from $1 million) in farm-direct CSC sales via MM; 2) develop best infrastructure/practices for a consistent program that is cost effective for all California FMs.

## Project Approach

The following activities and tasks were performed during the course of the project:

Establish and implement CalFresh Matching programs in at least 150 partner FMs throughout the state in order to boost sales for CSC farmers:
The Ecology Center added 7 new partners through a competitive application process bringing the MMC up to 18 funded and 5 unfunded partners that served 153 FMs in 2014-15. There were at least 840 CSC growers being served through the pre-existing MMC partners; when the 7 new partners were added, this number grew to a total of 1,033 CSC growers that were served.

Pre-screen 3,500 CalFresh eligible shoppers at FMs: The MMC partners screened 927 CalFresh eligible shoppers. Please see Lesson's Learned section of this report.

Recruit and provide technical assistance to new FM partners adding MM programs: Ecology Center staff and other Consortium members reached out to new FM operators to encourage them to join the MMC and provide MM at their markets. Nineteen FM operators applied to join the MM program. Recruitment and technical assistance were conducted through email, phone calls, webinar, and in-person meetings. As a result, 7 new funded market operators and 4 unfunded market operators joined the MMC.

Establish and implement CalFresh Access in at least 20 new FMs throughout California: the Ecology Center was in communication with market operators representing 90 FMs. Of those, 28 established CalFresh access; the Ecology Center assisted 16 others in further implementation and promotion of existing CalFresh Programs. Together, these two outcomes benefitted approximately 557 CSC growers.

Track MM sales data and MM market locations throughout the State: all MM partners reported monthly to the Ecology Center with their complete sales and customer tracking data. The Ecology Center collated the individual reports into a master that shows all MM activity for California. In addition (under separate funding and not using any Specialty Crop Block Grant Program funding), the Ecology Center fully launched Farmers' Market Finder (www.fmfinder.org), which allows users to find their local markets and to see if those markets offer MM.

Convene the full MMC - twice in person and 10 times via phone: Eleven monthly conference calls were conducted. A two-day, in-person meeting was also held in Oakland in March 2014 with all partners in attendance. In November 2014, a second two-day, in-person meeting was held in Fresno. In addition to the existing MMC listserv, the Ecology Center also established an internal MMC website that was updated for communications and sharing of meeting agendas, best practices, and reporting forms.

Partner with 15 partner organizations throughout California in order to reach out to CalFresh eligible populations and promote using benefits at FM for the purchase of CSC: the MMC had 18 formal funded partners. In addition, the Stanford Law Clinic created a Memorandum of Understanding (MOU) that allowed additional, unfunded partners to participate in the Consortium's learning community in order to expand the

MM outreach and implementation. Utilizing this MOU, the Ecology Center on boarded an additional five unfunded partners, representing seven FMs.

Partner with local media, social service agencies and community based organizations to distribute posters, flyers and other outreach materials to promote the purchase of CSCs at the local FMs: the MMC partners worked with agencies across California to get out posters, fliers, emails and other outreach materials viewed by approximately 227,962 MM eligible shoppers for the purpose of recruiting them to shop with their local CSC grower at the FM. In addition to the 227,962 printed materials distributed, in May of 2014, MM experienced significant attention in the news media. Through funding from First5 Los Angeles, the MM program received press in 14 online and print media outlets, including the Los Angeles Times, which together receive over 4 million daily views. Ecology Center staff and MMC partners also worked to develop the statewide MM website and online presence in order to promote CSCs; promote and educate farmers, market managers and the public about the MM program; onboard new partners; and support program legitimacy. The MM site went public in February of 2014. Visit it at www.marketmatch.org .

Administer market manager, customer, and CSC farmer surveys at target MM locations in order to evaluate the program efficacy: MM customer and farmer surveys were administers by MMC partners July through October 2014. A total of 503 customer and 187 farmer surveys were collected during this time. (See Attachments 1 and 2) Market Operator program feedback was solicited through the 11 MMC calls and two, in-person meetings.

Foster a learning community in the MMC through executing face-to-face meetings, trainings, monthly calls, and online toolkit: the calls and meetings took place as scheduled, and the resulting MMC learning community was very active. The new MarketMatch.org website includes an internal partner area where MMC partners can securely login, submit monthly reporting, market information, and utilize a toolkit in order to better implement and promote their MM programs. The MMC Project led to tremendous collaborative efforts on behalf of CSC growers, including the (funded separately) California Alliance of Farmers' Markets that is working to make the selling atmosphere for the specialty crop growers more consistent and profitable. Long-term MMC partners have actively recruited and mentored new members, assisting them in offering MM, and have been extremely generous with their time. The MMC has created a very strong community that is turning out to be of tremendous benefit to CSC growers.

Report monthly on outreach conducted and redemption at FM of CalFresh (67% of total and tracked by vendor where possible) and MM: all MM partners reported monthly to the Ecology Center with their complete sales and customer tracking data. The Ecology Center collated the individual reports into a master that showed all MM activity for California. The MMC generated a total of $2,120,607 for CSC farmers. This includes 67% of CalFresh redeemed at participating FMs and 100% of the Women Infant and Children, Farmer's Market Nutrition Program (WIC FMNP) and 100% of MM dollars redeemed. All $2,120,607 was spent, 100%, with CSC farmers.

Build program scale and sustainability though national and state partnerships: the MMC has created very active partnerships with national partners such as Fair Food Network and Wholesome Wave in order to ensure that California is always utilizing best practices and is helping to shape the sustainability and scale of MM.

Create a MM program report and evaluation: All reports were executed as planned and the evaluation surveys were conducted in late July to October 2014. The final survey analysis is included as an attachment to this report. (Attachment 1 and 2)

Expand and enhance MM Program by improving At Market Customer and Farmer experience: three hundred large format MM banners were printed to increase visibility and ease of customer use, clearly directing them to the site for EBT Point of Sale (POS) use and token distribution. Additionally 3,600 farmer booth signs were printed to help direct MM customers to eligible CSC growers' booths, and 3,000 market booth signs were printed to help inform customers on how the program works.

Ensuring that funds are used solely for CSCs is core to the Ecology Center's workplan. MM incentives are only redeemable with CSC growers. This is achieved through restricting the growers who are allowed to redeem MM scrip to those who grow and sell CSCs, restrictions printed on the MM scrip, shopper and farmer education, clear policies and careful training and oversight.

MM is designed to drive CalFresh shoppers and revenue directly to CSC growers who retain 100% of the revenue. As part of this process, it is necessary to increase the number of markets that accept EBT and the number of EBT shoppers that come to FMs so the CalFresh shoppers are able to shop directly from CSC growers at the market, and know their benefits are redeemable at that market. To avoid using project funds for unallowable products, all aspects of the needed CalFresh outreach are capped at 67% of their total cost. While CalFresh can be spent on unallowable products, the ineligible crops/foods available at certified FMs are a small fraction of their offerings and therefore eliminating 33% of all CalFresh purchases allows for an ample "cushion" of potentially unallowable purchases, ensuring that all CalFresh expenses billed to the project are 100% for CSCs. Recent review of EBT expenditures at over 60 northern California markets show that more than 80% of all EBT redeemed at FMs is spent on CSCs. This further demonstrates that the 67% number is indeed conservative. To ensure no project funds support ineligible crops/foods, Ecology Center is presenting no more than 67% of the EBT/CalFresh outreach program expenses for project funding; the other 33% of expenses, covered by matching funds, will cover any unintended contact with ineligible crops or producers. Example: project funding will only support 67% of the cost of the EBT specialist.

In order to increase safeguards and more accurately measure the true percentage of CalFresh funds that go to CSC growers, the Ecology Center worked with seasoned MMC partner, Pacific Coast Farmer Market Association (PCFMA), and others, to pilot several methods to ensure that the benefit matched by incentives also went to SC farmers.

All marketing messages and materials created with project funding focused solely on the purchase of CSCs. The outreach either promotes the MM program (which solely benefits CSC farmers), a specific specialty crop (i.e., "Buy local strawberries today at the XYZ Market with your EBT card"), or is focused on the purchase of state grown fruits and vegetables (i.e. "You can use your CalFresh EBT card and MM to purchase fresh, California-grown specialty crops at the XYZ Market from 10-2 each Tuesday!"). This ensures that project funds solely support the sales of CSCs, while enhancing the shopper base for the CSC growers. The Ecology Center ensured that messaging was in alignment with the Specialty Crop Block Grant Program requirements.

Ecology Center undertakes partner contracting, site visits, reviews all materials, leads monthly calls, and conducts two face-to-face meetings in which adherence to rules are discussed with all MMC partners in order

to maintain vigilant enforcement of the intended goals.

The MMC Partners worked in 23 counties at 153 farmers' markets: Agricultural Institute of Marin – operates farmers' markets in Marin, Alameda and San Francisco counties; Alchemist Community Development Corporation – partners with farmers' markets in Sacramento and Yolo County; North Coast Growers Association – operates farmers' markets in Humboldt County; Coastside Farmers' Markets – operates farmers' markets in San Mateo County; Visalia Farmers Market – operates farmers' markets in Tulare County; Agricultural & Land-Based Training Association – working in Monterey, San Benito and Santa Cruz Counties; Fresno County Economic Opportunities Commission – partners with farmers' markets in Fresno and Madera Counties; Hunger Action Los Angeles – partners with farmers' markets in Los Angeles County; Pacific Coast Farmers Market Association – operating farmers' markets in Alameda, Contra Costa, San Francisco, San Mateo, Santa Clara and Solano counties; Sustainable Economic Enterprises of Los Angeles – operating farmers' markets in Los Angeles County; Phat Beets – operating farmers' markets in Alameda County; Mission Community Market - San Francisco county; Laytonville Farmers' Market - in Mendocino County, North Coast Opportunities - partners with the Ukiah farmers' market in Mendocino County; Valley Farmers' Market Association operates farmers' markets in Kern County; Point Reyes Farmers' Market - Marin County; Contra Costa Certified Farmers' Markets operating farmers' markets in Contra Costa County; Agricultural Community Events Farmers' Markets –in Marin and Sonoma County; Child Parenting Institute –in Sonoma County; Sebastopol Farmers' Market – in Sonoma County; Quincy Farmers' Market – in Plumas County; and Crescent City Farmers' market – in Del Norte County.

## Goals and Outcomes Achieved

The activities completed in achieving the goals and outcomes of the project are as follows:

Grow the MMC from 11 partners at 130 FMs serving 840 CSC growers, to 15 MMC partners serving 150 FMs and 1,140 CSC growers: This project resulted in 23 partners offering MM at 153 FMs serving 1,033 CSC growers.

Partner with local media, social service agencies, and community-based organizations to distribute posters, flyers and other recruitment materials to 500,000 CalFresh consumers: MMC partners reported 227,962 pieces of outreach materials distributed. In addition, since its launch in February of 2014, the new MM website received 1,838 page views. Through funding from First5 Los Angeles, the MM program received press in 14 online and print media outlets, including the Los Angeles Times, which together receive over 4 million daily views.

Establish and implement CalFresh access in at least 20 new FMs throughout California in order to boost sales for CSC farmers and make them MM ready: the Ecology Center established CalFresh access at 28 FMs and further implemented and promoted CalFresh access at 16 others, benefitting approximately 557 CSC growers.

Pre-screen 3,500 CalFresh eligible shoppers at FMs across the state: nine hundred seventy-five eligible shoppers were pre-screened. The pre-screening process is conducted by project partners at FM, ideally in conjunction with CalFresh agency staff. Individuals are asked a series of questions to determine whether they may be eligible and then as appropriate are assisted with the application process. In some cases, CalFresh agency staff support these efforts by attending market to facilitate the application process.

Foster a learning community in the MMC through executing 2 face-to-face meetings, trainings, monthly calls, and an online toolkit: this project resulted in 11 monthly MMC calls, one MM workshop, and two, two-day, in-person MMC training. One webinar training for new partners was executed April 7, 2014. The new MarketMatch.org website includes an internal partner area where MMC partners can securely login, submit monthly reporting, market information, and utilize a toolkit in order to establish and promote their MM program.

Leverage over $260,000 in matching funds to build program scale and sustainability though public and private, national, state, and local partnerships: the Ecology Center and the MMC members successfully leveraged the MM program into two large-scale expansions. (1) First5 Los Angeles engaged the Ecology Center's MM program under a 5-year, $2.5 million contract to expand MM to children and families throughout Los Angeles County; (2) the statewide partner expansion, infrastructure, learning community, local funding, and training was all leveraged to garner a 2-year, $3.7 million grant from the United States Department of Agriculture's new Food Insecurity Nutrition Incentive program, which will result in significant expansion of the project. No project funding was used in order to raise these additional funds in support of the MM program.

Based on best practices, research and test the minimum MM incentive amount required to recruit the maximum number of CalFresh shoppers: the Ecology Center's Executive Director, Program Director, and Program Manager have conducted extensive review of previous data to analyze this issue. Several MMC partners (Alchemist Community Development Corporation in Sacramento and Fresno Economic Opportunities Commission) have conducted preliminary incentive level change pilots. The data from these pilot sites are currently being analyzed.

As technology develops, explore token-less, electronic delivery systems to replace market scrip: the Ecology Center has identified possible token-less systems that improve efficiency, reduce administrative overhead, reduce the potential for fraud and can be scaled to an electronic delivery system that would eliminate the need for market scrip. Explorations allowed the project team to develop a concept and plan to pilot and test bar code scrip and then electronic scrip to analyze outcomes and determine best practices that will be utilized in future years.

Determining the long-term health benefits, benefits to the CSC growers, and the optimal incentive amount are all long-term goals. This project has allowed Ecology Center to make progress on these long-term goals. The project team developed forms, templates and systems, as well as knowledge and familiarity to track data and expenses, and ensure compliance with federal regulations. Much of the infrastructure was created because of the unique nature of this grant program and the number of partners involved.

The majority of the Ecology Center's goals were met or exceeded! Three areas where totals fell short of the goals were: the goal of pre-screening 3,500 CalFresh eligible shoppers (975 were pre-screened), reaching the anticipated 1,140 CSC growers (reached 1,033), and distributing recruitment materials to 500,000 CalFresh consumers (269,598 consumers received recruitment materials).

In the case of reaching CalFresh shoppers with materials, the MM program opted to use fewer printed materials and focus more heavily on electronic views on the website and through earned media. When "views" from MM earned media are counted into the total, this goal was exceeded by several million views.

The MMC partners that were engaged in pre-screening found that this aspect of the program has significant structural challenges and it has been eliminated from the program design going forward. While MM incentives have proven again and again to be extremely effective, prescreening for SNAP eligibility at FM has proven impractical. This is discussed further in "lessons learned".

The CSC grower goal of 1,140 was set without knowing which new markets/partners would be added to MM. As it happened, the MMC added 12 partners and 23 new markets, but the markets were not as large as anticipated.

The Ecology Center grew the MMC from 11 partners at 130 FMs serving 840 CSC growers, to 23 MMC partners serving 153 FMs and 1,033 CSC growers; helped 28 new FMs come online with EBT access, which all resulted in 1,033 CSC growers making $2,120,607 in federal nutrition benefits and MM sales during this project term, which is $654,168 more than 2013.

The major successful outcomes of the project are as follows:

- Nearly 20% of farmers reported sales increase of 25% - 49% due to CalFresh and MM at the FM.
- Eighty eight percent of MM customers reported that MM was important in their decision to spend their benefits at the FM instead of elsewhere.
- Seventy nine percent of customers reported the amount of CSCs purchased increased as a result of MM.
- Eighty percent of customers reported that their trips to the FM had increased and they buy CSC as a result of MM.

## Beneficiaries

The primary group that benefited from the completion of this project's accomplishments was CSC growers selling through FMs. Other groups that benefited from this project were low-income shoppers who benefitted from an increased number of FMs accepting EBT and the added buying power needed for SNAP shoppers to purchase sufficient quantities of fresh SCs.

One thousand thirty three CSC growers and 70,542 low-income shoppers benefited from this program during this project term.

## Lessons Learned

As a result of completing this project, the project staff has learned the following:

There is strong demand for the MM program from FM operators. During the course of the project many more FM operators expressed interest in offering the program than the Ecology Center could accommodate as part of this project.

MM is an effective tool to leverage CalFresh usage at FMs. The addition of a MM program significantly increase the use of CalFresh, and other nutrition benefits, at FMs. This is an important lesson as it shows that investing in an incentive program can result in an increase in revenue for specialty crop growers in California.

FMs are challenging settings for pre-screening of CalFresh eligible shoppers. Two of the more significant challenges include finding qualified personnel available to work during the market hours (markets are often on weekends), and convincing customers to take time out from their shopping trip. Many customers are unwilling to take time from their shopping to participate in the pre-screening process. Anyone attempting to conduct pre-screening of market customers should be aware of these challenges and plan strategies to overcome them. These challenges are particularly difficult to overcome, as they require the cooperation of individuals outside the scope of this project.

Local conditions heavily impact the implementation of the MM program. The degree to which there is effective outreach, transportation to and from the market, support of relevant local agencies, and how easy it is to access specialty crops from other sources all can have a significant impact on use and redemption of the MM program.

The capacity and size of the organization implementing MM affects the cost of incentive delivery. Economies of scale exist that allow larger organizations and organizations with greater resources to distribute incentive at a lower per unit cost.

The goal of researching and testing best practices for the minimum MM incentive amount required to recruit the maximum number of CalFresh shoppers was not achieved through this project. Those tests and evaluations, in order to be robust, require the guidance and oversight of a trained evaluator and more time was needed than was available during this project period.

In the case of reaching CalFresh shoppers with materials, the MM program opted to use fewer printed materials and focus more heavily on electronic views on the website and through earned media. When "views" from MM earned media are counted into the total, this goal was exceeded by several million views. This focus on electronic materials represents both a change in how people receive information away from printed materials and towards websites, apps and other electronic forms. The effectiveness of the incentive distribution indicates that this strategy for distribution of information was very effective.

**Additional Information**

Please see: Attachment 1 California Market Match Consortium Customer Survey
Attachment 2 California Market Match Consortium Farmer Survey

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 4 | **Project Title:** Solano Grown Online Farmer's Market | |
|---|---|---|
| **Grant Recipient:** Solano Grown | **Grant Agreement No.:** SCB13004 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Michelle Stephens | **Telephone:** (530) 863-9073 | **Email:** michellelinstephens@gmail.com |

## Project Summary

The food hub and online farmers market were designed to provide an additional venue to market local agricultural products for specialty crop producers.

Many Solano County farmers do not participate in local farmers markets. They cited lack of customer base at some markets, inability to get stall space at more popular markets, cost of booth fees, loss of product due to transportation, and time away from production activities as some reasons for this. Many growers also do not sell via the internet as they do not have websites and those with websites often cannot afford the point of sale software or vendor fees.

The goal of this project was to expand a newly developed online farmers market, a local market enterprise, which would produce increased income flow without increasing the amount of upfront costs to the growers. By using an online market, the grower could sell without being away from the farm, deliver only product that is already sold to the market, adjust prices as warranted, manage inventory, include a description of the products, growing methods, and highlight their farm in a farmer biography. The project's long-term impact was expected to be the establishment of a viable collaborative market linked to other community organizations, enhanced public awareness of local farmers, and increased income for participating specialty growers.

Project staff believed that the expansion of the online market would build upon the successful "Solano Grown" branding that has been created in the past in partnership with the Solano Community College (SCC), the Solano County Department of Agriculture, and Solano Grown members. Project staff hoped to create a sustainable food hub that provided a long-term source of fresh local foods for the community.

Specialty crop producers comprise ~27% of the farm gate value in the county and represent 70% of the members of Solano Grown, a cooperative marketing organization for Solano growers. Previous outreach to Solano County buyers included a survey of residents regarding purchase methods. Survey results indicated interest in online purchase methods and distribution hubs. Based on this response, project staff felt an online farmer's market would be a successful tool for specialty crop growers.

The purpose behind the food hub was to create economic opportunities for specialty crop producers by providing an alternative venue to conduct sales and provide access to local farm fresh products to consumers through online shopping. The benefits included: (1) an opportunity for growers to draw from a larger demographic, expanding the customer base beyond the immediate area of physical distribution, such as a farm stand or farmers market; (2) seasonal market opportunities; (3) the market fit well with existing direct marketing already being used by growers as producers can list as little or as much product as they have available, providing another outlet for products; (4) an entirely new marketplace for many producers (online);

and (5) a new cooperative local enterprise that is projected to provide long-term partnership benefits for growers and the community.

Solano County received funding under the 2011 Specialty Crop Block Grant Program (SCBGP) Project 36: *Solano Grown Marketing*, to advertise specialty crops produced in Solano County. This project built upon this previous work by providing a place for consumers to purchase specialty crops directly from specialty crop producers. This funding built upon previously established brand development and moved that branding into advertising for specialty crop producers. The campaign included: billboards, radio, print and other media and resulted in increased knowledge of specialty crop producers and products available within the county and neighboring Bay Area. This in turn spurred purchases from those producers. The project also included a survey of residents regarding purchase methods. Survey results indicated interest in online purchase methods and distribution hubs.

Solano Grown is now an independent 501(c)(6) non-profit organization, and proceeds from the overall sales conducted at the market will be used to continue marketing efforts for specialty producers in the future. The first step toward sustainability was the establishment of a cooperative relationship with SCC. SCC hosted the distribution food hub location. This location provided access to the public for pick-up but also provided a distribution center for fresh local foods on campus. This project also built on the foundation of specialty crop growers involved in Solano Grown. By reaching out to this network of farmers, Solano Grown had an already identified group of farmers who could benefit from the online farmer's market.

## Project Approach

At the beginning of this grant, Solano Grown lost its non-profit status because of a filing error. As a result, the grant was immediately put on hold with approval from the California Department of Food and Agriculture, while Solano Grown worked to have its non-profit status reinstated. Once that was accomplished, it was necessary to re-establish contact with the specialty crop growers that had already been contacted. The start and stop nature of things made it difficult to reestablish good connections with the farmers. The farmers were skeptical and hesitant to sign up for the online marketplace because they did not know if the project was going to move forward. Subsequent farmer collaboration suffered because of this event.

Specialty crop farmer outreach continued and a small group of farmers signed up to sell crops on the website in 2014. This was an abbreviated selling period which only lasted two months, May and June 2014. During this time, sales were minimal. In 2014, a Market Manager was hired to conduct outreach to farmers and accept and distribute specialty crops through the Food Hub.

In 2015, the Solano Grown Board began outreach again with renewed energy and was able to engage and include 13 farmers on the website for the opening of the market in May. The year of 2015 also marked the hiring of a new employee, a Farmer Liaison. For the remainder of the grant, a Market Manager and a Farmer Liaison helped to achieve the goals of the grant.

Project staff began a concerted advertising effort in 2015 to let potential specialty crop buyers know about the resource available to them. Advertising efforts included online Facebook ads, online ads through local publications, print ads in local publications, rack cards to be handed out at tabling events, and direct mailers to potential customers. The online marketplace was also advertised to local specialty crop farmers through ads with the Solano Farm Bureau.

The Market Manager and Farmer Liaison reached out to farmers and noted time spent on outreach to specialty crop farmers. Any time spent on non-specialty crop farmers was paid with Solano Grown funds, not SCBGP funds. That being said, both the Market Manager and the Farmer Liaison focused efforts on specialty crops and therefore did not have many hours that were outside of the grant purpose. The online host of the farmer's market also tracked the products offered by each farmer participating in the online marketplace so it was easy to calculate which specialty crops were being sold on the marketplace.

Solano County has been a strong supporter of this project from the beginning and continually provided guidance and assistance in the outreach to specialty crop growers. The county also waived fees for Solano Grown to help keep this endeavor cost-efficient. In addition to the county, the SCC Horticulture Department was also supportive. SCC provided the Food Hub location to Solano Grown free of charge. This represented a huge savings and enabled Solano Grown to focus the majority of the grant funds on specialty crop farmer outreach and the increase of specialty crops sales. Additionally, members of the Horticulture Department provided countless volunteer hours to ensure the success of the Food Hub. Without this time and energy, project staff would not have been able to accomplish what it has.

## Goals and Outcomes Achieved

The online marketplace was created to help specialty crop growers sell more specialty crops. The project had the following goals: 1. Increase in overall gross sales volume online of 2% each month from launch, and; 2. Increase in farmer participants by 4% each month. In order to achieve these goals, the marketplace was advertised throughout the Solano County region to engage potential buyers. This advertising was done via larger online mechanisms like Facebook and also through more local channels such as local newspapers, weeklies, and direct mail campaigns to the neighborhoods closest to the food hub. In addition to print and online advertisement, the board attended and tabled at local events to spread the word about the online marketplace to potential customers.

When focusing on the increase in specialty crop farmer participants, project staff used the existing Solano Grown membership to advertise the availability of the marketplace as a new sales channel, as well as the local Farm Bureau to entice new farmers not already associated with Solano Grown to join the marketplace.

There has been gradual growth for both farmers and buyers which is beneficial to specialty crop growers in Solano County. It is difficult to say if this growth will have a lasting effect though because the feasibility of the online marketplace is still to be determined. Without outside grant funding, it is doubtful that the marketplace can cover the base costs of the online marketplace itself and advertising costs. While there has been mild interest, it may not be enough to support the marketplace moving forward.

The overall goal of this project was to increase the sales of specialty crops in Solano County through the use of the online farmer's market. The Solano Grown Board worked toward that goal by specifically trying to increase in overall gross sales volume online of 2% each month from launch and an increase in farmer participants by 4% each month.

During the duration of the grant period, the sales were somewhat regular, but did not result in a steady 2% increase each month. When there was an increase, it was often more than 2%. Throughout 2015, sales fluctuated in the hundreds of dollars, with a high of $317.80 and a low of $105.20. The sales from 2016 showed steady interest through the end grant period, with a small dip between January and February and from

March to April. As the heavy specialty crop growing periods started, sales looked strong. Below is a chart showing the sales numbers and the percent change from month to month.

Specialty Crop Sales through Online Marketplace:

| Year | Month/Year | Sales | % Change |
|---|---|---|---|
| 2014 | 5/14 | $36.00 | |
| 2014 | 6/14 | $25.20 | -30.0% |
| 2015 | 5/15 | $279.68 | 1009.8% |
| 2015 | 6/15 | $272.02 | -2.7% |
| 2015 | 7/15 | $105.20 | -61.3% |
| 2015 | 8/15 | $173.50 | 64.9% |
| 2015 | 9/15 | $317.80 | 83.2% |
| 2015 | 10/15 | $160.90 | -49.4% |
| 2015 | 11/15 | $156.00 | -3.0% |
| 2015 | 12/15 | $146.80 | -5.9% |
| 2016 | 1/16 | $208.22 | 41.8% |
| 2016 | 2/16 | $139.96 | -32.8% |
| 2016 | 3/16 | $154.66 | 10.5% |
| 2016 | 4/16 | $116.32 | -24.8% |
| 2016 | 5/16 | $260.40 | 123.9% |
| 2016 | 6/16 | $275.33 | 5.7% |

The goal to increase specialty crop farmer participation by 4% each month has been achieved though it has been uneven. During the bulk of 2015, there was a steady increase in farmers, going from 11 in July of 2015 to 18 by the end of 2015. At the beginning of 2016, there was a drop off as many farmers did not have product to sell and postponed marketplace participation until they did. Project staff anticipated an increase in participating specialty crop farmers as more specialty crops were ready for sale and that came to fruition. Starting in January of 2015 with five farmers, the farmer participation grew steadily through the end of the grant period. Below is a chart showing the farmer participation numbers and the percent change from month to month.

Specialty Crop Farmers Participating in Online Marketplace:

| Year | Month | Farms | Growth from Previous Month |
|---|---|---|---|
| 2015 | May | 13 | |
| 2015 | June | 12 | -7.7% |
| 2015 | July | 11 | -8.3% |
| 2015 | August | 13 | 18.2% |
| 2015 | September | 13 | 0.0% |
| 2015 | October | 14 | 7.7% |
| 2015 | November | 16 | 14.3% |
| 2015 | December | 18 | 12.5% |
| 2016 | January | 5 | -72.2% |
| 2016 | February | 5 | 0.0% |
| 2016 | March | 9 | 80.0% |
| 2016 | April | 13 | 44.4% |
| 2016 | May | 16 | 23.1% |
| 2016 | June | 19 | 18.8% |

As shown above, the 2% growth in sales from month to month was achieved at times but was more sporadic and uneven than hoped for by project staff. There were eight instances of a drop in sales from the previous month during the duration of the grant but when there were increases in sales, they outpaced the 2% goal. This shows that while the growth was uneven, it represented steady sales for the specialty crop growers. This is a success in the eyes of the project staff because even incremental increases in sales can have a dramatic impact on small- and medium-farmers.

The 4% specialty crop farmer participation was met regularly during the grant period. There were only three instances of a drop in farmers from month to month and two months that showed flat growth. As with the sales goal, the farmer participation was steady. While these metrics did not reveal the dramatic impact that was anticipated, it did show that there was benefit derived from the online marketplace and the farmers that participated were able to see value in their participation.

The steady participation by the specialty crop growers is a success. Business owners do not continue activities that do not benefit them and by staying active within the marketplace, the growers showed that this was a valuable tool in their larger marketing and sales portfolio. This participation in conjunction with the small but steady sales shows a successful impact within the farming community.

## Beneficiaries

The specialty crop farmers that sold their products through the website benefitted from this project by having an additional sales avenue. Often, farmers are constrained by the availability of markets and the online marketplace provided a low-risk sales opportunity. The marketplace customers also benefitted from the project by being able to purchase locally grown specialty crops through a relatively easy, online mechanism that allowed mixing and matching of different farmers' products with a quick, one-stop pick up. The online marketplace had 19 farmers that participated and benefitted through increased sales and access to an

additional sales channel. The online marketplace was used by approximately 60 customers throughout the grant period. These customers benefitted by having access to fresh, locally grown specialty crops. These purchases totaled over $2,800.

## Lessons Learned

Positive outcomes include increases in sales for the specialty crop farmers that participated in the online marketplace. Those farmers that sold product were able to increase their sales, even if only incrementally. These sales are still important and help make ends meet for smaller and beginner farmers. Project staff saw that it was important to make it as easy as possible for specialty crop farmers to use the online marketplace. The Food Hub Manager and Farmer Liaison both spent time assisting farmers with the uploading of their products and other troubleshooting. Without that support, the specialty crop growers would not have had the sales they did.

Lesson: Small farmers need a variety of sales channels but also need assistance so it is easy to sell within these channels.

Project staff found during the grant that advertising in local publications, whether online or print had the greatest return on investment. When the grant proposal was originally written, all online advertising was focused on Facebook ads; however, it was found that very few, if any, sales resulted from the Facebook ads. As a result, the grant funds were redirected to local online advertising with the community newspaper. These ads received immediate attention from local buyers. In a one-week period in June, online wallpaper ads received over 25 click-throughs and the mobile ad received 13 click-throughs in the same amount of time.

Lesson: For the type of hyper-local sales that the Solano Grown Online Farmer's Market is promoting, hyper-local advertising should be used as well.

This project also had to battle low sales during the entirety of the grant period. Originally, project staff thought that the problem stemmed from the abrupt closing of the online farmer's market in 2014 due to issues with the non-profit status. While that definitely played a part and the steady sales from the peak season (June-September) in 2015 gave project staff hope, the sales dwindled once again in November 2015. Part of this may be the seasonality and lack of product diversity through the winter but there are bigger issues at play regarding the viability of an online farmer's market in the Solano area.

The Board discussed this topic in depth and emerged with theories and lessons on why the online farmer's market was not as successful as the original grant writers anticipated. These ideas are below:

1. Consumers want to see and touch their produce before buying it. The online farmer's market takes this tactile element out of the shopping experience and many customers have been reluctant to use the farmer's market for purchases as a result. Without that in-person component, consumers have difficulty getting over the hurdle of trust in the product. They were reluctant to take a risk on buying a product and hoping it was fresh and in good condition.

Lesson: It is important to establish trust with customers regarding product quality before expecting online purchases.

2. Community College students are not the ideal customer for the online farmer's market. Originally the thought was that placing the food hub at the college would bring a critical mass of customers who were already on site for other reasons. Unfortunately, this line of thought has not borne fruit. The average community college student is either a. still living with their parents and not cooking meals or b. is more budget minded and not purchasing local specialty crops from an online farmer's market. The food hub never sold to a student at SCC though some of the faculty purchased specialty crops. As a result, what was originally thought to be a central location with many buyers in a mile radius ended up being out-of-the-way for the customer the marketplace ended up attracting. That lack of a central location was a hindrance to both customers picking up specialty crops and farmers delivering their specialty products.

Lesson: When choosing a location for a Food Hub, thoroughly research potential customers ahead of time to identify the most central location.

3. The cost of the specialty crops on the marketplace can be high at times. This problem was identified and discussed early with some of the specialty crop farmers. Unfortunately, for the most part they were not interested in lowering their prices. The price variability made it difficult to have steady sales for some farmers and they did not necessarily see it as something they could or were willing to fix.

Lesson: Competitive pricing is necessary for the sales of average specialty crops.

Project staff were surprised with the lack of traction the online marketplace had with customers in Solano County. There is steady interest in buying local in Solano County and at the beginning of this process the Board thought that interest would translate to specialty crop sales. This was not the case.

The Board was also expecting more interest from the farming community. This might be a good thing though because it may reflect that Solano County farmers have quality sales channels in place and did not need additional ones. That being said, project staff thought there would be more participation from local farmers and this was not the case.

While the overall goals of this grant were achieved, the grant was not a huge success. The number of farmers participating and the amount of sales never reached what was anticipated when the grant proposal was drafted. The Board feels that there were many reasons for this ranging from difficulty using the online marketplace to customer's preference for a tactile experience when buying produce.

**Additional Information**

The website for the Online Marketplace is https://www.localfoodmarketplace.com/solano/.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 5 | **Project Title:** NCO Food Hub Project | |
|---|---|---|
| **Grant Recipient:** North Coast Opportunities (NCO) | **Grant Agreement No.:** SCB13005 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Patty Bruder | **Telephone:** (707) 467-3200 x282 | **Email:** pbruder@ncoinc.org |

## Project Summary

The NCO Food Hub Project was designed to expand market access for local specialty crop producers by developing a food hub to manage and streamline aggregation, distribution, and marketing of source-identified local foods to distributors, wholesalers, retailers, and institutional purchasers. The project was developed to address the fact that many local specialty crop producers were unable to access mainstream markets, largely because of the remoteness of the area and its widely scattered communities, although some producers also lacked the technical knowledge to produce a consistent, quality, and reliable supply of specialty crops and lacked access to infrastructure for aggregation and distribution. NCO also recognized the needs of buyers, who wanted to benefit from the growing consumer demand for local specialty crops but lacked a full understanding of the variety and quantity of specialty crops being produced throughout the area. Some also lacked the experience and/or capacity to deal directly with individual growers.

NCO planned the food hub to prepare specialty crop growers to connect with the mainstream food system by developing aggregation and processing infrastructure and providing technical assistance (TA) to help them satisfy the requirements of institutional and commercial buyers. To better understand the specific needs of both producers and buyers, NCO initiated the project by carrying out preparatory activities as listed in the project workplan. These included: establishing an Advisory Council to provide guidance and oversight; thoroughly researching existing food hub models and best practices; and convening stakeholders from throughout the value chain and conducting focus groups, baseline surveys, and individual interviews to assess their specific needs and challenges. These initial efforts made it clear that obstacles to efficient aggregation, distribution, and marketing of local specialty crops were numerous and complex, as described below.

- Geography. Lake and Mendocino Counties together cover 4,762 square miles, an area almost equal in size to the state of Connecticut. Communities are small and scattered throughout the rugged terrain.
- Farmer demographics. The average farmer age is 58, and would-be farmers are slow to enter production because the extensive export-oriented viticulture in the area has made access to affordable farmland for specialty crop production very limited.
- Price. Small-scale farmers want to diversify their marketing channels beyond farmers markets, but must secure the highest price point possible to ensure their financial viability, which has led to a general aversion to wholesale marketing and any strategy that adds cost to a product already perceived as “too expensive” by buyers. Buyers have stated they are operating on razor thin margins and have difficulty justifying higher prices considering the time, labor, and administrative burden of local procurement.
- Volatile supply and demand. Buyers want to connect with local specialty crop producers, but have been frustrated by the lack of consistent supply of quality products and the inability to track and anticipate production from local farms. For their part, producers are independently planning their production without a clear understanding of demand and competition, resulting in unmarketable surplus and insufficient diversity of products.

- Lack of technical capacity. Many producers lacked the business acumen to operate a financially viable farming enterprise, had inadequate post-harvest practices (grading, packing, etc.), lacked access to needed infrastructure, and lacked the time and expertise to effectively and efficiently market their products. These conditions posed significant barriers to increasing their market share. Many buyers lack understanding of seasonality, regulations, and small-scale growing practices and challenges, and may have inflexible and varied purchasing practices that complicate local procurement.
- Conflicting definitions of local. While eating local is a popular phenomenon and demand is seemingly increasing, it has not necessarily resulted in increased sales for farmers, since many corporate chains are promoting all California-grown produce as local. Consumers who think they are purchasing local produce may in fact be consuming produce grown hundreds of miles away.
- Financial risk. Inconsistent and low-volume supply, coupled with volatile demand, competition with mainstream distributors, and widespread geographic dispersion of local farms and end-users placed the long-term financial viability of a centrally-located, physical aggregation and distribution hub in doubt.

In spite of the challenges, local specialty crop producers and buyers were committed to improving the viability of the local specialty crop market, and both were willing to collaborate toward this end. With essential components in place—producers, willing buyers, existing distributors, and the beginnings of a marketing campaign—project staff developed a revised plan of action that addressed the same outcomes as the original proposal but focused on maximizing access to quality, reliable, and consistent local product through decentralized nodes (see Attachments 1, 2, and 5) and multiple delivery routes to facilitate aggregation and distribution. NCO placed greater emphasis on building the long-term capacity of the local food value chain and empowering stakeholders with the information they need to work together effectively. The primary difference was the removal of the centralized aggregation, packaging, and distribution component. food hub operations were supported with specialty crop buyer education, specialty crop producer training and technical assistance, and streamlined sales and marketing.

Although Mendocino and Lake Counties were historically primary breadbasket producers, much of the area's production capacity has been lost, and many small-scale crop growers lack the time and infrastructure to connect to the regional distribution system as well as the capacity to market, package, and distribute their produce to comply with the requirements of institutional and other large buyers. These gaps limit their ability to access mainstream retail and wholesale markets. In recognition of the growing demand for local foods, the food hub was designed to enable specialty crop growers to connect effectively and efficiently with the regional food system by addressing gaps in the value chain to increase their access to business and institutional buyers.

The Food Hub Project built on two previous Specialty Crop Block Grant Program (SCBGP) grants, neither of which included the aggregation, distribution, marketing, and technical assistance components that were integral to the food hub.

- 2011 SCBGP Project 46: *North Coast Opportunities Farm2Fork Project* provided training, equipment, and TA to specialty crop producers and to schools and other buyers to increase institutional purchasing of locally grown specialty crops. This effort trained 65 school food service staff, and as a result 4 school districts began buying fresh produce from 12 local specialty crop growers, representing a sustainable 100-250% increase in local farm-to-school purchasing. An additional 9 school districts, 3 hospitals, 7 grocers, and 15 restaurants also developed their local purchasing capacity through

Farm2Fork and over 100 regional producers had the opportunity of benefiting from the increased institutional demand for local specialty crops. The food hub project created processes and an infrastructure to support continued access to local markets for specialty crop producers.

- 2009 SCBGP Project 32: *A Growing Movement to Seed Healthy Eating* worked to maintain and expand the Lake County Grown online ordering system and to facilitate partnerships to increase market access for local farmers and buyers. NCO recognized that an online ordering system would play a key role in developing the link between institutional buyers and growers by allowing orders to be placed through the food hub while retaining individual grower identity. The food hub project built on the foundation laid to develop and operate the NCO Food Hub online marketplace (www.localfoodmarketplace.com/mendolake/Products.aspx).

## Project Approach

PHASE ONE: PREPARATORY WORK (October 2013 – March 2015)

During the first 18 months of the project, NCO carried out a range of preliminary work, as described below.

- NCO conducted outreach to inform specialty crop producers and buyers about the project through press releases, live radio interviews, email correspondence with 125 specialty crop producers and 30 buyers, and presentations to the Mendocino County Food Policy Council, Mendocino County Farmers Guild, and Mendocino County Farmers Market Association (McFARM). Staff also met individually with key stakeholders, including Agricultural Commissioners and Environmental Health Directors. An informational meeting was held with local United States Department of Agriculture (USDA) representatives and 15 community partners to leverage their support and networks for disseminating project information to specialty crop producers.
- In December 2013, NCO partnered with the Mendocino County Farmers Guild to convene a forum of 65 specialty crop producers who provided input on aggregation, marketing, and distribution needs.
- NCO recruited 22 producers, buyers, and community members to participate in an Advisory Council that began meeting in March 2014 and met regularly throughout the project. Members included professionals from County Departments of Environmental Health, local banks and credit unions, specialty crop producers and buyers, independent marketing consultants, and non-profit managers.
- NCO performed extensive research on food hub models and best practices.
- To assess local needs, NCO held three focus groups with 20 producers, collected 24 baseline producer surveys, and conducted one-on-one interviews with 40 specialty crop producers, 10 restaurants, four retailers and grocers, three distributors, and 25 nonprofit, governmental, and other stakeholders.
- NCO worked with an external evaluator to develop project monitoring instruments and compiled data collected through the assessment process into comprehensive producer and buyer databases that included information on location, existing market relationships, specialty crops and quantities produced and sold, buyer requirements in terms of quantity, standardization, order size, ordering and delivery specifications, producer capacity, and interest in participating in the food hub.
- Assessment information was used to create both physical and digital maps of specialty crop farms, buyers, and distribution routes to facilitate communication and logistics (see Attachment 1).
- Drawing on information collected through the assessment process, staff provided a range of training and technical assistance to address identified needs, as summarized below.

*Table 1. Training and TA activities*

| Date | Activity | Participants |
|---|---|---|
| March 2014 | Farmers Convergence Event, with workshops on local distribution, food safety, farm financing, farm-to-institution sales, value-added production, and USDA support services. | 175 specialty crop producers and buyers |
| December 2014 | Wholesale Success for Specialty Crop Producers Training | 12 producers |
| December 2014 | Capay Valley Farm Tour | 12 producers |
| March 2015 | Farmers Convergence: workshops on farm mapping, soil health, financing, small farm economics, food hub sales, retail produce management, labor laws, GAP, small farm production techniques | 140 producers and buyers |
| March 2015 | Specialty Crop Farm Recordkeeping | 11 producers |
| February 2016 | Wholesale Success for Specialty Crop Producers Training | 23 producers |
| March 2016 | Farmers Convergence: workshops on direct marketing, going wholesale, farm financing, no-till production, labor, ask a retailer, farm accounting, composting, hedgerows, Food Safety Modernization Act (FSMA) | 150 producers and buyers |
| March 2016 | Food Safety full day workshop | 19 producers |
| April 2016 | Sales and Marketing for Specialty Crop Producers | 12 producers |
| May 2016 | Specialty Crop Farm Equipment | 14 producers |
| 2015-2016 | A total of 160 hours of 1:1 training and TA provided to specialty crop buyers, chefs, and school district food service directors to demonstrate the process of purchasing through the Food Hub and provide support with production planning and other topics. | 25 producers |

- Working with a contracted marketing consultant, project staff developed a comprehensive branding campaign aligned with the Grown Local brand, to promote local specialty crop purchasing and consumption.
- In collaboration with three other food hubs in development or operation in the region, project staff developed a Community of Practice with regular conference calls to share hub-related information and resources toward the development of a future regional network to expand market opportunities for specialty crop producers.
- After assessing a number of existing online ordering systems, including the version that was being used by Lake County Grown, Local Food Marketplace was selected and project staff worked with them to adapt the existing online ordering system to meet food hub requirements for online ordering, invoicing, billing, and tracking while providing real-time online availability listings to enable buyers to purchase from multiple producers (and vice versa) through one invoice and one payment.
- Using in-house accounting expertise, an internal accounting system was set up to integrate with the online ordering system.
- The policies, procedures, and logistics of availability, ordering, and delivery were developed in partnership with farmers and buyers. NCO finalized food hub procedures to ensure that all specialty crops were packed in closed full cases by producers and not opened until they reach the buyers. This structure minimized overhead and eliminated the need for organic certification or produce handler licenses. Through ongoing communication, NCO determined that the food hub could be licensed as a Commissioned Merchant, given that it would not be in possession of specialty crops sold through the food hub. The hub also managed financial transactions, thereby eliminating cash flow issues. The sales

system has the added benefit of providing records and tracking production for participating producers. Surplus production that is not purchased through the system can be channeled to secondary markets at discounted rates, if desired by producers. Labels that properly identify local products according to regulatory requirements are utilized. Source identification and growing practices are communicated to buyers and customers utilizing local branding materials.

- In order to decrease transportation costs and increase geographic reach for producers, NCO worked with producers, distributors, and other partners to coordinate delivery routes. Mendocino Coast Produce, a local delivery business, agreed to reserve space on their truck for up to 100 cases of produce per each delivery cycle, with a minimum of one case per delivery location and four cases per pickup location. Project staff also developed a series of delivery routes spanning the two counties that ensured that specialty crops could be picked up from and delivered to most areas within the target area. There were two weekly deliveries, Tuesdays and Fridays, based on buyer and producer needs.
- Regional nodes were developed as aggregation points, mobilizing existing cold-storage infrastructure where possible and investing in additional storage capacity to enable safe cross-docking. The nodes use shipping containers and CoolBot air conditioning systems with two areas cooled to two different temperatures to accommodate varying specialty crop temperature requirements. Node sites include Caspar, Ukiah, and Willits, where NCO installed the shipping containers, as well as locations with storage solutions made available at no cost by four local specialty crops producers.
- NCO piloted the food hub in late 2014. Through the pilot, staff were able to understand the platform from both buyer and seller points of view, and to make appropriate modifications.
- NCO began accepting applications from producers and buyers in the spring of 2015. (See Attachment 4 for Farmer Guide to Using the Food Hub)

PHASE TWO: IMPLEMENTATION (April 2015 – June 2016)

- Food hub operations began in May 2015, with staff coordinating twice-weekly sales and deliveries. Total revenue by the end of the grant was $103,915 with a gross margin of $12,769. Most of the margin was spent on delivery fees, with a small amount held in reserve for unanticipated future expenses.
- The marketing campaign launched in June 2015 concurrently with full food hub implementation. Marketing strategies included customized point-of-sale materials; radio and print advertisements; news articles and editorials (see Attachment 3); social media; photo ID cards for participating farmers; and online videos and blogs. The Grown Local logo, deployed in neighboring Sonoma County with great success, is used as an identifying brand. Later in the period, beginning with the surge of late summer and fall produce, radio ads highlighted the food hub and key local specialty crop buyers. Staff also worked with key buyers to develop in-store signage to introduce local specialty crop farmers.
- Project staff led specialty crop producers and school district food service directors in coordinated production planning to meet institutional needs, first determining which crops producers could grow in larger quantities and then working with food service directors to plan a calendar of monthly purchases based on the statewide Harvest of the Month program. These plans resulted in forward contracts for more than nine tons of local specialty crops (e.g., apples, cantaloupe, pears, peppers, slicing tomatoes and cherry tomatoes, spinach, summer squash, and watermelon) from three specialty crop producers during the coming school year.
- Project staff carried out ongoing efforts to identify opportunities to utilize existing distribution channels, through backhauling or backfilling agreements with established distributors already serving

the region and with producers who have existing delivery routes to bring their harvest to regional markets.

The active participation of the Project Coordinator at all stages of the project enabled NCO to monitor activities to ensure that all transactions involved only specialty crops. Specific strategies to ensure that the project would solely enhance the competitiveness of specialty crops are described below:

- Members of the Food Hub Advisory Council were informed at the start of every meeting that the focus of the food hub is exclusively on specialty crops.
- During interviews with specialty crop producers and buyers, project staff specifically stated that only specialty crops were eligible for participation in the project, and staff made regular visits to participating producers to ensure that the project worked only with specialty crops.
- All direct technical assistance, consulting, and trainings were offered only to specialty crop producers.
- For workshops and conferences, tracking mechanisms were established to ensure that grant funds supported only costs directly related to specialty crops. NCO and its partners secured donations to support the approximately 20% of costs that were not specific to specialty crops.
- Outreach efforts targeted growers and buyers who purchase specialty crops. To ensure outreach solely enhanced California specialty crops, this was explicitly stated in all outreach materials.
- No non-specialty crops were handled or sold by the food hub, as confirmed by sales records. The food hub's online sales software allowed only specialty crops to be listed, and all food hub sales were carefully tracked by type and quantity of each crop.
- Packaging developed or purchased through the food hub was provided only for specialty crops.

The project benefitted from close partnerships with stakeholders who provided valuable input and support throughout the project. Contributions made by each partner follow.

- Capay Valley Farm Shop partnered with NCO to offer two "Wholesale Success for Specialty Crop Producers" technical trainings.
- Clearlake Community Food Pantry partnered with NCO in distributing food hub specialty crops.
- Food Hub Advisory Council members met regularly to advise NCO on issues ranging from logistics to pricing to ownership structure.
- General Produce trucked food hub produce to communities not served by other routes.
- Mendocino Coast Produce carried food hub produce and arranged delivery schedules, allowing the food hub to operate with low overhead during the initial phase of the project.
- Mendocino County Department of Agriculture provided support through the County's Approved Source Food Safety Program and also provided meeting space for Advisory Council meetings.
- Mendocino County Farmers Guild provided meeting space and facilitated connections with other regional Farmers Guilds. Through these networks, NCO reached more local specialty crop producers, and specialty crop producers gained access to Guild trainings and resources.
- Mendocino Food Policy Council provided input on project development and promoted the food hub to specialty crop producers and buyers.
- Specialty crop buyers, including school district food service directors, produce managers, grocery marketing directors, chefs, and restaurateurs, worked with project staff to refine operations and marketing plans. These professionals provided feedback on marketing materials, met in person to plan purchasing, and took time to discuss pricing plans and purchasing habits.

- Specialty crop producers, in addition to their business relationship with the food hub, contributed to the project by: letting the hub use cold storage space at their locations; providing potential customer contacts; responding to project surveys; providing production planning advice; allowing their farms to be photographed for marketing purposes; and leading tours of their farms for potential customers.
- University of California Cooperative Extension (UCCE) helped facilitate the Capay Valley Farm Tour and offered a full-day workshop on food safety following the 2016 Farmer Convergence.
- Several organizations contributed in-kind to the Farmers Convergences, including the Community Alliance with Family Farmers (CAFF), CA FarmLink, FarmsReach, the USDA Farm Service Agency, Anderson Valley Food Shed, CropMobster, the Grange Farm School, and KivaZip.

## Goals and Outcomes Achieved

Activities carried out by project staff have been detailed in preceding responses. All of those activities were implemented to achieve the performance goals and measurable outcomes.

The anticipated long-term outcome of the project is to sustain the operations of the food hub to continue to enhance the competitiveness of specialty crops by providing local producers with expanded access to local institutional and retail markets. In close collaboration with the Advisory Council, NCO has actively addressed food hub sustainability following the grant period by researching and assessing a range of ownership models and structures. The preliminary plan is to create a specialty crop farmer cooperative with annual fees, democratic control of budget and operation, and multiple levels of membership depending on each farm's size and usage of food hub services. Although the plan has yet to be finalized, it has been well-received by the Advisory Council and other farmers that have been engaged in the discussion.

Goal/Outcome 1. Increase access to local retail and institutional markets for local specialty crop producers resulting in an average per-farmer increase of 10% in specialty crop sales and an average per-farmer decrease of 15% in transportation costs related to distribution of specialty crops.
During the final months of the project, staff surveyed 23 participating specialty crop producers about their experience. Asked how many times they had sold through the food hub, 14 producers (61%) reported that they had sold 2 to 5 times, while 9 producers (39%) sold more than 5 times during the grant period. Producers were asked to report farm business costs (e.g., transporting produce to markets, marketing, and post-production costs) that were impacted by their participation in the food hub. Of 21 producers, all but 2 reported decreased costs in at least one expense area. The extent of the decrease in costs varied widely, ranging from 1% to 100%. (Note that, while 21 producers reported cost decreases, not all provided an amount of decrease.) Producers were also asked to report any gains in farm income resulting from their participation, and the source of their increased income (e.g., increased sales, higher sales prices, more sales of surplus and seconds). Of 23 producers, all but 4 reported increases in their income that ranged from 0.1% to 60%. Producers were next asked to report changes in the amount of time they spent on their farm business, as well as the types of activities (e.g., marketing, transportation, direct sales) for which the time spent changed. In all, 16 of the 23 producers (70%) reported reduced time spent in at least one activity. For example, the most active producers were able to reduce their drive to market by an average 80 miles one way and were also able to access new, more distant markets without increasing their travel time.

Goal/Outcome 2. Increase in purchase of local specialty crops by institutional/retail buyers, with at least 20 institutional/retail buyers of local specialty crops and an average increase of 10% in the quantity of local specialty crops purchased by local institutional/retail buyers by the end of the project.

At the full launch date in May 2015, the food hub began with five farmers selling and eight buyers purchasing specialty crops intermittently. In June 2016, at the end of the project and just 14 months later, there were 9 orders twice a week, with specialty crops sourced from 11 different farmers purchased by 21 different buyers. From January 2015 through June 2016, the top 10 buyers and the top 5 producers accounted for 80% of food hub sales. The most active buyers regularly purchased twice weekly throughout the reporting period.

At the end of the project, staff surveyed 25 food hub buyers, including restaurants and markets, schools, and buying clubs. Asked how many times they had purchased through the food hub, 17 of 24 buyers (71%) reported that they had purchased more than 5 times. The top reason that buyers gave for buying through the food hub was customer demand (76%), although nearly half (48%) also identified the food hub's competitive pricing as a factor. Other factors included local farmers' increased ability to meet buyer requirements in terms of timeliness and availability (32%), quantity (32%), consistency (32%), and packaging (24%).

In specific response to the goals, 84% of the buyers reported that they were purchasing more local specialty crops. Reported increases ranged from 5% to 300%, with the most frequent response being 10%. In terms of variety, 20 buyers (80%) reported purchasing more types of local produce, and in terms of cost, 14 buyers (61%) reported paying either lower prices or the same amounts for local specialty crops purchased through the food hub, while 36% reported paying higher prices. Only one buyer ventured to estimate the percentage by which his costs decreased, which was 25%.

Using the food hub launch date of May 2015 as a baseline, progress can be seen by comparing the numbers of participating producers and buyers, as well as sales figures, over the course of the grant, as shown below.

*Table 2. Baseline and end-of-project data*

| Indicator | May 2015 | June 2016 | Difference | Percent Change |
|---|---|---|---|---|
| Number of specialty crop producers selling through the Food Hub | 5 | 47 | +42 | +840% |
| Number buyers purchasing through the Food Hub | 8 | 30 | +22 | +275% |
| Number Food Hub orders | 18 | 609 | +591 | +3,283% |
| Revenue generated by specialty crops sold through the Food Hub | $2,007 | $103,915 | +$101,908 | +5,078% |

NCO collected baseline data from both producers and buyers through focus groups, baseline surveys, and individual interviews. Baseline data collected at the beginning of the project were primarily qualitative in nature; most local specialty crop producers were either unable or unwilling to share specific details related to their income and expenditures. Rather, baseline data collected by the project focused on local specialty crop producers (e.g., where they are located, types of crops they produce, where their produce is sold, marketing strategies) and local specialty crop buyers. Intensive interviews with 16 producers revealed that: 13 were selling locally (within 100 miles); 7 wanted to sell wholesale; 7 would scale up and grow more if they were

sure they could sell it; and their most successful crops were cucumbers, tomatoes, greens, squash, potatoes, and orchard fruit. Other quantitative outcome data has been cited previously in this report.

Working with local partners, NCO successfully created a local specialty crop aggregation, sales, and distribution hub, making it possible for producers to market and distribute their produce more efficiently and economically while retaining brand and location identity and supporting their economic vitality. By the end of the grant period, 47 specialty crop producers had sold produce through the food hub, and 30 buyers had purchased through the food hub, resulting in total sales of $103,915.

## Beneficiaries

Project beneficiaries include specialty crop producers, specialty crop buyers, and community members.
The 47 specialty crop producers that sold through the food hub benefited from the project in numerous ways:

- Increased farm income.
- Training on food handling safety, crop planning, marketing, and packaging for mainstream markets, etc., resulting in increased capacity to meet institutional and commercial buyer requirements.
- Through NCO, access to liability insurance coverage for specialty crops sold through the food hub.
- Reduced marketing, transportation, and distribution costs.
- Reduced challenges related to aggregation, packaging, marketing, and distribution.
- Ability to retain and market grower-identified products.
- Ability to focus effort on growing, rather than marketing and delivering their specialty crops.
- As a result of the Grown Local marketing campaign, increased community awareness of the availability and value of specialty crops.

The 30 business and institutional buyers that participated in the project benefited through:

- Increased access to products that were source-verified and grown using sustainable techniques.
- Increased capacity to satisfy customer demand for locally-sourced specialty crops.
- For locally-owned businesses, a market advantage because they became known as the best resource for purchasing local specialty crops.
- Stronger relationships with local specialty crop producers.

Additional benefits, beyond those that accrued to producers and buyers, included the following:

- Increased access to local specialty crops for local consumers.
- Increased community awareness of the availability of local specialty crops and their value.
- More food dollars kept in the community, thus increasing regional wealth through the multiplier effect, which calculates that every $1,000 in net farm income generates an additional $930 in the community.

By the end of the grant period, 47 specialty crop producers had sold produce through the food hub, and 30 buyers had purchased through the food hub.

## Lessons Learned

Specific challenges and lessons learned are described below.

- Early in the grant process, NCO was challenged by the complicated maze of regulations around food safety and other regulations. NCO accessed technical support in understanding the regulatory and licensing requirements for food hub operation; understanding these requirements made it possible to

provide producers and buyers with accurate information in securing needed certifications and ensuring regulatory compliance.

- On the opposite end of this scale, NCO learned that some requirements were less, rather than more, onerous than previously believed. At the outset of the project, school district food service directors were leery about procuring from local farmers because of the extensive food safety regulations that govern school meals. However, NCO learned from USDA Regional Representatives that schools do not have to follow the more stringent procurement procedures when purchasing in amounts of less than $150,000. NCO then offered technical assistance on compliance to food service directors, covering bids, contracts, forward contracts, and marketing, so that they could purchase through the food hub.
- A second lesson learned from working with schools was that, because of the tight constraints on the time they have for processing foods, they preferred to order specialty crops that would require minimal processing, such as cherry tomatoes, or foods that they would normally purchase elsewhere that required the same amount of time to process as locally-procured items, such as fruit.
- Input from the Advisory Council made it clear that most specialty crop producers operate on a small scale that precludes them from accepting wholesale prices, either because they have limited land area, meaning they cannot grow the size of their operation to make up for a reduced margin through increased volume, or because they have a limited resource base that does not allow them to save labor costs through mechanization. To address this challenge, NCO developed a food hub structure that allowed producers to set their own prices.
- Food hubs must learn to effectively communicate the value of the services they are providing, since it is not in their power to set market rules. In spite of producers' and buyers' theoretical support for the food hub, in practice some producers with long-term market relationships chose to sell directly rather than through the food hub. A related challenge continues to be the pressure on margins. The food hub uses a markup of 15%, although most research recommends markups of 20-30%. However, even at the 15% markup some buyers contacted producers directly to work out a better deal, and others have continued to purchase through mainstream distributors, even though the local specialty crops are of higher quality. On the other hand, several producers agreed to route their existing wholesale accounts through the food hub. This level of buy-in will continue to be key to the food hub's success. Project staff are continuing to reiterate and reinforce why the food hub is valuable to the local food system.
- NCO developed a marketing package around Grown Local branding. Producers and buyers that become Grown Local members sign agreements and gain the right to use the Grown Local logo and marketing materials at three different levels, depending on their purchase amounts. The agreements are structured with Grown Local brand sustainability in mind so that after the grant funding ends, retailers and farmers will pay an annual fee for continued access to the materials.
- Production planning turned out to be a hurdle. To address this challenge, project staff spent long hours working with producers to determine which crops they might be able to grow in larger quantities, and with the school district food service directors and market produce managers to review their invoices; track purchases, quantities, and costs; and identify foods that could be purchased locally at similar prices without adding to processing time.
- Lack of redundancy is a challenge to a small rural area, where the loss of just one farmer can result in shortages that reduce supply and inconvenience buyers. Continued outreach, to engage new producers, and support, to retain participating producers, are essential to produce quantities that meet the needs of local buyers.

- Most small-scale specialty crop producers do not maintain records on transportation or marketing costs, making it difficult to assess changes in these expenses.

In response to a request, NCO is compiling a description of the decentralized node design and operation, and will share it through the National Good Food Network.

Through the USDA Community Facilities Grants Program, NCO secured funding to buy a refrigerated delivery truck to provide the distribution support that is essential to operating the decentralized node food hub model.

At the beginning of the project, the Coordinator initiated contacts with other food hubs in the region. The initial contact developed into an informal Community of Practice with monthly conference calls to share challenges and solutions towards the development of regional market access. Recognizing the value of this network, in 2015 University of California, Davis took on facilitation of the group, which continues to meet every month.

Through a range of revisions, project goals were achieved, as discussed throughout this report.

## Additional Information

See Attachments

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 6 | **Project Title:** Creating Value-Added Demand for California Figs – Foodservice/Food Manufacturing Ingredient Education Program (California Fig Ingredient Program) | |
|---|---|---|
| **Grant Recipient:** California Fig Advisory Board | **Grant Agreement No.:** SCB13006 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Karla Stockli | **Telephone:** (559) 243-8600 | **Email:** kstockli@californiafigs.com |

## Project Summary

The initial purpose of this project was that there was an 88% increase of fig and fig ingredient imports into the United States over the base year of 2007-2008 resulting in a devastating effect on this United States specialty crop, threatening the economic viability of fig growers, processors, suppliers and workers. Due to this aggressive import pressure, the California fig industry requested funding to create a comprehensive ingredient education program to educate key target audiences about domestically grown- and produced-figs and fig ingredients and the importance of choosing figs from California.

In addition, 70% of the California fig production competes with imports in low value, commodity business segments. To remain viable, the industry needed to develop markets that recognize the value California figs and fig ingredients contribute to specialty foods instead of competing in the low-value commodity segments. The proposal objectives were to support the emergence of niche, high-value markets among multiple audiences by demonstrating the use of California figs and fig ingredients in product development and clearly differentiating why California figs are preferable to imports. California dried figs are a high-quality and versatile ingredient which provide a full range of possibilities in new products and menu items: enhancing flavors, lowering overall ingredient costs, adding nutrients of concern while reducing fat and sodium to meet demand for flavorful and good-for-you food. This program focused solely on promoting the specialty crop, California dried figs.

This project was important and timely to the California fig industry for several reasons. The initial investment provided the industry an opportunity to strategically build an ingredient development program for long-term sustainability and success. In this effort, the industry created a comprehensive ingredient education program to educate key target audiences about California grown- and produced-figs and fig ingredients. The program funding also provided the ability to conduct one-on-one appointments with 18 key targeted national account product developers resulting in new products for foodservice and retail using California fig ingredients as well as increased awareness to about 46,000 influential food professionals on the importance of California grown figs.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Activities that were completed in order to achieve the performance goals and measurable outcomes identified in the approved project proposal were as follows:

- Partnership alignment. Contract negotiations and partnership alignment were completed.

- Survey. Conducted a pre- and post-program chef and food technologist attitudes and intent to use California fig and fig ingredients survey among food professionals to establish a benchmark and measure performance.
    - Results: Out of over 500 respondents: 74% represented product developers from foodservice volume ingredient categories, up 6% from benchmark; 49.94% indicated use of dried figs, up 10.73% from benchmark. In addition, the survey validated that product developer needs are perfectly aligned with the solutions California fig and fig ingredients provide to them: 1) nutrition: 37.89% were interested in dried figs for product development for nutrition, up 10.01% from benchmark; 2) functionality: 52.17% were interested in dried figs for product development because of functionality which is up 8.90% from benchmark; and 3) natural sweetener: 35.4% were interested in dried figs as a natural sweetener which is up 10.4% from benchmark. 67% of respondents also indicated an interest in learning more about California dried figs and fig ingredients for product development.
        - Conclusion: The California Fig Ingredient Program provided the opportunity to target and educate new potential users of California fig ingredients to shift usage and meet program objectives while setting the stage for continued future one-on-one product development appointments.

- New product concepts. Developed 10 new California fig and fig ingredient concepts to demonstrate the unique possibilities using California fig and fig ingredients in the specialty food categories. Including formulation from small-to-large scale for commercial use presentation styles for the Institute of Food Technology (IFT) Supplier Nights/Culinary School Curriculum Seminars and Product Development Meetings.
    - Results: The development of 10 new California fig and fig ingredient concepts allowed for the project team to customize meeting presentations for each appointment showcasing the concepts to best provide solutions to product developer needs.
        - Conclusion: These innovative product concepts provided the ability to demonstrate the solutions to product developer needs.

- Ingredient concept photography. Professional photography of 11 finished ingredient concepts was completed.
    - Results: Photography was taken of Fig Pepita Bar, Fig Powerball, Fig Chocolate Bar, Fig BBQ Sauce, Fig Steak Sauce, Fig Thai Curry Sauce, Fig Bread, Fig Biscotti, Fig Horchata, Fig Kombucha, and Fig Coffee. Photography has been used in meeting materials for the ingredient program which is designed to enhance the competitiveness of California Figs and re-gain market share from low-cost imports.
        - Conclusion: Professional photography brings the ingredient concepts to life and enhances meeting and presentation materials.

- Ingredient development meetings. Conducted 18 ingredient development appointments reaching 187 attendees in total for one-on-one customized presentations to demonstrate the unique use of California fig and fig ingredients in new products and educate each targeted account on the functionality of California fig ingredients to clean up labels (reduce sodium, refined sugars, imitation coloring and flavors) while increasing nutrition (fiber, potassium, calcium, antioxidants and more).

- Results: Out of 18 appointments, two companies are in the final stages while six are in the beginning stages of new product development using California fig ingredients.
    - Conclusion: Conducting the ingredient development appointments has provided the opportunity to enhance the viability of California fig ingredients and sustainability with potential of new products in higher value niche markets.

- Developed list of ingredient companies. Developed a potential targeted list of companies for product development meetings to conduct educational California fig ingredient seminars to demonstrate the unique uses of California fig and fig ingredients in new products.
    - Results: About 335 (67% of 500) key accounts are interested in learning more on California fig product ingredients.

- IFT Sectional Meetings/Culinary School Curriculum Seminars. Completed three IFT Supplier Nights (Minnesota, Illinois and New Jersey) and two Culinary School Curriculum Seminars (Johnson & Wales and Southwest Minnesota State).
    - Results: These events provided the opportunity to demonstrate unique ingredient versatility and functionality of California fig ingredients in new concepts to over 8,000 attendees (IFT Sectional Meetings) and 60 attendees (Culinary Schools).
        - Conclusion: These opportunities enhance the viability and sustainability of California figs and fig ingredients with increased awareness to identified target audience, adding new target accounts to existing database for future new product development appointments to regain market share from low-cost imports.

- Ingredient kit. Developed a California fig and fig ingredient kit (mission figs, fig pieces, fig nuggets, fig paste, fig powder, fig fiber and fig juice concentrate) for fulfillment from the Culinary School Curriculum Seminars, IFT Supplier Nights and Ingredient Development Meetings.
    - Results: Over 550 kits fulfilled to food professionals.

- Printed support materials and presentations. Developed materials and presentation for use during IFT Supplier Nights, Culinary School Curriculum Seminars and Ingredient Development meetings.
    - Results: California fig brand and look for ingredient education program.

- Food Arts partnership. Developed three recipes for the Annual Food Arts Chef event in Chicago, Illinois.
    - Results: Demonstrated the unique uses of California fig and fig ingredients in savory applications through sampling to approximately 1,500 influential food professionals and added attendees to a database for potential product development meetings in the future.
        - Conclusion: Ongoing outreach and fulfillment of the California fig ingredient kit and securing meetings.

- Figology Council. Established the ingredient and culinary council with four experts in the field of Research Chefs, Cereal Chemists, Food Technology and Chefs.
    - Results: These experts provide ingredient development expertise, collaboration and expert validation to the California fig program.

- Research Chefs Association (RCA) Conference and American Association of Cereal Chemists Conference (AACC). Exhibited innovative California fig ingredients to a combined total of nearly 3,000 attendees at these two leading food professional conferences.
    - Results: Demonstrated unique ingredient versatility and functionality of California fig ingredients (RCA: Fig Bar, Fig Powerball, Korean BBQ Sauce, Thai Dipping Sauce and Asian Steak Sauce; AACC: Fig Bar, Fig Powerball, Fig Chocolate Bar and Fig Bread) to targeted audience of cereal chemists and food scientists.
        - Conclusion: Through this participation, project staff were able enhance the viability of California fig ingredients and add over 3,000 key contacts to a database and contributed to the 335 ingredient meeting target list. In addition, project staff provided ingredient kits to interested attendees and schedule future meetings to develop new products using California fig ingredients.

- Natural Products East. Exhibited innovative California fig ingredients creating awareness and reaching 35,000 Research Chef and Food Technologist attendees with California fig messaging which was perfectly aligned with program objectives for natural, functional and nutritious.
    - Results: Demonstrated unique ingredient versatility and functionality of California fig ingredients: Fig Coffee, Gluten Free Fig Biscotti, Fig Energy Bar, Fig Powerball and Fig Meat Free Salami to targeted audience of research chefs in the health and better for you segment of food and retail goods.
        - Conclusion: Although the show provided the opportunity to demonstrate California figs and fig ingredients to a large audience and add key contacts to the ingredient meeting target list, project staff would not participate in the future because of the overall size of event and organizational flow which limits the ability to have valuable interaction with attendees.

- Efforts to disseminate project results. The California Fig Ingredient Education team (California Fig Advisory Board (CFAB) staff, Food Technologist and Food Agency Professional) met with California dried fig processors, growers and the CFAB during the program to provide periodic project updates and results. A complete report will be generated upon completion of the program.

The overall scope of the project did not benefit commodities other than California figs, a specialty crop.

The significant contributions and roles of project partners are as follows:

The Food Innovator on the project was a full-service company focused solely on the food ingredient industry and has used their expertise to build the foundation of the California Fig Ingredient Program. Their ability to fully understand the functional benefits and the applicable fig ingredients to use in product development resulted in concepts which demonstrated versatility and functionality to product developers contributing to the long term success of the program – from lowering ingredient costs, reduced baking time, cleaning up label through the replacement of refined sugars, imitation colors and flavors.

The Research Chef on the project used their expertise to elevate California figs and fig ingredients in niche specialty food categories instead of competing in low-value commodity markets that are impacted by low-cost

imports. Recognized for their success as an award winning chef, they have contributed to program awareness and acceptability.

The Food Technologist on the project has provided food technology expertise and development of California fig products. Their experience developing markets for food ingredients has been key in the development of ingredient categories and concepts of California figs and fig ingredients in niche specialty food.

## Goals and Outcomes Achieved

The activities described above were completed in order to achieve the performance goals and measurable outcomes identified in the approved project proposal.

All goals for the reporting period were exceeded with the exception of the percent positively shift sales which is too early to determine. The results of the program are summarized below:

a. The first target goal was to positively shift usage and preference amount chef/culinary and food technology professional target audience by 5-10% during the program.
    a. Result: Positively shifted usage and preference among chef/culinary and food technology professionals by 10.73% during the program.

b. The second target goal was to increase new product and menu development by 16% over the same period prior year; resulting in 10-15 new products and menu items during the program.
    a. Result: Increased new products by 110% resulting in 21 new food products during the program. There was also a significant increase (51 in non-food category (cosmetics, pet food, etc.)) which previously was not tracked but appears to be opportunistic for future growth and further expansion from low-value commodity ingredient categories.

c. The third target goal was to positively shift sales from low-value to commodity segments to niche added value segments by 8-13% during the program.
    a. Result: Although there is a positive shift from low-value commodity segments to niche added-value food categories: such as snacks, energy bars, beverages and condiments; non-food categories: such as lipsticks, body care and pet foods, it is too preliminary to track the percent shift in sales at this time.

The baseline data gathered to date and the progress toward achieving set goals follows:

1. Survey. Conducted pre- and post-program surveys to understand current awareness perceptions of California figs and fig ingredients.
    a. Result: As previously stated, out of over 500 respondents: 74% represented product developers from foodservice volume ingredient categories; 49.94% indicated use of dried figs (up 10.73% from benchmark). In addition, the survey validated that product developer needs are perfectly aligned with the solutions California fig and fig ingredients provide to them: 1) nutrition: 37.89% were interested in dried figs for product development for nutrition, up 10.01% from benchmark; 2) functionality: 52.17% were interested in dried figs for product development because of functionality, up 8.90% from benchmark; 3) natural sweetener: 35.4% were interested in dried figs

as a natural sweetener which is up 10.4% from benchmark. 67% of respondents also indicated an interested in learning more about California dried figs and fig ingredients for product development.

i. Conclusion: The California Fig Ingredient Program provided the opportunity to target and educate new potential users of California fig ingredients to shift usage and meet program objectives while setting the stage for continued future one-on-one product development appointments.

2. New product and menu items containing California fig and fig ingredients will be measured pre and post-program through Mintel.
   a. Result: Increased new products by 110% resulting in 21 new food products during the program. There was also a significant increase (51 in non-food category (cosmetics, pet food, etc.)) which previously was not tracked but appears to be opportunistic for future growth and further expansion from low-value commodity ingredient categories.

3. Ingredient shipments to low-value commodity segments and niche added-value segments will be measured using data collected through the Fig Inspection Site and Annual Statistical Review.
   a. Result: As previously stated, although there is a positive shift from low value commodity segments to niche added-value food categories: such as snacks, energy bars, beverages and condiments; non-food categories: such as lipsticks, body care and pet foods, it is to preliminary to track the percent shift in sales at this time.

The major successful outcomes of the project follow:

a. Positively shifted usage and preference among chef/culinary and food technology professional target audiences by 10.73% during the program.
b. Increased new products by 110% resulting in 21 new food products during the period of the program.
c. Identified significant increase in non-food categories (51) which were previously not tracked with opportunity for future growth and continued expansion from low-value commodity segments.
d. Conducted 18 ingredient development appointments resulting in 12% in final product development stages while 34% are in the beginning stages of new product development using California fig ingredients.
e. Strategically developed an ingredient program and have set the stage for continued growth resulting in long-term sustainability and viability for this specialty crop.

**Beneficiaries**

The primary beneficiaries of this project are the entire California fig industry, including more than 100 farmers, marketers, farm managers, and processors. The industry's 700 full-time and 3,500 part-time employees will benefit by retaining employment during these economically challenging times. Also, the communities where they reside (Madera, Fresno, Merced, Kern, Imperial, and Yolo Counties), which experience unemployment rates ranging between 6.4 to 24%, exceeding the state unemployment average of 6.2%, will also benefit from the fig industry's economic activity. Consumers will benefit by purchasing a California grown nutritious fruit that will support better for you food choices to maintain a healthy lifestyle.

The number of beneficiaries affected by the project’s accomplishments and potential economic impact of the project is estimated at 4,500.

## Lessons Learned

The California fig industry is very pleased with the results of this project. They recognize the positive momentum created for commercial use of California grown figs and fig ingredients in new product development efforts for. Along the path of achieving this success and industry support, the CFAB has learned the importance of identifying contractors with skills and expertise to manage and execute objectives in the timeline established, allocating staff time to support program objectives effectively, and securing internal staffing support to assist with management and execution of the program. Moving forward, the CFAB will ensure that any grant implementation team is appropriately staffed to ensure the project's success. Recognizing these items in the future will ensure grant implementation is seamless and on track to complete within the established timelines.

## Additional Information

See Attachment.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 7 | **Project Title:** Baking Seminars for Food Professionals in Japan and South Korea | |
|---|---|---|
| **Grant Recipient:** American Pistachio Growers | **Grant Agreement No.:** SCB 13007 | **Date Submitted:** December 2015 |
| **Recipient Contact:** Peter Vlazakis | **Telephone:** (559) 475-0435 | **Email:** pvlazakis@americanpistachios.org |

## Project Summary

Faced with rising production and increased competition from foreign suppliers, it was essential that American Pistachio Growers (APG) and California Dried Plum Board (CDPB) develop ties with food manufacturers in key export markets around the world. The purpose of this project was to conduct a series of baking seminars in Japan and South Korea as a way to educate food professionals on the technical benefits and added value of baking with pistachios and prunes. APG and CDPB partnered with the world-renowned Culinary Institute of America (CIA) to introduce participants to the health benefits, sustainable production practices and stellar food safety records of both industries. These markets were specifically chosen because of their high value and strong growth potential. Combined, the baking sector in both countries was valued at $36.7 billion dollars in 2012 according to statistics from Euromonitor, making it one of the most lucrative regions in the world for baked goods. These seminars highlighted differences in product quality and food safety to strengthen existing relationships and forge new ones, helping guarantee the continued purchase of U.S. products. Together, APG and CDPB sought to enhance demand for these specialty crops and help ensure the continued prosperity of the pistachio and dried plum industries in California.

Through market development projects such as this, APG and CDPB are able to create new economic opportunities for specialty crop producers. By cooperating, the organizations were able to leverage their combined assets in an effort to build demand for pistachios and prunes globally. The result helped offset production increases and stave off international competition, ensuring that California remains the key supplier of pistachios and prunes to both countries. The project targeted Japanese and South Korean bakers and food professionals, who play an integral role in purchasing both products as ingredients in markets that stand as global leaders in the production and consumption of baked goods.

A number of challenges threatening the viability of international markets for California pistachio and prune producers made this project important and timely. Increased yields and acreages will result in a doubling of pistachio supply between now and 2020, making it essential that APG find new uses for this important California specialty crop around the world. Increased usage as an ingredient in Japan and South Korea will help stimulate demand and offset the impending rise in pistachio production. At the same time, the seminars allowed CDPB to raise awareness of the benefits of using California-grown prunes in baked goods. Japan is the largest overseas market for prunes in the world and exports to South Korea have grown as a result of the United States-Korea Free Trade Agreement. However, stiff competition from lower priced foreign product is threatening the competitiveness of California prunes in each high-value market.

Increased demand will also allow the prune industry to secure and maintain higher market prices, which are a vital response to both the global short supply and to build a competitive long-term position as compared to higher-value crops produced by California growers. Value-added promotions such as this baking sector project help facilitate expanded utilization of prunes and create better price opportunities. By building demand

among high volume users in the baking industries in both markets, APG and CDPG will be able to ensure the sustainability of both specialty crop industries for generations to come.

This project did not build on any previously funded Specialty Crop Block Grant Program project.

## Project Approach

APG and the CDPB secured the services of Marketing Focus International (MFI) to start planning the baking seminars. Representatives from the CIA were contacted and an agreement was signed to begin work developing the recipes and curriculum that would be used at each event. At the same time, MFI began researching potential in-country consultants in Korea and Japan to help carry out the grant activities. After receiving proposals and evaluating them against the approved grant budget, APG/CDPB hired Sohn's Market Makers in Korea and Motix Co. and Office K2M in Japan to organize the seminars and recruit participants. These in-country consultants immediately began work to find and secure venues, hire local support staff (including chefs and translators) and develop recruitment lists. The CIA finished developing recipes for the seminars and produced high-resolution photography suitable for recipe books and other collateral materials. APG/CDPB used a graphic designer to design the recipe books and other collateral material for the seminars. Once finalized, these were sent to the in-country contractors for translation and printing. Finally, MFI began finalizing travel arrangements and recruitment for the seminars in South Korea and Japan. Invitations were sent out to key baking industry representatives in both countries and ads were placed in major industry publications to promote these events.

In April 2014, representatives from MFI and CIA traveled to South Korea and Japan to execute the series of baking seminars. They were joined by the Project Director (PD) from APG in South Korea and the PD from CDPB in Japan. Following their arrival in South Korea, the group traveled directly to Busan, site of the first seminar. After a preparation/training day with the in-country staff, the seminar was held on April 15$^{th}$ at the Yeonsan International Bakery Academy. In total, 58 bakers, hotel/resort chefs, and baking institute members attended the seminar. The following day, the group traveled to Seoul to begin preparations for the second Korean baking seminar. On April 18$^{th}$, the second baking seminar was held at the Richemont Bakery Academy, where 88 attendees enjoyed presentations and technical baking demonstrations designed to encourage them to use California pistachios and prunes as an ingredient.

Next, the group traveled to Japan for three planned seminars. After a day of orientation and training with the in-country support staff, the first Tokyo seminar was held on April 22$^{nd}$. Ninety-six bakers, chefs, industrial users, and media representatives attended the event, where they learned about how to incorporate California grown pistachios and prunes as an ingredient in their products. On April 23$^{rd}$, 72 people participated in the second baking seminar, also held in Tokyo. Both events took place at the brand new Shoei Foods test kitchen facility in downtown Tokyo. These seminars were the first outside events hosted at this state of the art facility. Finally, the group traveled to Osaka for the third and final Japanese baking seminar. On April 25$^{th}$, 70 attendees took part in the seminar held at the Iwase Este test kitchen.

Following the seminars, surveys were collected, responses were analyzed, and final results were shared with APG/CDPB. Overall, these seminars represented a significant accomplishment for APG/CDPB. They not only provided information about innovative ways to bake with pistachios and dried plums, but highlighted differences in product quality, food safety, health benefits, and production practices of the two industries. The seminars helped strengthen existing relationships with bakers who already use pistachios and dried plums,

establish new relationships, and provided a valuable way of reaching key purchasers of ingredients in both South Korea and Japan.

As a result of the original baking seminar expenses coming in under budget, approval was given to use the unspent balance of funds for recipe contests in Japan and South Korea. Press releases were prepared and distributed to the major food publications which provided further exposure of California grown pistachios and prunes. Application materials were developed and the contests were promoted to members of the baking trade in both countries. In Korea, a total of 102 recipes (54 for pistachios, and 48 for prunes) were received, while in Japan, 65 pistachio recipes were submitted. (The CDPB did not participate in the recipe contest in Japan due to a conflicting contest held in late 2014.) The recipes were judged by leading instructors and authors in the bakery trade and ultimately, 6 prize winning recipes were selected in Korea, along with 5 in Japan. (Prizes were financed by APG and CDPB.) The results of the contests, along with winning recipes, were publicized in major trade publications in both markets. Furthermore, one winning recipe from South Korea was produced and sold commercially in a chain of bakeries.

This project did not benefit commodities other than specialty crops. All project activities focused on pistachios and plums.

The Vice President of Global Marketing for APG traveled to Korea and the Executive Director for the CDPB traveled to Japan to attend the seminars. A representative from MFI traveled to all five seminars in Japan and South Korea. They provided presentations to the attendees on the benefits of using California pistachios and prunes in baked goods, as well as the health and safety advantages of the products over foreign competition. Furthermore, the President of Shoei Foods, a leading importer and manufacturer in Japan, spoke at the Tokyo seminars, supporting the products and the project. The featured chef from the CIA prepared the final products for the attendees that were very well received. Ninety-seven percent of attendees rated the recipes produced for the seminars, in the good to excellent category. The in country partners, Sohn's Market Makers in Korea, Motix and Office K2M in Japan, made an excellent contribution in organizing the seminars and recruiting quality participants, with 98% of them rating their experience at the seminar in the good to excellent category.

Following completion of the seminars, MFI continued to work with Sohn's Market Makers, Motix, the APG and CDPB to plan, organize and execute a recipe contest. These principals promoted the contest, recruited participants, collected entries, selected judges and organized venues. Finalists were chosen, recipes prepared and the winners selected. Winning recipes were photographed and promoted via social media, press releases and magazine articles. Contestants recipes became the property of APG/CDPB and were included in the binders prepared for the bakery seminars.

## Goals and Outcomes Achieved

A total of five baking seminars were held in Japan and South Korea including two in Tokyo, one in Osaka, one in Busan, and one in Seoul. They were held in four outstanding facilities which only enhanced the quality of the seminars. The seminars themselves specifically targeted two areas. One was to educate bakers, chefs and purchasing decision makers on the benefits of California pistachios and dried plums over foreign competition. Power Point presentations were made by APG and CDPB employees, as well as their 3rd party consultants, featuring these benefits, which included farming practices, health and food safety issues. Secondly, the recipes and curriculum developed for the project was clearly directed to the use of California pistachios and prunes as an added value ingredient in baked goods.

Two recipe contests were held as a follow-up activity to the baking seminars. Contestants were made up of participants of the bakery seminars and other members of the baking industry from both countries. The contests resulted in 167 total entries, including 102 in South Korea and 65 in Japan, which far exceeded expectations. The winning recipes were promoted in both countries, resulting in positive media attention for California pistachios and prunes. Furthermore, one winning recipe from South Korea reached commercialization and is being sold at a major department store.

No outcome measures for this project were long term. However, export statistics will continue to be monitored as a way of gauging increased use of pistachios and prunes among bakers in Japan and South Korea.

For the baking seminars, target recruitment was set at 75 attendees per seminar, or 375 total participants. Actual attendance exceeded expectations with 384 participants. Total attendance would have been higher, but attendance in Korea was limited by the size of each facility. In total, 355 completed surveys were received, reaching 95% of the original targeted attendance.

The goal of the survey was to have 95% positive responses, and this was achieved and exceeded, with 98% of participants rating their experience at the seminar in the good to excellent category. Secondly, participants were asked if they would use, or recommend, using California pistachios or prunes in their business and 93% responded positively. This result far exceeded the established goal of 80% positive responses.

For the recipe contest, a total of 167 recipes were received, with 102 being collected in South Korea and 65 in Japan. This participation rate exceeded expectations and is a testament to the strong interest for using pistachios and prunes among bakers. Eleven winning recipes were selected and one has reached commercial production.

For export increases, a baseline cumulative target was set at 10-20% in the year following the baking seminars as compared to a baseline. Actual shipment data showed that in 2014, exports of pistachio and prunes to South Korea and Japan totaled 17,358.3 metric tons, a 1.8% increase as compared to the five year historic average. While the export goal failed to reach the target, other factors outside of APG/CDPB control, such as a smaller than expected 2013 plum crop, may be partly to blame. When examined individually, pistachios showed a 21% increase, while prunes had a 4% decrease. However, prune market prices in South Korea showed significant improvements throughout 2015, increasing by 10% to reach $2,942 per ton. Furthermore, exports of pistachio kernels, which are preferred as ingredients by bakers, increased 46%, far exceeding the project goal. Overall, both APG and CDPB feel strongly that this project will have a continued impact on demand for pistachios and prunes in Japan and South Korea. Going forward, both organizations are planning to maintain and expand activities targeting the baking industry in both countries.

## Beneficiaries

The primary beneficiaries of this project are the 900 pistachio growers and 900 prune plum growers in California. Pistachio producers spend nearly $409.1 million annually for products and services, which equates to more than $1.1 million in industry expenditures each day of the year. Their total economic impact was calculated at $672.3 million in 2011 and combined, growers and processors provide 5,280 jobs in the farming and non-farming sectors. In total, the industry generates more than $221.1 million in labor incomes for

residents of the state. Furthermore, business taxes paid by the pistachio industry as a result of increased economic activity totaled $24 million in 2011.

The California prune industry is one of the oldest specialty crops in the state, tracing its roots back to the 1850s Gold Rush. It employs more than 4,000 full-time and seasonal workers and total acreage devoted to plum prune production now stands at 52,000. California leads the world in production producing 272 million pounds of prunes in 2012, roughly 48% of the world's supply.

Increased shipments to Japan and South Korea will indirectly benefit the 9,280 full-time and seasonal workers that both pistachio and prune plum industries employ. According to U.S. Census Bureau statistics, the economic value of the 21% growth in pistachio shipments as compared to the 5 year average equaled $7.8 million and while prune shipments decreased by 4%, higher prices translated to only a $19,391 decrease in value. Cumulatively, this increase fell just short of the projected $8 million sales increase outlined in the grant proposal.

## Lessons Learned

The planned baking seminars provided a very aggressive timetable. Originally, seminars were planned in three different cities in Japan, but preparation and travel time did not allow these to be executed as planned. However, the change to having two seminars in Tokyo and one in Osaka proved to be very positive. APG/CDPB were able to secure the new teaching/test kitchen of Shoei Foods, a major food manufacturer and distributor in Japan. This modern, brand-new facility accommodated 168 participants in central Tokyo for the two seminars. APG and CDPB were the first outside organizations to use the facility. A tribute to the respect Shoei has for APG and CDPB.

At the Richemont Bakery facility in Seoul, Korea, 88 participants attended the seminars. This was a little more than the facility could handle, due to companies sending several employees that were not registered for the seminar. However, it again represented the excitement generated for California prunes and pistachios as an ingredient.

Overall, the aggressive attendance and survey targets were exceeded, thanks to the hard work of all concerned with the organization and execution of the seminars.

The recipe contest was an excellent follow-up to the baking seminars, and provided increased interest from bakers and others in the food business. Furthermore, APG/CDPB were able to secure additional media coverage through press releases and hard work from the very effective in-country partners.

No unexpected outcomes or results came about as a result of the implementation of this project.

While largely successful, this project did fail to achieve a few of the stated project goals or outcome measures. While overall seminar attendance exceeded goals, the number of surveys received fell just short of expectations. In total, 355 completed surveys were received, reaching 95% of the original targeted attendance. Looking back, it was unrealistic to expect a 100% survey response rate and in the future, this target will be lowered to match the actual results of this grant. In addition, the cumulative export increase goal of 10-20% was also not achieved. While this was in part due to factors outside of APG/CDPB control, more specific export targets (individual vs. cumulative) may have led to a different result. For future grants, export goals

will be provided for each individual product and target increases will be lowered to match real world results from this project. When examined individually, pistachio exports to Japan and South Korea showed a 21% increase, far exceeding the project goal. Prune market prices in South Korea showed significant improvement in the year following this project, increasing by 10% to reach $2,942 per ton. Furthermore, exports of pistachio kernels, which are preferred as ingredients by bakers, increased an impressive 46%.

## Additional Information

Additional information has been attached to this report:

1. Japan Baking Seminars Activity Report
2. Korean Baking Seminars Activity Report
3. Compiled Survey Results
4. Korean Baking Recipe Contest Summary Report
5. Japanese Recipe Contest Photos
6. Korean Winning Recipe Commercialization (Pista-Prune Macaroons)

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 8 | **Project Title:** Building the Dried Plum Market with Younger Consumers with Dried Plum Granola | |
|---|---|---|
| **Grant Recipient:** Sunsweet Growers | **Grant Agreement No.:** SCB13008 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Stephanie Harralson | **Telephone:** (530) 822-2876 | **Email:** sharralson@sunsweet.com |

## Project Summary

Sunsweet's 250+ prune grower members face growing operating costs and economic competition and pressure from other commodities, such as nuts and fresh fruit that can yield a higher return per ton. In addition, household penetration of prunes is low at only 8%, with a core consumer age of 55+. In order to maintain a viable commodity, it is important to support a premium positioning and continually introduce prunes to a new consumer base. The current project aimed to introduce prunes into granola, a category that grew 12% in 2012 and appeals to a younger audience than the traditional prune consumer. In addition, the granola consumer shares a similar interest in healthy snacking, resulting in an openness to prunes as an ingredient. The goal was to create a new market for prunes by introducing a granola, providing increased value per ton to prune growers.

The project is very important, as California has experienced a 30% decline in prune acreage over the past five years, as the result of competing crops that provide a higher price per ton, and the increased cost of prune cultivation. Sunsweet developed a proprietary method to dice pitted prunes. This innovation lead to the ability to market prunes as a value added ingredient, which enhances the nutritional value of other foods by adding fiber and potassium, both nutrients that are considered shortfall by the United States Department of Agriculture.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

The Sunsweet team, along with a designer, designed and developed packaging. The initial design was completed early in the project. However, there were delays in the formulation of the product. It was difficult getting a granola that was different enough to compete in the category. Because of the growth of granola, there came to be a proliferation of competitive items. It was very important to the team to deliver on taste and nutrition. At the finalization of the project, a granola with nuts and prunes in a cluster form created a very unique and delicious snack. The packaging was updated to reflect the final product. A stand-alone product website was created with collaboration from an advertising consultant (Consultant) and a public relations firm (PR Firm). The outcome was a very user friendly website that communicates the product clearly and in an appealing way. In addition, the PR Firm created a fun quiz to help drive consumers to the site to discover their favorite flavor and learn more about the product.

Sunsweet worked with the Consultant and the PR Firm to develop the marketing and public relations programs to launch the product. The Consultant developed a media plan designed to have the greatest reach with the target consumer, in the markets where the product was being carried. The PR Firm aimed to reach influencers who could help communicate the message. It also helped to develop an "influencer kit" which can

be used in the future for expansion of the product to other markets. The term influencer is used to describe a health professional, such as a registered dietitian (RD), who has knowledge of a healthy diet and can help relay information to the public or media about prunes. The RDs typically are provided with educational materials, and are at their discretion to communication in their own fashion.

The marketing and advertising plan developed for the launch will serve as a model for continued expansion of the product.

Only specialty crop commodities benefitted from the project. All grant work, activities, and funds only benefitted California specialty crops. Sunsweet represents over 250 prune growers and 70% of U.S. prune sales. This project was sponsored by the California Dried Plum Board, which notes benefits to all California prune growers by attracting younger consumers to prunes, and creating a new eating occasion for prunes.

There were three main contributors to this project. A designer provided design on packaging. Much of their contribution was through in-kind or matching funds, where they provided strategic advice on positioning and ways to differentiate from competition in the market. The Consultant worked with Sunsweet to develop an efficient media plan that included television and social media advertising. They also managed production of a TV spot that highlighted the new product. They produced advertising assets for the social media program that will continue to be used over the next two years. The PR Firm designed a public relations program to help launch the product. This included a combination of outreach to health professionals, retail store registered dietitians, and influencer kit and television news segments featuring the product. The Sunsweet marketing team managed the project, overseeing planning and implementation. In addition, Sunsweet marketing reported progress to the board members and to growers.

## Goals and Outcomes Achieved

A website was built to help communicate the product. Traffic to the website in June 2016 was 5,579 unique visitors and 7,768 page views. This was driven by both public relations and advertising which attracted consumers to the website. Sunsweet will continue advertising the product and conducting public relations activity over the next two years, which should help maintain or growth the website traffic. Advertising and public relations also helped drive awareness of the product and generate sales. In addition, being able to demonstrate strong support for the product helped us get authorizations in stores. Total public relations impressions totaled 4.6 million. Expectations are to continue to receive coverage, since results from public relations are often long-term. Total media impressions was 13 million driven by television and Facebook. The creative assets that were used for the advertising will continue to be used over the next two years.

Sunsweet will continue to gain distribution in stores. The sales team is still in the process of presenting the product to retailers, and expects to have strong sales in the upcoming season which is an important time for prunes, as store traffic increases during fall and winter holidays. In addition, the project team will be continuing to invest in supporting the product with advertising.

The website traffic being over 5,000 unique visits in June 2016 was a significant accomplishment and met the goal that was set forth. In addition, it’s an important tool for educating the consumer about the product, providing engaging content.

Target distribution was 19,000 stores with national distribution in year 3. Due to the delays in the project, this has not been achieved yet. The current store count is 5,500. Over the next year, Sunsweet expects expansion based on the performance of the product.
Total revenue for the year is $300,000 which is short of the target but expected to grow, considering shipment to retailers did not start until March 2016. The marketing activities also helped the base prune sales, which have grown over the past year by $2.4 million.

As stated above, website traffic is currently at 5,000 per month from a baseline of zero. The product is available in 5,500 stores in several states and will continue to expand. Sales of the product total $300,000.

The major success of this project is the introduction of a unique product in the dried fruit aisle that generates increased household penetration of prunes. The prunes in the product are value-added because they are diced and processed in a proprietary way, so it creates a new opportunity for including prunes in the product. Due to it being quite different from the regular prune products, it will introduce a new consumer to prunes. The number of stores carrying and revenue generated from the item will continue to grow based on the continued support of this item.

## Beneficiaries

The beneficiaries of this project are the 250 California prune growers who form the Sunsweet organization. The project adds value to the prune crop by creating a value added usage in the granola product category, which has an upward trend. In addition, it helps communicate a usage for diced prunes as an inclusion in healthy snacks, to other food manufacturers who may be interested in developing new products using prune ingredients. Prune growers in California face higher operation costs and competition for acreage from other crops. By introducing this type of product, it increases the value of prunes and the return to the growers, allowing prunes to be a viable crop choice for California farmers.

The project benefits the 250 California prune growers. This project along with the development of other value added products, helped increase return per tonnage by 178% vs. 2013.

## Lessons Learned

The key lesson learned in this project was the need to make sure the new product would be able to compete in the market place versus the many competitors. This resulted in the finalization and positioning of the product taking longer than expected. The launch and marketing support was delayed, however the final product is something that will stand out in the market and successfully introduce new users to prunes.

During the development of the product, it was interesting to see the explosion of other “hybrid” snacks that combine dried fruit with granola or nuts, and that are merchandised throughout the store in produce, dried fruit, snack bars and other sections. The project team felt that the final product is on trend with these other healthy snack options, and fits well into the changing habits of consumers looking for convenient options that provide nutrition and satiety. Through this project Sunsweet learned the value of integrating both public relations and advertising so that there is valuable content for people as they learn about a new product or learn about prunes as a nutrition source. Digital advertising offers a new and efficient way to communicate a message and the project team has seen it through the result in sales, when supported by other traditional advertising methods.

## Additional Information

Please visit www.sunsweetfruitandnutclusters.com, and see attached documents.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 9 | **Project Title:** Building a Farm Trail: Developing Effective Agritourism Associations to Enhance Rural Tourism and Promote Specialty Crops | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis | **Grant Agreement No.:** SCB13009 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Shermain Hardesty | **Telephone:** (530) 752-0467 | **Email:** shermain@primal.ucd.avis.edu |

## Project Summary

Due to lack of economies of scale, small-scale specialty crop growers, need to add value to their products to remain economically viable. These growers often seek to diversify with farm stands, U-Pick, tasting rooms, festivals or other agritourism activities to stay in business or provide employment for families. Individual growers often have difficulty attracting visitors to their operations. Local, county-based and regional "farm trails," organized and promoted by grower-based agritourism associations, have proven useful in attracting visitors and adding value to a region's crops by providing a variety of activities and products unified by a recognized brand. Establishing agritourism associations and marketing collaboratively requires skills and partnerships that are new to most specialty crop growers. This project brought together experienced farm trail organizers and marketing and tourism professionals who provide technical assistance and marketing resources to assist newly-established groups of growers in building sustainable and effective farm trail organizations. Because California's local and county-based agritourism associations have few opportunities to learn from each other or to work together for mutual benefit, this project provided such opportunities through workshops, a statewide agritourism summit, a guide to farm and wine trail development, and online resources.

Public interest in food production is growing, creating demand for agritourism. Specialty crop growers' interest in connecting with the public through on-farm direct marketing and agritourism is increasing. This project offered important skill-development, marketing and networking opportunities to assist small-scale specialty crop growers in successfully taking advantage of these recent trends and partnering with others in their communities to develop rural tourism.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Objective one was to provide technical assistance to 60 specialty crop growers to develop and promote three agritourism associations, three farm trail maps, and three collaborative events. Project staff were able to achieve the following: Three Northern California marketing and economic development professionals were hired through this project as consultants to work as a team with three newly-established agritourism associations, the Sacramento River Delta Agritourism Association, Capay Valley Grown, and North Yuba Grown. Seventy-three specialty crop growers, who are members of the three associations, participated in the year one activities of the project. Members of the three associations met each other and the three consultants at an initial workshop in November 2013. At this workshop, the agritourism associations shared their challenges and plans, and the consultants presented beginning lessons in farm trail development and agritourism marketing.

The project manager, collaborators and consultants participated in a tour of each association's region, visiting with several members of each association at their operations. Each of the three tours concluded with a stakeholders/members meeting in which the consultants facilitated a group discussion helping association members to define their geographic region, their membership, and a representative committee to be responsible for selecting a graphic designer and working with that designer to create a farm trail map. The three tours and meetings were held in February, 2014. Each of the three agritourism associations selected a graphic designer, gathered members' information, drafted text, selected images and worked with the graphic designer to create a farm trail map brochure for their association. The three map brochures were completed, and 20,000 copies of each map brochure were printed, by August 2014. All of the map brochures are available for download on the project webpage: http://sfp.ucdavis.edu/events/Building_a_Farm_Trail_Project_2013_-_2015/

Members of the three stakeholder agritourism associations distributed the map brochures widely in their communities and through their tourism partners, generating increased tourism interest and community pride in each region. The three consultants and the project manager attended multiple committee and board meetings of the three agritourism associations and provided guidance to the groups in planning collaborative tourism events, drafting economic sustainability plans and in planning effective marketing for their associations. Each of the three agritourism associations selected a website designer with the help of the consultants, and worked with that selected designer to recreate the group's website. Each newly designed website included the group's farm trail map, member information, information about the region and a calendar of events. The websites were all completed and published by February 2015. The Sacramento River Delta Grown website is: http://sacriverdeltagrown.org/. The Capay Valley Grown website is: http://capayvalleygrown.net/. The North and Yuba Grown website is: http://www.northyubagrown.org/. All of the websites have been maintained and are regularly updated by the group members.

The project manager coordinated and facilitated the contracting with each of the consultants and designers for this project. All three groups planned, organized, promoted and operated a collaborative event as proposed. The goal was for 500 members of the public to attend each of the three events. Sacramento River Delta Grown had 300, rather than the goal of 500, attendees at their Passport Weekend event in August 2014. North Yuba Grown collaborated with other community organizations to hold the North Yuba Harvest Festival in September 2014, which had 700 attendees, exceeding the goal of 500. Capay Valley Grown organized an Open Farm Day event in October 2014, with an estimated attendance of 250 people visiting at least one of the nineteen farms open that day. Each of the groups repeated its collaborative event in 2015 and all have made plans for similar events in 2016. The project manager and collaborators organized and conducted a second workshop for all three stakeholder agritourism associations in November 2014. The groups discussed challenges and successes with each other, and learned from leaders of the Apple Hill Growers' Association and from project consultants. The 2nd workshop agenda and 2nd workshop notes are online at: http://sfp.ucdavis.edu/events/Building_a_Farm_Trail_Project_2013_-_2015/.

Objective two involved statewide agritourism collaboration, and sharing of lessons learned and best practices. Project staff and collaborators organized, promoted and facilitated the California Statewide Agritourism Summit, held on April 8, 2015. The Summit was attended by approximately 150 members of the California agritourism community who listened to presentations about specialty crop agritourism associations' successes and challenges and held small-group sharing and planning sessions. The summit agenda and notes from summit group discussions are posted on the University of California (UC) Small Farm Program website at

http://sfp.ucdavis.edu/events/Statewide_Agritourism_Summit_2015/ All summit attendees received an evaluation form to measure their increase in knowledge.

The Project Manager identified thirty representative California specialty crop producers based agritourism associations. The Project Manager contacted leaders from all 30 associations and requested telephone interviews. Leaders from 20 of the associations responded and agreed to interviews. The Project Manager conducted interviews with leaders of 20 specialty crop agritourism associations about their activities, membership, management, growth, challenges, needs and plans, and transcribed the responses. The Project Manager also requested materials from each of the interviewees for the resource library to be published online.

The Project Manager compiled the interviews and information from presentations by association leaders at project workshops into a guide, published online in November 2015. The guide, Marketing Regional Farms and Wineries: A guide for California Agricultural Marketing Groups, was distributed by email to leaders of all 30 identified agritourism associations. The link to the published guide was distributed widely to the California agritourism community through email announcements and in several issues of the UC Small Farm Program's AgTour Connections email newsletter. The guide and related resources provided by the groups interviewed are posted on the project webpage, http://sfp.ucdavis.edu/events/Building_a_Farm_Trail_Project_2013_-_2015/

The Project Manger requested response in December 2015, using an online survey, from leaders of 30 specialty crop producer based agritourism associations about increased collaboration, use of project materials and improvements in association marketing and management skills resulting from use of these materials. The survey was also shared with other specialty crop producer groups in the early stages of organizing collaborative marketing associations and with other subscribers to the AgTour Connections email newsletter. Response to the online survey was lower than expected, but those who responded had shared and discussed the guide with their association leaders, and said it was helpful.

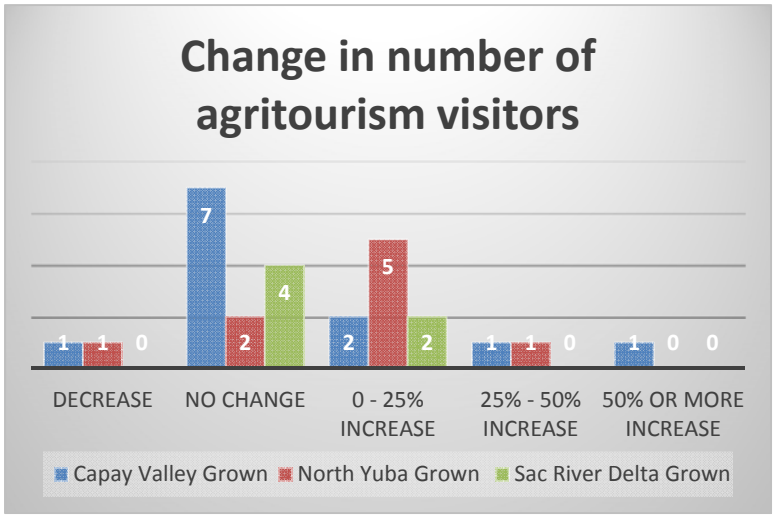
Each stakeholder group was informed that only producers of specialty crops were eligible to participate in the project. The Project Manager checked the crop list of each participating producer to ensure that each produced specialty crops; therefore, tracking mechanisms were in place to ensure that SCBGP funds were used to solely enhance the competitiveness of specialty crops. To ensure that only specialty crop producers received Specialty Crop Block Grant Program funds to travel to the Statewide Summit, the application for travel funding included a question about what crops each applicant grew. The Project Manager checked responses against the list of approved specialty crops before approving any travel reimbursement, and only approved that for specialty crop growers.

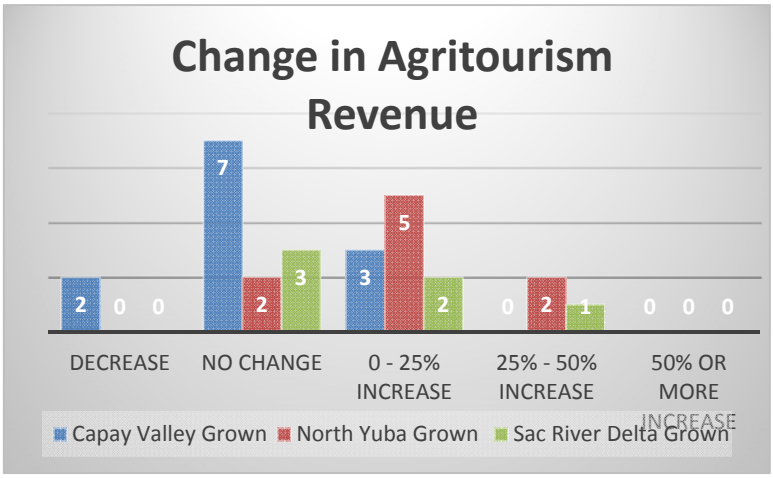
Collaborators shared extensive expertise and connections in the process of selecting graphic and web designers and printers and in distribution of the map brochures. Each of the contracted consultants shared detailed information regarding marketing, group dynamics and economic development. Collaborators provided meeting facilities and assisted specialty crop growers in promoting their activities. Collaborator/members of each of the three participating stakeholder groups were actively involved in the process of creating farm trail maps and sustainable organizations in their communities, organizing and promoting collaborative events, in planning for website redesigns. Collaborators provided additional

sponsorship for the Statewide Agritourism Summit. Collaborators Extension played an active role in planning, promoting and facilitating the Summit.

## Goals and Outcomes Achieved

Measurement of Goal 1: Increased number of agritourism customers:
The goal of at least 500 customers attending each collaborative farm trail of festival event organized by the three stakeholder associations was not met. Approximately 300 people attended the Sacramento River Delta Grown "Passport Weekend" event, and approximately 700 people attended the "North Yuba Harvest Festival" event. After analysis of raffle entry forms and reports from 7 of the 19 Capay Valley Grown farms that were open for the "Capay Valley Open Farm Day" on October 5, 2014, project team estimated that approximately 250 people participated in visiting association member farms as part of that event.




To further measure achievement of Goal 1, and to measure achievement of Goal 2, and increased revenue to agritourism operators, project team has conducted an online survey of the 73 specialty crop growers who participated as members of the three stakeholder associations. The survey was conducted in March 2015, soon after the three new websites went live. It asked about increased number of agritourism visitors/customers as compared with the previous year (2014), and also about changes in specialty crop revenue as compared with the previous year. Twenty seven responses were received, for a response rate of 40 percent. Expected measurable outcome for Goal 2 was not achieved, which was an average increase in agritourism revenue of 50% during project year one over the previous year, as shown in the included charts reporting the responses to the survey. The Project Manager and a marketing consultant met with each group to discuss the results of this survey and to plan for improvements in the marketing program to generate more revenue for association specialty crop members in the coming year.

Measurement of Goal 3: Increased tourism revenue to the communities surrounding the three stakeholder agritourism associations: The change in Transient Occupancy Taxes (TOT) received was obtained in March 2015 from each county tax collector in the regions of the stakeholder groups. In each region, the amount of tax increased from Fiscal Year 2013 to Fiscal Year 2014, indicating that tourism in general increased during this time period in each region. However, as the area included in the jurisdiction reported for each county was the entire unincorporated area of the county, and because the latest figures available were for 2014, project

staff are not able to claim realistically that the efforts of this project had a measurable impact on the increase in tourism to the region. The measurement of TOT income to the county does not seem to be a good metric for measurement of increased tourism revenue to communities surrounding the stakeholder groups. The Project Manager asked about more appropriate measurement tools for each community from members of the stakeholder groups during the evaluation and planning discussion.

Measurement of Goal 4: Increased effectiveness of agritourism associations' collaborative marketing:
A pre- and post- self-knowledge assessment of agritourism summit attendees about farm trail development and marketing was coordinated by the Project Manager at the Statewide Agritourism Summit. 150 people attended the statewide summit. Thirty-seven percent of the 30 surveyed agritourism associations reported use of project-created materials, but none reported improved association management or marketing skills at the time of the survey. Seventy-four summit attendees completed and returned the evaluation, 97 percent reported increased knowledge about farm trail development, marketing and networking opportunities. Summit attendees were asked: Please circle your level of awareness about the following on a scale of 1 to 5, with 1 representing having no or little awareness, and 5 being extremely knowledgeable.

Results: "Successful regional agritourism (farm trail) associations"
Pre Survey: mean response = 2.86
Post Survey: mean response = 4.08
"Opportunities for agritourism marketing and promotion"
Pre Survey: mean response = 2.9
Post Survey: mean response = 4.12

Marketing Regional Farms and Wineries: A guide for California Agricultural Marketing Groups was published online and shared with the leaders of 30 specialty-crop agritourism associations for response. The response from agritourism associations about the use and usefulness of the online guide to farm and wine trail development is as follows: Leaders from 11 of the 30 identified specialty crop agritourism associations reported reading the guide, sharing it with their boards of directors, and finding useful information with the potential for improved management and marketing by their organizations. In the year following its publication, the project manager shared the "Marketing Regional Farms and Wineries" guide at workshops and meetings with multiple groups of growers in the process of starting or strengthening their collaborative marketing. Leaders of these groups commented that the lessons shared in the guide were helpful in setting up effective management and marketing practices. In addition, the guide has been downloaded at least 180 times from links shared in regular email newsletters to California agritourism operators and an unknown number of times directly from the UC Small Farm Program website."

Major accomplishments of this project include 73 specialty crop growers are members of the three stakeholder agritourism associations that are now sustainable, have effective websites, editable farm trail map brochures, a financial sustainability plan and improved marketing skills. These growers, through their associations, have increased potential for agritourism income as an outcome of this project. As an outcome of the California Statewide Agritourism Summit, attendees from nine California regions have plans to stay in touch and work together to improve agritourism collaboration in their regions. Members and leaders of more than 30 specialty crop grower-based agritourism associations, and an unknown number of not-yet formed groups of growers in California have increased access to experienced advice and resources shared by contributors to the online farm trail marketing guide produced through this project.

## Beneficiaries

Seventy-three specialty crop growers who are members of three agritourism associations, North Yuba Grown, Sacramento River Delta Agritourism Association, and Capay Valley Grown, benefited from this project by increased agritourism marketing and association management skills and increased agritourism visitors and agritourism revenue, with the potential for further increases.

Approximately 500 specialty crop growers who are members of approximately 25 agritourism associations will potentially increase revenue from on-farm sales and tourism activities due to their associations' participation in the Statewide Agritourism Summit, resource-sharing, collaborative marketing education and networking activities organized by this project in Year two.

Approximately 2,000 California specialty crop growers who offer agritourism activities will potentially increase their agritourism income by using materials produced by this project to develop farm trails and collaborative marketing efforts.

Rural communities benefited from the marketing of specialty crop agritourism in their communities by increased tourism income to agritourism and other community businesses and through increased job creation and increased tax revenues for all impacted businesses. The agricultural community benefited from the increased public understanding and support of specialty crop production by urban visitors generated by this project. The California specialty crop industry benefited from the combined marketing and educational efforts of more skilled collaborative regional agritourism associations by increased sale of California specialty crops to Californians.

## Lessons Learned

Collaborative work can take longer than expected due to the multiple demands of production and marketing for the growers' core operations and the additional demands of new collaborative projects. Lesson learned: Allow more time for activities that require growers to gather information, edit documents, and meet together for decision-making and other collaborative work.

Small committees can work effectively together for the benefit of the larger group, but the larger group must agree on the committee makeup. When planning and organizing on behalf of the larger association, a small committee of three to five members can meet, share the tasks, communicate and make decisions well. However, the trust of the membership of the larger association is essential for the work of the committee to be accepted. It is best to select the working committee at a larger group meeting where all have a chance to provide input and help select the committee.

Agritourism development in a community is a long-term effort. Do not be discouraged by a lack of quantifiable results in the first year. However, small marketing efforts and activities by individuals and groups can grow over time and develop into significant revenue-producing and ongoing benefits for communities and for specialty crop growers who participate.

In this age of overwhelming communication, it is very hard to get people to respond to an on-line survey. If at all possible, either offer an incentive for participation or try another method of asking for response, such as a telephone call or a paper form mailed or handed out at a workshop or meeting.

TOT changes may not be the best measure of changes in agritourism income to a small local area or group of producers for at least two reasons: 1) Often it can be hard to obtain this information for a small enough area to be effective in measuring localized changes. 2) Much of agritourism income is from local and reginal day-travelers, and does not include any overnight stay, so would not be measured by TOT.
The project staff could try to survey the agritourism operators about their agritourism income; however, based on past experience, they are very reluctant to disclose their income in surveys. Instead of measuring agritourism income, project staff could measure the economic benefit to the community surrounding an agritourism association by conducting a survey of visitors to the agritourism operations. This would involve asking these visitors to share how much they spent for food, gas, lodging and other expenses in the surrounding community during their trip.

## Additional Information

The Project Manager published a post on the UC ANR Green Blog in September 2014 announcing the completion of the three stakeholder associations' new farm trail maps:
http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=15229

The Project Manager gave a presentation about the project at the National Extension Tourism Conference held in Galveston, Texas in October, 2015 which involved no expenditure of project funds:
http://extensiontourism.net/files/2015/11/leff_building_farm_trail_net2015.pdf

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 10 | **Project Title:** Bay Area Urban Agriculture Marketing Association | |
|---|---|---|
| **Grant Recipient:** Alameda County Deputy Sheriffs' Activities League | **Grant Agreement No.:** SCB13010 | **Date Submitted:** December 2015 |
| **Recipient Contact:** Hilary Bass | **Telephone:** (510) 225-5954 | **Email:** hbass@acgov.org |

## Project Summary

This project addressed critical elements and needs of local food systems and economies in underserved and low-income communities located in the San Francisco Bay Area. Dig Deep Farms (DDF) is an urban farm and community-supported agriculture operation serving Ashland, Cherryland and other underserved areas of Alameda County. Ashland and Cherryland specifically are communities that are part of unincorporated Alameda County, situated between the city of San Leandro and the city of Hayward. In 2010, the population was 36,653, the majority Latino, African American and Asian. The median family income in Ashland in 2010 was $54,358 and in Cherryland $50,233, compared to $85,014 in Alameda County. The percent of persons below the poverty level (2006-2010) was 15.8% in Ashland and 21.0% in Cherryland, rates far higher than surrounding communities and Alameda County. Only Oakland has a higher poverty rate. For persons over the age of 16, about 33% are no longer in the labor force; unemployment is over 10% in four of eight census tracts in Ashland and Cherryland.

The food environment of Ashland and Cherryland is very poor. Most census tracts in Ashland and Cherryland have only small corner stores or liquor stores with few or no fresh fruits and vegetables. Six out of eight census tracts in Ashland and Cherryland appear to meet the U.S. Department of Agriculture (USDA) criteria as food deserts.

The significance of the project was to move urban farm production and distribution of fresh, healthy fruits and vegetables to the next level. The intent of the project was for the Alameda County Deputy Sheriffs' Activity League (DSAL) to organize the Bay Area Urban Agriculture Marketing Association (BAUAMA) to work in cooperation with peers in the East Bay and South Bay to better serve the communities with healthy specialty crops, job opportunities, and ultimately hope. The project increased demand for and access to California specialty crops through education, added retail channels, and innovative marketing.

This project set out to enhance the marketability and competitiveness of specialty crops through local market development, California grown participation, economic opportunities through local market development, and farmer to consumer connections through direct marketing opportunities.

DSAL set out to link urban farms in the BAUAMA to increase access to specialty crops in local underserved communities. The BAUAMA aggregated, expanded product supply and diversity, improved packing and distribution, and built long-term sales and competitiveness with training and technical assistance in specific market channels.

This project also intended to achieve a nutrition objective that complements market enhancement with cooking and nutrition education through cooking demonstrations at DDF farm stands by staff.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

The following activities were performed:

- Hired and oriented the BAUAMA Coordinator, and when she left, DSAL staff brought on another person to take her place.
- Both coordinators built relationships with partner farms that DSAL has been able to sustain throughout the duration of the grant and will continue to work with.
- Staff collected information about the eating and shopping behaviors of people in the community (Attachment 1), which showed that people wanted to purchase fresh produce, but in a convenient and affordable manner. This supported DSAL's plan for opening farm stands and doing cooking demonstrations at the stands, as well as working on increasing the Community Supported Agriculture (CSA) programs. Staff did not collect additional surveys because there was so much anecdotal information from the CSA and farm stand customers via daily phone calls, delivery conversations and farm stand interactions. All of DSAL's customers continuously drive the modifications, changes and improvements to the planting plan and aggregation of other produce plan.
- DSAL staff hosted Cooking Matters at the farm stand sites for 6 cooking demonstrations where they prepared different dishes to show the people how to use specific specialty crops that were in season. DDF staff continued these demonstrations on a monthly basis to introduce new recipes and strategies for cooking with specialty crops that many people seemed unsure about. Some examples of produce highlighted are: Brussel sprouts, collards, mustard greens, okra, spinach, squash, swiss chard and tomatoes.
- Staff met with the farm partners to determine what the farms produce and how much could be purchased from them on a regular basis for distribution at the farm stands and CSAs. This has also resulted in contract growing agreements where staff pre-purchased strawberries from a partner knowing they would be needed for raw product sales as well as conversion into consumer packaged product (jam).
- Staff tracked sales monthly throughout the grant period and have seen an overall increase, as well as a reduction in cost of goods to consumers.
- Supplemental Nutrition Assistance Program (SNAP) enrollments were taken care of by the Social Services partner. Staff sold the produce directly in front of Social Services buildings because the majority of the people coming out were SNAP clients.
- The BAUAMA Coordinator met/communicated with partners weekly about orders and needs
- Based on the increase in sales within the CSA program and the farm stands, staff conclude an increase in consumption of specialty crops.

The specialty crops that are grown and aggregated are all intended to be sold through current distribution channels. Only specialty crops were grown for this project and all activities focused on specialty crops. Project staff tracked all project expenditures in relation to products promoted by the project, traded by BAUAMA partners, and used in nutrition activities. In order to enhance the competitiveness of the specialty crops grown, staff created weekly newsletters to go into the CSA bags that highlight a different specialty crop each week and included a recipe. Staff did the same at the farm stands, but would also conduct demonstrations when possible to show people how to prepare that item.

Project partners include:

- Alameda County General Services Agency: provided the land and lease agreements for the large farm parcel and the food hub.
- Alameda County Environmental Health Department: provided necessary permits for the farm stands and reviewed plans along the way for the food hub development to ensure it was up to code.
- Alameda County Civic and Economic Development Department: worked with DDF to find new selling opportunities for DDF.
- Alameda County Social Services Agency: engaged on the DDF Advisory Committee as well as a major partner in the farm stand operation. They have stepped into a major partnership role as a funder and supporter of developing farm stands within the community, specifically in front of SSA offices. The goal for them is similar to DSAL's in that they want to increase access to locally-grown specialty crops for SNAP clients as well as support job creation in the green economy. DSAL's partnership with them has resulted in hiring 2 new staff members to run the farm stands and the development of 5 total stands throughout Alameda County in neighborhoods that are lacking in immediate access to locally-grown specialty crops.
- Alameda County Sheriff's Office: Provides staff oversight for all of DDF under the non-profit DSAL. Additionally, they are supportive of partnership development for the purpose of adding new land space for DDF to grow more produce. Their support is often one of the more encouraging factors for new partners since they carry such a great reputation.
- Oakland Builders Alliance: contributing all of the labor to build out the food hub
- Tri-Valley Regional Occupational Program: training people in culinary and food related skills while incarcerated so they are able to intern/work with DDF upon their release.
- Soulciety: providing paid youth interns to DDF to learn skills for their future while helping get work done on the farm
- La Clinica de la Raza: referring youth patients to purchase food from DDF stands as part of their preventative health plan.
- Tiburcio Vasquez Health Center: referring adult patients to purchase food from DDF stands as part of their preventative health plan
- Highland Hospital: purchasing CSA bags from DDF as part of their preventative health plan for high risk patients
- Alameda County Small Business Development Center: serving as a member on the DDF Advisory Committee.
- Inner City Advisors (ICA): serving on the DDF Advisory Committee
- Fire Department: Continues to provide land space to DDF for farming next to one of their stations in the heart of the Ashland community. They value the purpose of the program and provide water and space for free.
- Pacific Apparel: Donates a part of their property and water to DDF. There is a greenhouse and 11 raised beds on this site and will soon have a community events area where people can share food and eat healthy specialty crops directly from the garden.
- Capay Valley Farm Shop: This was the first food hub visited and the developers gave great feedback on what worked for them when building out their aggregation process. They included detailed information on software systems used for billing and selling product including offering free software tutorials.

## Goals and Outcomes Achieved

Outcome 1:
Goal: The BAUAMA farms will increase sales volume.
Performance Measure: Annual revenue from sales.
Benchmark: Previous year annual sales
Target: Increase in sales revenue by at least 10%.
Progress: Staff delivered steady groupings of bags to high-risk pregnant women being served at Tiburcio Vasquez Health Clinic and additional patients at Highland Hospital. These Food Rx projects are great wins for both DDF and the patients being served through the health centers. The baseline of produce revenue for October of 2013 to March of 2014 was a total of $208,303.96, with $121,751.91 of that being from grant (non-SCBGP) reimbursement (58%). Jumping forward to October of 2014 to March of 2015, the total was $321,281.26, with $98,905.32 of that being from grant (non-SCBGP) reimbursement (30%). This demonstrates an increase of 154% in total sales and an increase of 257% in actual revenue coming from direct sales of produce rather than grants/contracts.

Outcome 2:
Goal: BAUAMA will increase the volume of product received and the volume of product distributed to BAUAMA partners
Performance Measure: Pounds of produce received/distributed
Benchmark: Previous year pounds of product received/distributed
Target: Increase pounds of product received/distributed by 5% over the one-year project period.
Progress: DSAL didn't use pounds as a measurement tool due to the difficulty of tracking (many items come by the bunch rather than pound). What made for a consistent tool was the cost of raw goods. Staff used this as the baseline to see how much DSAL was spending on partner farms to aggregate for redistribution through the CSA bags and produce stands. Staff estimates that DSAL received/distributed over 45,000 pounds for 2013 and over 58,000 pounds for 2014. DSAL's baseline of cost of goods (purchasing specialty crops from BAUAMA partners) for October of 2013 to March of 2014 was a total of $137,240.11, with $38,455.52 of that for produce purchases directly. October of 2014 to March of 2015, the total was $106,399.26, with $25,747.17 of that for produce purchases directly. This demonstrates a 33% decrease in raw goods purchased, however it does show more specialty crops produced through DSAL. Although DSAL still purchases from BAUAMA partners, staff were able to increase productivity at DDF and decrease spending, in turn providing more specialty crops to consumers at better prices (see Attachment 2 for harvest list).

Outcome 3:
Goal: Urban residents will report increased access to and consumption of local produce as a direct and indirect result of sales and marketing activities of BAUAMA farms and the Cooking Matters classes/DDF cooking demonstrations.
Performance Measure: Survey of urban residents
Benchmark: Number of urban residents who report access to and consumption of local produce in first month of project
Target: 2,500 urban residents will report increased access to and consumption of local produce as a result of project sales and marketing activities and Cooking Matters classes/DDF cooking demonstrations, as estimated by population survey methods
Progress: Staff did not conduct a formal survey of people but based on the number of visits and sales at the produce stands (approximately 200 people per day, 5 days per week since October 2014) combined with the

frequent interactions with customers in the CSA program, DSAL has dramatically increased access to and consumption of local produce. By observation and verbal remarks to project staff, it is more than apparent that people are appreciative of having locally-grown produce in such close proximity to them and where they can use their EBT benefits to purchase it. The cooking demonstrations drive great conversations about recipes, cooking tips and ideas for spinning family traditions into new healthy options. Staff may still conduct the survey in the future, but based on what was understood from the customers and the past survey, DSAL was able to grow, purchase and sell specialty crops that they enjoyed.

Outcome 4:
Goal: Low-income residents will be enrolled for SNAP benefits.
Performance Measure: SNAP enrollment. Project partners will be trained to conduct SNAP outreach by local food banks, and will conduct pre-screening and screening activities at farm events, including regular produce stands and special events.
Benchmark: Number of low-income residents in Ashland and Cherryland enrolled in SNAP in the first month of the project
Target: 1,500 low-income residents will be enrolled in SNAP as a result of the project. (this target was selected by the original writer of the proposal)
Progress: Staff did not participate in a push to sign more people up for SNAP benefits, but did conduct major outreach within and around the SSA buildings to ensure that those enrolled in SNAP were aware of the farm stands and to inform them that they could use their benefits to purchase the produce. Staff experienced an increase in SNAP customers at the stands. Participating BAUMA partners would pass along the information of where to sign up for benefits and some would carry EBT machines at their farmers market.

Five farm stands were created to service at-risk areas, three of which being in front of SSA offices where people receive SNAP benefits. DSAL increased sales at the farm stands each month since they were started. Staff handed out flyers informing the community when and where the markets were located, and which days would have cooking demos. Staff localized issues and problems concerning volume of produce needed to create a sustainable program and tools needed to fulfill the project objectives. DSAL learned that education is very important when serving at-risk communities that need guidance when understanding health, nutrition, and turning produce into healthy meals. After collecting information, DSAL staff realized the initial goals were set too high for servicing the community. The logistics of picking up the produce was a huge cost burden for staff and the farmer. Creating drop sites and picking up from farmers markets, where the farmers are already going, is the new system of aggregating product from farms.

During this time DSAL only sold specialty crops. No subsidized crops are currently being sold at the farm stands or in the weekly produce bags. The cooking demonstrations exposed people to dishes and recipes that they would not normally make themselves. Staff chose creative culturally appropriate dishes to share with the community to encourage people to buy specialty crops. Due to the partnership with SSA, DSAL was able to sell product at a lower rate to increase affordability of product.

Staff have continued to have cooking demonstrations at the farm stand locations when possible. The community enjoys the recipes that the DSAL team put together and are more interested in purchasing those specific ingredients after sampling the item. Even on days when staff are unable to do the demonstration, there are always new specialty crop recipes available for customers to take home.

In addition to the accomplishments listed above, DSAL staff participated in the Sheriff's Office re-entry model which is referred to as Operation My Home Town (OMHT). This model consists of the Youth & Family Services Bureau (YFSB) therapists meeting inmates inside Santa Rita Jail, case managing them inside as they complete programs and services pre-release, picking them up upon release and continuing to case manage them until they are stable back in the community. Some of the OMHT clients are good fits to intern within the DDF operation. The interns work on the farm or at the farm stand for four weeks and get paid a stipend from a non-SCBGP funding source. Once their four weeks are up, they are either hired on with DDF or connected to other employment opportunities by their case manager. One of the OMHT interns did an outstanding job on the farm stand and the team decided to hire her on as their assistant.

As for long term project goals, the only thing that still remains is the actual building of the food hub, which has taken longer than anticipated, though staff are fairly certain that it will actually be completed and open in January or February 2016.

DSAL believes that all goals have been achieved except for doing an official survey of local residents. Staff were able to acquire narrative feedback in so many different ways, that they ultimately opted against doing one.

## Beneficiaries

The main beneficiaries of this project are the 2,500 plus resident of Ashland and Cherryland who now have access to and consume specialty crops through this program. The secondary beneficiaries are the specialty crop farmers who sold produce through this project. DSAL staff have found that there are a wide range of county departments, local non-profits and residents that all benefit in some way from DDF. The SSA for example, was eager to alter the way in which they offered people social benefits, like general assistance and food stamps/SNAP. SSA contracted with DDF to create 3 new positions for CalWorks clients to manage the farm stands that are placed in front of the SSA offices, where people coming out can use their benefits to purchase fresh, locally-grown specialty crops. This creates several wins for SSA as well as increasing the scope of what DDF can do.

Similarly for Tiburcio Vasquez, Highland Hospital and La Clinica, doctors and clinicians are looking for real ways to impact the health outcomes of their patients knowing that access to, and consumption of, specialty crops would play a significant role in preventing serious issues. DDF's CSA program that delivers to people's doorsteps offers a way to reduce barriers to accessing the food, and the clinician's prescription to eat the food increases the odds of people actually consuming it. The food Rx model works well for those partners as well as increasing DDF's customer base.

One of the local farmer partners, Avalos Farms, was contracted by DSAL to grow a large quantity of strawberries for DDF. DDF staff then distributed the strawberries through farm stands and CSA bags. This benefited the DDF customers, as well as Avalos Farms.

For County Supervisors who grapple with the many challenges of the unincorporated area, particularly related to employment, the re-entry population, crime and blight, DDF offers tangible solutions for them to support. DSAL not only created jobs and internships for the re-entry population through the OMHT re-entry system, but also is beautifying previously blighted properties with farms

It is hard to specifically quantify the exact number of beneficiaries of the project as the ripple effect is impossible to really know. However, here are some ideas of how the impact could be occurring:

- 60+ CSA customers weekly, which have families/friends/co-workers with whom they share food and recipes with.
- About 150-200 farm stand customers a day, 5 days a week, totaling over 750 customers a week, which staff also assume have families/friends/co-workers with whom they share food and recipes with.
- There are 8 DDF employees who are employed because of this program. These employees all have dependents of one kind or another whose lives depend on this income.
- The local farmers that DSAL purchases produce from to aggregate with DDF produce are all small farmers. Regular purchases of their produce help to sustain them and their families. This represents an additional 6-12 people who get to have jobs in the farming and logistics arena, plus the families they represent.
- There are somewhere between 20-40 youth interns that come to DDF to learn work skills throughout each year. These youth not only gain tremendously from their personal experiences working hard on DDF, but they leave there and discuss that experience with their peers, who may not have otherwise been on that positive track. Additionally, it is more likely that these youth will find permanent employment in the future as a result of having experience working on DDF, which will result in greater economic and social benefits and quite possibly the next round of specialty crop farmers.
- The same general story is true for the OMHT interns coming straight out of Santa Rita Jail. There are approximately 15 interns per year and their rate of re-offending is less than 13%, which is greatly improved from the more normal rate of 60-80%.
- When the food hub opens, that will represent additional cohorts of youth and adults learning skills, getting certificates, working as interns, getting hired in DDF and elsewhere as well as starting their own specialty crop businesses.

## Lessons Learned

One lesson to learn from this experience is that even when there is money in place, people ready to work, plans laid out and expected timelines, it doesn't always go according to plan. Staff have had to be nimble, adjust, redirect efforts, work around barriers, and everything in between. Staff had to realize that they can't do everything themselves. Letting the SSA partner agency take responsibility for increasing SNAP sign-ups was essential to getting other goals achieved.

As a result of ongoing efforts to build a food economy as a public safety initiative, DSAL was able to receive a Byrne Criminal Justice Innovation Award from the Department of Justice. They understood the value of blending economic development with public safety and wanted to further support that work. As a result, DSAL has additional partners working to plan and execute a strategy for getting to know local residents and supporting them in increasing specialty crop awareness as well as having some use their skills to start new specialty crop businesses in the area.

What was also realized as the project developed was that in an effort to become more sustainable, DSAL needed to grow more produce and purchase less from partners as a way to reduce costs to customers. Though DSAL still purchases from BAUAMA partners, staff were ultimately able to increase productivity and decrease spending, providing quality specialty crops to area residents at a price within their budget.

## Additional Information

Attachment 1 Community Survey
Attachment 2 Master Harvest List

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 11 | **Project Title:** Sustaining California's Flower Farmers through Sustainability Certification | |
|---|---|---|
| **Grant Recipient:** California Cut Flower Commission | **Grant Agreement No.:** SCB13011 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Kasey Cronquist | **Telephone:** (805) 696-5000 | **Email:** kcronquist@ccfc.org |

## Project Summary

Over the past two decades, South America's (SA) flower industry has not only taken over the majority of the U.S. fresh cut flower market, now representing approximately 80% of all flowers sold in the U.S., but they have spent millions on the development of their image as a sustainable flower growing region. In fact, every existing sustainability certification program for flower production was created for marketing purposes, helping the SA flower industry, importers and retailers to compensate for any reputational issues that countries like Colombia and Ecuador might face in the U.S.

Unwilling to associate the high standards and requirements of growing flowers in California with SA, many of California's flower farmers have steered clear of sustainability labeling, unwilling to certify under the same programs benefiting the SA floral industry. However, based on retailer and consumer interest in wanting agricultural producers to use sustainable farming practices, and consumer interest in buying California-grown agricultural crops, the California Cut Flower Commission (CCFC) decided to develop a certification program for the sustainable production of cut flowers in California.

This project addressed several timely and important issues for the California cut flower industry. First, over the last several years there has been a growing interest by consumers for local, American grown products. A recent study commissioned by CCFC found that flowers flown in from SA have a 3-16 times higher transportation footprint than California grown flowers, a noteworthy distinction that is currently not measured by any of today's consumer facing floral certifications. Second, retailers are increasingly requesting that farms be certified sustainable by a third party. Last, regulators in California appreciate working with industries that have third party audit programs already in place that measure environmental impact.

Therefore, it was timely and important to develop and implement a sustainability certification for California flower farmers that more accurately reflects the sustainable growing practices and ensures they are California-grown. The certification program was based on the comprehensive and rigorous self-assessment workbook for the sustainable production of California cut flowers and greens developed by CCFC in 2014.

This project built upon a2010 Specialty Crop Block Grant Program Project 48: *California Cut Flower Industry Sustainability Study*. Some of the grant funds were used to:

1) Carry out a survey of California flower farmers to determine:
    a. What sustainable practices were being used
    b. What percentage of flower farmers were using them
    c. Align practices with existing certification programs available to California flower farmers
2) Evaluate certification programs for cut flowers to determine their adequacy to measure sustainability performance of California flower farmers

3) Calculate the transportation footprint of flowers from SA to 10 different U.S. retail destinations and compare it to that of shipping California flowers to the same destinations.

Based on the outcomes of the above work, CCFC concluded that a sustainable certification program designed for California flower production conditions would add value to California cut flowers and differentiate them in the marketplace from flowers imported from SA and other overseas countries. This work led to the project described in this report.

## Project Approach

- A project stakeholder committee of six flower farmers was formed to work with an agricultural consulting firm (Firm) to develop the certification program and oversee program launch and implementation.
- The project stakeholder committee, and Firm, created practice-based sustainable flower production standards via webinars.
- The project stakeholder committee, and Firm, assigned points to each farming practice standard to be awarded to flower farmers using the practice.
- The Firm submitted the flower production farming practice standards and point system to a third party certifier which arranged for the practice standards and point system to be scientifically peer reviewed.
- Flower practice standards were revised based on a peer review and submitted to the third party certifier for accreditation which was granted in December 2014.
- The Firm developed certification and auditing protocols according to the third party certifier specifications.
- The Firm established criteria to achieve certification according to the third party certifier specifications.
- The Firm developed and launched the internet-based certification sustainable management information system (SMIS) that provides the following functionality:
  1) Flower farmers use it to record the farming practice standards they are using and those they are not,
  2) Flower farmers tally points awarded for practices being used and produce a certification report indicating whether they have qualified,
  3) Auditor creates a report based on the flower farmer's practice assessment to use during the audit of the flower farm that verifies the farming practice standards are being adhered to;
- CCFC established the program name, BloomCheck, a logo, and messaging for a retail and consumer facing certification program marketing campaign.
- CCFC launched the certification program to flower farmers by announcing it at key meetings, e-newsletters, and emails.
- The Firm created the following documents for flower farmers to use to help prepare for their audits: BloomCheck Companion Document, BloomCheck Management Plan Guide, BloomCheck Pesticide Do Not Use, BloomCheck Certification Manual.
- The Firm created a four-part video series to be used to introduce flower farmers to the BloomCheck program and how to prepare for an audit.
- Two webinars were held to introduce flower farmers to the certification and auditing protocols.
- The third party certifier certified four flower farms during 2015.
- CCFC collected flower and greens total annual sales data from CCFC flower farmer members for 2012 and U.S. flower sales to establish a benchmark.

The only commodity that benefited from this project is California grown cut flowers.

## Goals and Outcomes Achieved

The goal of the project was to increase U.S. market share and farm-gate value of California grown cut flowers through the implementation of a third party certification program based on sustainable flower production practices. The performance measure is the increase in market share and farm-gate value of California grown cut flowers.

The benchmark was the total annual sales of flowers in 2012, or $231,499,806, which was two years before the certification program was developed and launched. This benchmark will be compared to annual sales figures of certified flowers in 2017, two years after the launch of the certification program. The goal is to increase market share by 5% or $18.5 million in farmgate value for California flower farmers.

The activities completed during the project toward achieving this goal and outcome were the design, development and implementation of the third party certification program for the sustainable production of cut flowers in California, and the benchmarking of non-certified flower sales in 2012.

The outcome measures for this project are long-term. CCFC successfully developed and launched the BloomCheck program, certified four flower farms in 2015, and one in 2016.

The one goal that was not achieved was certifying 20 flower farms in 2015. Five flower farms have been certified to date. CCFC was unsuccessful in certifying more flower farmers because of a delay in the completion of the certification program. Developing a rigorous and thorough certification program is a challenging and time-consuming process. As a result, the timeline for launching the program was pushed back.

## Beneficiaries

The completion of the BloomCheck certification program will benefit all 225 cut flower farmers remaining in California, who collectively supply approximately 18% of the cut flowers sold in the U.S. The program is available to all cut flower farmers in California, and CCFC's goal is to expand far beyond the farms currently involved in the program's development. Four flower farms achieved BloomCheck certification in 2015 and one in 2016.

This project will affect all 225 cut flower farmers in California who collectively represent more than $278 million in total cut flower sales in the US. By developing a sustainability certification program, CCFC expects market share of California-grown cut flowers to increase by 5% by 2017, or $18.5 million based on 2011 farm-gate values.

## Lessons Learned

First, developing a rigorous and thorough certification program is a challenging and time-consuming process. As a result, there was a delay in the completion of the certification program which delayed the timeline for launching the program. The overall delay resulted in fewer farms being certified during the life of the grant than was predicted at the beginning.

Second, growers who have never participated in a sustainable farming certification program often do not have standard operating procedures in place and record keeping systems that are necessary for an auditor to verify that the sustainable farming practice standards are being adhered to. This situation was observed on some of the flower farms audited for BloomCheck in 2015. This is a situation remedied through good grower outreach and education detailing the requirements for certification and audits, and also through the flower farmer's first year experience of the certification program.

Finally, an insight gained by the Firm from not only developing BloomCheck, but also in designing and implementing other programs, is that the probability of a third party sustainable farming certification being successful is greatly increased by the presence of a group or organization that the target grower community is a part of, and not related to the certifier. This encourages growers to participate in the certification program and also helps them prepare for the audits. CCFC can and will fill this role, which greatly improves the likelihood that BloomCheck will be successful and grow.

There were no unexpected outcomes or results during the life of the project.

A lesson learned for those new to the process of developing a sustainable farming certification program would be to allow more time for the development and subsequent accreditation of a certification program. Another lesson learned for those new to implementing a sustainable farming certification program is to provide education and outreach to the population of growers who might participate to ensure they will be successful in their first audit.

## Additional Information

The following documents are provided as additional information:

1) BloomCheck Certification Manual
2) BloomCheck Companion Document
3) BloomCheck Management Plan Guide
4) BloomCheck Do Not Use List by Pesticide Trade names

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 12 | **Project Title:** California Food for California Kids | |
|---|---|---|
| **Grant Recipient:** Center for Ecoliteracy | **Grant Agreement No.:** SCB13012 | **Date Submitted:** December 2015 |
| **Recipient Contact:** Chris Smith | **Telephone:** (510) 845-4595 | **Email:** chris@ecoliteracy.org |

## Project Summary

More than 1 billion meals are served annually in California public schools, making local school districts a significant and largely under-tapped market for specialty crop growers. The Center for Ecoliteracy (CEL) created a targeted implementation and marketing program to increase the use of specialty crops in school meals by providing nutrition service directors and district personnel with the recipes and technical expertise they need to procure, prepare, and serve more California fruits and vegetables. This project also designed and launched a communications strategy to build enthusiasm for locally grown specialty crops in school meals with students, parents, staff, and school communities.

With new U.S. Department of Agriculture (USDA) regulations requiring the use of more fresh fruits and vegetables in school meals, this grant provided a timely opportunity to support the efforts of the USDA mandate, encouraging more California-grown specialty crops to be purchased, prepared, and served in meals for students.

The economic impact to specialty crop producers has the potential to be significant: a one percent reallocation of the California school meal budget to California specialty crop producers equals $5.6–7.8 million per year. According to the California Department of Education, California schools produced 1,078,870,492 meals during the 2013-2014 academic school year.

By providing nutrition service directors across the state with the resources, motivation, and professional development to serve more California-grown food in school meals, the project also benefited school districts, and ultimately the students themselves. The California Thursdays program could also positively impact student health and achievement by increasing the amount of fresh, local specialty crops in school meals and their enthusiasm for eating it.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

CEL achieved its project objectives through a two-track process. Track 1 addressed the supply side of the school food market for specialty crops by targeting decision-makers in the school food system and providing the necessary tools and assistance for success. Track 2 addressed the demand side of the school food market by targeting parents and students statewide with new promotional materials and platforms advocating for more California-grown specialty crops in school meals and showcasing specialty crops.

TRACK 1

Created and Disseminated a Food Service Providers' Toolkit:
CEL created and disseminated a Food Service Providers' Toolkit comprised of practical resources for nutrition services professionals, including (a) recipes featuring at least 51% California specialty crops; (b) flavor profile resources and displays; and (c) Rice Bowl Strategy posters which 54% contained and highlighted California specialty crops. CEL worked diligently to ensure that recipe analysis was performed and tracking tools were employed to manage funds dedicated to California specialty crops. The toolkit provided practical and realistic examples that enabled food service directors to plan, procure, and serve a California-sourced reimbursable meal at least one day per month beginning in October 2014, and to commit to a goal of implementing weekly California-sourced offerings within one year.

The toolkit was disseminated on a flash drive to all participants who attended CEL's statewide conferences. In addition, CEL established a Listserve as part of its web-based extension activities so that participating districts could share ideas, techniques, tools, recipes, and strategies for successful programs.

Recruited and Developed a Network of Committed Food Service Providers:
CEL recruited school districts that demonstrated the highest readiness factors and motivation to serve California-sourced specialty crops while representing the widest range of district sizes and geographic diversity. Each district representative committed to:

- Attend and participate fully in a statewide conference in August 2014;
- Serve a California-sourced reimbursable meal featuring specialty crops at least one Thursday per month beginning in October 2014; and
- Establish a goal of implementing weekly California Thursdays offerings within one year.

The network involved 15 school districts (surpassing the stated goal of 10 school districts) that collectively serve over 190 million meals per year and represent both large and small districts as well as a range of urban, rural, and suburban districts. The purchasing power of these districts increased the likelihood of news coverage by showing the potential economic impact of increasing the procurement of California produce. The range of districts provided a wide assortment of model solutions and recommendations for future school districts to emulate while demonstrating the ability to build awareness among a variety of school communities.

Conducted Two State-wide Conferences to promote California Specialty Crops for Professionals:
CEL hosted a daylong workshop and two-day exhibit at the California Nutrition Services Association (CSNA) annual conference on November 14 -16, 2013, attracting 149 workshop participants attending from 49 school districts in 20 counties. CEL was encouraged by the interest and dedicated additional resources to increase the capacity of the workshop. Among the 1,200 people who attended the conference, 80% of those attendees are estimated to have visited the exhibit where they learned more about CEL's activities to promote California specialty crops. The main objective of these conferences was to enhance California specialty crops and to create awareness to food professionals that there is a need for more specialty crops in California school meals.

On August 7, 2014, CEL conducted a second statewide conference dedicated to launching the implementation of "California Thursdays," an implementation and marketing program, with a pre-qualified statewide network

of nutrition service directors from among the pool of 2013 attendees (see "*Network of Committed Food Service Providers*" above). By identifying experienced innovators and early adopters, CEL was able to provide a focused conference that included professional development, technical assistance, training, and practical resources, which enabled the program to achieve significant results in districts throughout the state.

Disseminated Best Practice Stories & Best Practice Press Releases:
CEL worked with school districts to develop and disseminate four best practice stories featuring innovative nutrition services directors from across the state, including Fort Bragg, Oakland, Riverside, and Ventura Unified School Districts, (a) at the first statewide conference; (b) through tailored press releases to local media markets; (c) via CEL's social media and website; and (d) amplified by allied organizations.

Conducted Surveys and Implemented Program Evaluation:
CEL worked with Resource Development Associates to design an improved survey instrument. The baseline survey was conducted on August 7, 2014, at the launch of the California Thursdays campaign. The follow-up survey and evaluation were implemented after each district served a freshly prepared school meal featuring fresh California-grown fruits and vegetables in October of 2014. Results of the evaluation are included in the evaluation section below.

TRACK 2

Market Research:
CEL identified and engaged a nationally recognized advertising agency, barrettSF, as well as an award-winning communications firm, Brown Miller Communications (BMC), to develop the creative strategy, produce key assets, conduct market research, and provide technical expertise for the statewide launch of the marketing campaign. BMC conducted focus group research in three California regions: (1) Greater San Francisco Bay Area; (2) Riverside County; and (3) San Diego County. In addition to conducting the focus groups, BMC presented the results of the study at the statewide conference in August 2014. The participants in the focus group were parents of children in public schools, in one session one parent had a child in a private school. There was a mix of professional and stay-at-home parents, as well as a mix of income levels. The purpose of the focus groups was to understand parents' perceptions and attitudes about their children's school meals program and the impact of serving more California fruits and vegetables. The study revealed the following attitudes:

1. Parents care about the food their children receive at school;
2. The parents prefer California-grown specialty crops and products, and connect health and achievement with school meals;
3. Parents believe that freshly prepared food is healthier than processed food; and
4. The parents are anxious for change.

The focus group participants were unanimous in wanting their schools to create meals using California-grown specialty crops and products. Among the reasons cited were:

- California grows a wide variety of fruits and vegetables.
- It would be good for children to have more choices of fresh produce in season.
- One mother confided that she tries to teach her children what is healthy, but the school should provide that through example. The mother said that if schools served healthier meals with more fresh fruits and vegetables, it would make a mother's job easier.

- Mothers in Riverside liked supporting their farmers and local economy, reducing the carbon footprint, and improving the meals' nutritional value.
- Bay Area mothers agreed that fresher ingredients provide more nutrition and better appearance; one commented "origin is only part of the equation." Another said, "A lot can happen between the farm and the kitchen."

CEL's Rethinking School Lunch Program Manager, arranged and conducted market research with students and teachers by conducting peer-to-peer taste tests and surveys to elementary and high school students. The taste test results consistently show favorable responses to freshly prepared food made with California-grown fruits and vegetables. These findings support the belief that freshly prepared foods with California-grown ingredients are desirable, and challenges general assumptions proffered in the media that students do not eat fruits and vegetables.

Website and Social Media:
Following the August 2014 statewide conference with 15 members of the network, results began to exceed the projected plan. Several school districts immediately began implementing meals featuring fresh California specialty crops under the "California Thursdays" banner. In September 2014, CEL launched a California Thursdays webpage (www.ecoliteracy.org/california-thursdays) to reflect early news and earned media coverage, and to begin promoting the program ahead of the public launch. CEL increased activity in its social media campaigns on Facebook and Twitter. The website, CEL tracked the activity to ensure that funds were spent on core website design and html coding with the project funds, including the introduction, video, recipes, infographic, and success stories for the California Thursday specialty crop program only. Any additional aspects of the website were paid by other non-grant funds.

CEL identified and engaged Plumbline Studios to design and implement the standalone California Thursdays website. The website launched in October 2014 and provided resources in Track 1 and Track 2 to promote California specialty crops and to assist new school districts in joining the expanding network.

California Thursdays Campaign:
The California Thursdays campaign was launched on August 7, 2014. The 15 participating school districts in the statewide network committed to serving a school lunch meal featuring California-specialty crops on Thursday, October 23, 2014, and to promote the event in the media.

BMC provided hands-on training to address media inquiries with the goal of helping districts to direct the press to achieve successful interviews and news stories that promote increasing California specialty crops in school meals. Participating school districts were provided with key objectives, facts, and a rationale for the initiative.

Within two weeks of the conference, on August 21, 2014, Oceanside Unified School District utilized skills and talking points from the conference, resulting in a feature news story in the *San Diego Union-Tribune* about Oceanside's California Thursdays program. In addition, Oakland Unified School District Youth Radio began filming a video that was aired on the "PBS News Hour" on September 15, 2014.

On October 23, 2014, the 15 California Thursdays school districts participated in a simultaneous statewide event by serving a California-sourced reimbursable meal featuring specialty crops. This was an unprecedented

event and drew significant media attention, including: two national features (PBS News Hour television and Public Radio International (PRI)'s Marketplace radio); 37 local television, radio, and print features; and 65 web-based outlet features with a total of more than 240 million impressions.

Video Spot:
CEL engaged Monstro Design to create an animated video to describe and promote the California Thursdays program. The resulting video can be found on the California Thursdays website and has received favorable responses from food service professionals and the general public alike for its ability to present the value of bringing fresh California specialty crops to school meals in a visually appealing and succinct manner.

CEL implemented detailed specialty crop tracking mechanisms for each of its two program tracks based on (1) analyzed ratios of California specialty crops to total crops featured in recipes; and (2) clear guidelines which emphasized and made specialty crops the main ingredient in regards to marketing and promotional materials. CEL implemented detailed tracking mechanisms for each of its two program tracks based on (1) analyzed ratios of California specialty crops to total crops featured in recipes to ensure more than 51% specialty crops were in the recipe; and (2) clear guidelines regarding marketing and promotional materials, along with costs were charged for specialty crops only.

Network of California Thursdays School Districts – The network of California Thursdays school districts included Alvord, Coachella Valley, Conejo Valley, Elk Grove, Hemet, La Honda–Pescadero, Lodi, Los Angeles, Monterey Peninsula, Oakland, Oceanside, Riverside, San Diego, San Francisco, and Turlock Unified School Districts. Each of these districts committed to attending the statewide conference, serving a California-sourced reimbursable meal at least one Thursday per month beginning in October 2014, and serving one California-sourced reimbursable meal once per week within one year. In addition, food service directors agreed to participate in our surveys, identify the challenges and solutions of the program, and communicate with and support other members of the network. To increase awareness in the public for the program, each food service director was trained to work with the media and provided with marketing materials.

Marketing Campaign Partners – Brown Miller Communications (BMC) provided expertise in developing and executing a focus group study in three regions of California. They subsequently reported these findings to the network of participating school districts. BMC developed training materials for handling media inquiries and presented this training in August 2014 at the statewide conference and implementation launch. BMC created and disseminated press releases and media alerts both statewide and locally, created an on-line media room with information about California Thursdays and each district's meal program featuring specialty crops, and prepared the groundwork for earned media coverage for each of the participating districts scheduled to launch the event on Thursday, October 23, 2014. Additionally, BMC followed up with media contacts on that day. As a result of BMC's expertise and the unprecedented nature of this effort, exceeded the expectations for spreading the word about California Thursdays.

Communications Production Partners – Monstro Design developed the concept production on the California Thursdays video. Plumbline studios provided strategic, creative, engineering, tracking, and Google Adwords services for the California Thursdays website.

Assessment Partners – Resource Development Associates provided expertise in making adjustments to the survey instrument that was used to measure outcomes. The survey instrument was adapted to

capture (1) preparedness to incorporate California specialty crops into the school lunch program; and (2) increased desire to include more fresh California specialty crops in school meals.

## Goals and Outcomes Achieved

CEL surveyed nutrition service directors at 15 school districts implementing California Thursdays immediately following the training and rollout of the California Thursdays communications campaign, then again four months post implementation. Accomplishments and barriers were captured in the surveys as well as reporting on non-school district groups (included PTA or other parents' groups, specialty crop producers and suppliers) engaged in increasing the availability of California specialty crops in school lunches.

Additionally, CEL surveyed nutrition service directors who participated in this project about the overall impact on the use of California specialty crops to understand (1) changes in the usage of California specialty crops in school lunches; (2) changes in systems-level readiness for increasing the use of California specialty crops; (3) additional training and technical assistance needs to increase the use of specialty crops in the school lunch program; and (4) sustainability of the California Thursdays program.

CEL's California Thursdays program has made progress towards its long-term objective of influencing demand for California specialty crops in school meals. Through the development of collateral materials featuring California fresh specialty crops and associated professional development opportunities, the program has increased in the capacity as well as the motivation for districts to make use of California specialty crops in school lunches. The campaign has also helped to spread awareness of this work and its importance beyond the school district nutrition departments themselves throughout the districts. Increased demand for California fresh fruits and vegetables among these other stakeholders bolsters the ability for produce growers to supply them as well. These efforts will support increasing demand for these fresh California specialty crops, which will in turn stimulate the supply.

By providing training and resources to nutrition service directors, this program has facilitated an increase in their abilities, level of motivation, and readiness to procure, prepare, and serve more California specialty crops in their districts' school meals. Specific expected measurable outcomes are demonstrated by results from surveys of nutrition service directors about their districts' school meal programs as mentioned below.

With regards to the stated goal of increasing the use of California specialty crops in school lunches, 13 of 15 districts (86.7%) participating in the four-month post-implementation follow-up survey responded "Yes" when asked whether they have "increased the use of California specialty crops in [their] school lunch program[s] this academic year compared to last year." Among those respondents who offered estimates as to how much this use increased, amounts ranged between 10% and 30%.

In addition, a comparison of the responses given to the follow-up survey with those given to the baseline survey shows an increase in the level of readiness following the roll-out of this program, as well. When respondents to the baseline survey were asked to rate how prepared their districts were to incorporate the use of fresh fruits and vegetables into school lunch programs, the average score among all respondents was 4.23 on a scale of 1-5 (with 1 being "Not at all" and 5 being "Extremely"). Four months later, respondents to the follow-up survey reported an average score of 4.63, an increase of 9.4%.

The follow-up survey was also used to poll respondents about what strengths and/or challenges were encountered while incorporating more California specialty crops into school lunch programs and to seek recommendations about new resources that may be helpful in the future. This data will be useful in determining how to further sustain the program's goals and achieve better outcomes. The most frequently listed strengths of the program in facilitating the use of California specialty crops in school lunches were: support from directors (three respondents), district policy (three respondents), and new vendor relationships (three respondents). The most frequently listed challenges faced in facilitating the use of California fresh fruits and vegetables in school lunches were: cost (seven respondents); and product availability (four respondents). The most frequently requested resources were: assistance sourcing specialty crops (four respondents), such as a database of vendors that could be shared among districts; and assistance with staff training and equipment for processing specialty crops (two respondents each).

Finally, the follow-up survey sought to measure progress toward the campaign's goal of "non-school district groups (included PTA or other parents' groups) engaged in increasing the availability of California specialty crops in school lunches." All 15 districts (100%) indicated that they had shared the California Thursdays materials with at least one such group, with the average number being 4.5 of the 7 types of groups listed. These groups included PTA or other parents' groups (9 out of 15 districts responding to the survey, or 60%); Afterschool Providers (6 out of 15, or 40%); Faculty and Staff (14 out of 15, or 93.3%); School District Administration (14 out of 15, or 93.3%); School Board (10 out of 15, or 66.7%); Students or School Club (10 out of 15, or 66.7%); and "Other" (4 out of 15, or 26.7%).

Baseline data collected in the aforementioned baseline survey of nutrition service directors included self-reported preparedness and motivation scores (on a scale of 1-5, with 1 being "Not at all" and 5 being "Extremely") of directors and districts in incorporating California specialty crops in school lunch programs and in implementing California Thursdays on a monthly basis. Changes in these indicators seen in the four-month post-implementation follow-up survey are given in the following table:

| | | Nutrition Directors | | School Districts | |
|---|---|---|---|---|---|
| | | Preparedness | Motivation | Preparedness | Motivation |
| Incorporating California specialty crops into school lunch programs | Baseline Survey Average | 4.32 | 4.86 | 4.23 | 4.29 |
| | Follow-up Survey Average | 4.50 | 4.49 | 4.63 | 4.94 |
| | Percent Change | +4.2% | +1.5% | +9.4% | +15.2% |
| Implement/continue California Thursdays on a monthly basis | Baseline Survey Average | 3.52 | 4.77 | 3.48 | 4.02 |
| | Follow-up Survey Average | 4.44 | 4.94 | 4.56 | 4.88 |
| | Percent Change | +26.0% | +3.5% | 31.2% | +21.1% |

Between the baseline and follow-up surveys, the average score for district preparedness to implement or continue California Thursdays increased 31.2%, from 3.48 to 4.56 (out of 5). Nutrition Directors also increased their preparedness to implement or continue the program by 26%. Both of these scores represent significant positive outcomes for the project objectives.

## Beneficiaries

The school districts participating in the California Thursdays network served 1,327,604 California Thursdays meals between October 23, 2014 and December 31, 2014, which further benefited the students who consumed freshly prepared meals made with California fresh fruits and vegetables as well as the producers from whom the districts procured the additional California specialty crops.

The media coverage for the California Thursdays statewide rollout on October 23, 2014 served to increase public awareness about California-grown fruits and vegetables and thereby benefit a range of specialty crop stakeholders.

Thirteen school districts responding to the follow-up survey reported having "increased the use of California specialty crops in your school lunch program this academic school year compared to last year." California Thursdays supported these districts through the dissemination of its materials to the district Nutrition Services Departments, who in turn shared them with other district staff. Increased staff capacity for using fresh fruits and vegetables increases the likelihood they will be used and creates economic incentives for producers. Together these districts accounted for 1,077,789 enrolled students in the 2014-2015 school year, representing 17.3% of the state total. In a telephone survey of participating districts conducted by CEL, 11 districts reported data about the number of California Thursdays meals served between the October rollout and the end of the 2014 calendar year, which totaled 1,327,604 meals.

Nutrition service directors responding to the follow-up survey were asked to indicate with whom they had shared California Thursdays materials. All 16 respondents indicated that they had shared the materials beyond their district meal program personnel. Direct beneficiaries include: PTA or other parents' groups (9 out of 16 districts responding to the survey, or 56.3%); Afterschool Providers (6 out of 16, or 37.5%); Faculty and Staff (15 out of 16, or 93.8%); School District Administrators (14 out of 16, or 87.5%); School Board (10 out of 16, or 62.5%); Students or School Club (10 out of 16, or 62.5%); and "Other" (4 out of 16, or 25%). Responses listed in the "Other" category included "posted a blurb on CEL website," "media," "city agencies," "local hospitals," "community members, and community developers."

## Lessons Learned

One of the biggest lessons learned as a result of completing this project is that the success of the program and subsequent growth of interest in participating, is that it also introduces organizational capacity issues. It is now a challenge to manage with current resources. CEL was able to recruit more active members within the network than planned. Since the conclusion of the first statewide event, more than double the number of school districts have asked to join the network of districts serving more California specialty crops. CEL is experiencing the challenge of meeting the increased demand in new members. It requires more attention and coordination than the current resources can manage effectively. CEL is investigating all options to accommodate the high volume interest in demand. CEL expected 10 school districts to commit to participating in the pilot network and was surprised by the interest from more nutrition service directors in joining the project. For phase 1, the project team accepted a total of 15 districts into the projects active network. Shortly after the conclusion of the grant period, interest throughout the state of California increased significantly, and the expanded network nearly tripled, currently including 42 districts.

Another significant lesson learned is that the individualized systems used by school districts do not lend themselves to easily-obtainable metrics and collective assessment. Collecting and analyzing aggregate

procurement data is a challenge. Each district has its own approach to tracking purchases, and most are not set up to track provenance in an ongoing manner. That is in part because distributors and most food purveyors themselves have not traditionally provided source information to their customers. In addition, weights and measures vary significantly within a particular fruit or vegetable in its various forms. However, a few indications at the conclusion of this project lead the project team to believe that distributors are beginning to recognize the value of providing more information about the origins of their products as Nutrition Services Directors demand that information in order to participate in the program and support California specialty crops.

Contrary to what media coverage often suggests, during this grant period, students proved that they were enthusiastic about consuming more California specialty crops in their school meals. During the October 2014 statewide rollout events, nutrition service directors enlisted student-led groups to actively participate in activities like peer-to-peer surveys, tasting stations, event promotion, and garden clubs. In addition, they reported that students enthusiastically chose the California Thursdays lunch option that day (containing increased amounts of specialty crops) over less healthy yet familiar foods. This shows early signs that with an effective marketing and student-tested recipes featuring specialty crops, it is possible to spark a shift in student attitudes and behaviors toward healthy meals as “cool”, “more delicious”, and “more local”.

The intention to engage in a general market research telephone poll was revealed to be an unnecessary effort because of pre-existing studies. Philanthropic professionals, most notably from Pew Charitable Trust, affirmed the results CEL discovered around the consistently high polling support among parents of all backgrounds and affiliations for the general proposition of improving school meals. Marketing professionals made clear that early and generalized market research would be unlikely to provide a useful baseline, and recommended a more targeted effort in the form of a scheduled set of focus groups with parents.

Recruiting, hiring, and managing an external social media writer proved to require more resources than anticipated. CEL determined that it would be more cost effective and easier to manage the social media efforts with in-house staff.

One significant challenge involved clarifying the tracking mechanisms in order to ensure grant funds are expended to solely enhance the competitiveness of California specialty crops, rather than more broadly to fresh California-sourced food. Nutrition service directors are required to meet complex USDA menu pattern and meal reimbursement regulations for school meals, which dictate percentages of foods in different categories. Analyzing the recipes to ensure that they meet the requirements became an unexpected project effort. The key lesson learned in this process was to develop tracking mechanisms and analysis that would comply with grant requirements while working within the USDA School Food Service requirements. The project team ensured that this projects purpose was to solely enhance specialty crops. CEL implemented detailed tracking mechanisms for each of its two program tracks based on (1) analyzed ratios of California specialty crops to total crops featured in recipes to ensure more than 51% specialty crops were in the recipe; and (2) clear guidelines regarding marketing and promotional materials, along with costs were charged for specialty crops only.

One of the key lessons learned was to simplify the project message and deliverables by focusing tightly on solely enhancing the competitiveness of California specialty crops. The marketing materials featured bright, beautiful images of the specialty crops alone. The effect of this constraint actually resulted in more efficient

use of the project team's time and simultaneously increased the attractiveness of the message. School districts were able and eager to use the striking images in the school nutritional marketing efforts. Responses indicate that students and parents liked them, too.

Another significant challenge involved the time required to secure a top-tier advertising agency to provide creative direction for the marketing campaign, which shifted from the end of 2013 to the early part of 2014. The change was due in part to the calendar cycles of work flow at the end of the year and in part to the time required to secure subsidized services from major agencies for a nonprofit campaign. A major agency was secured ultimately, but CEL needed to shift some of the campaign effort to a smaller agency to meet the schedule and deliverables.

## Additional Information

Please find the three informational pieces mentioned below available at this link
http://www.hightail.com/download/ZWJYS3doZ1BJMHVVbDhUQw

(1) A sample pre-approved poster within the projects series of specialty-crop posters;

(2) A screen shot of the California Thursdays website when it was launched in fall of 2014; and

(3) An infographic (available in 2014 on the website) showing the original network of 15 participating school districts.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 13 | **Project Title:** Making the California Women, Infants and Children (WIC) Program Work for California Farmers and WIC Program Participants | |
|---|---|---|
| **Grant Recipient:** University of California, Davis | **Grant Agreement No.:** SCB13013 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Richard J. Sexton | **Telephone:** (530) 752-4428 | **Email:** rich@primal.ucdavis.edu |

## Project Summary

The Women, Infants and Children (WIC) Program Farmers' Market Nutrition Program permits eligible families to receive $20 in vouchers to purchase fresh fruits and vegetables at WIC-approved Farmers' Markets. Just under three million was expended in this program in 2010 in California. However, in 2014 over $87.5 million is expended annually through the California WIC Program for participants to purchase fresh, frozen, or canned fruits and vegetables using cash-value vouchers (CVV) – hereafter the Fruit and Vegetable Checks (FVC). Presently only a small fraction of these FVCs ($73,000 in 2014) are redeemed though farmers' markets, resulting in great loss in potential revenue to California's specialty crop producers.

While approximately 380 farmers' markets throughout California are authorized to redeem vouchers for the more limited Farmers' Market Nutrition Program, only 36 farmers' markets, concentrated in Southern California (Los Angeles and San Diego counties), are authorized to accept the CVVs given to eligible WIC participants. Expanding the number of direct marketers and farmers' markets authorized to sell to the larger WIC population is a fundamental goal of the project and is an essential step to increasing the share going to California farmers of the more than $87.5 million expended annually on fruits and vegetables through the California WIC program. Moreover, farmers who engage in direct marketing receive the full value of FVC redemptions whereas markups by market intermediaries decrease the farm share for FVCs redeemed at commercial retailers. For example, the farm shares for fresh fruits and vegetables sold at retail in 2013 were 35% and 27%, respectively. Thus, a farmer may receive only $2.70 to $3.50 in value when a $10 FVC is redeemed at a traditional food retailer, instead of the full $10 at a farmers' market.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Data Analysis: As part of this project, the UC Davis researchers obtained data detailing every WIC Program voucher redeemed in California for several recent years, enabling project staff to derive the first comprehensive information on WIC program expenditures at farmers' markets. For most months, total FVC redemptions in California have varied between $6 – 8 million, while the farmers' market share of FVC redemptions fluctuated around 0.05% of this total for most months, with some seasonal increases during the summer. The farmers' market share rose substantially, to above 0.15% in the summer of 2014, before declining quickly again in the fall/winter. Focusing specifically on 2014, the most recent year for which complete redemption data is available, just over $73,000 in FVCs was redeemed at farmers' markets, approximately 0.08% of total FVC redemptions in California.

The statewide figures do not paint a complete picture given that authorized farmers' markets are relatively concentrated geographically, and thus most participants in California lack access to a farmers' market that is authorized for FVC checks. The project team compared redemptions of FVCs at farmers' markets relative to other authorized vendors for California counties that have at least one farmers' market authorized to accept FVCs. The average share of FVC redemptions at farmers' markets in counties with at least one authorized market is 0.11%, compared to 0.08% statewide, but large differences in redemption rates are revealed across counties. In Fresno County, only one farmers' market is authorized and redeems 0.10% of FVCs. In contrast, both Placer and Santa Cruz counties each have one farmers' market authorized to redeem FVCs, which account for only 0.01% and 0.02% of FVC redemptions in the county, respectively. Thus, increasing the number of farmers' markets authorized to redeem FVC is only one small component to increasing the share of FVC redemptions at farmers' markets.

Geographic Information System (GIS) Analysis: All farmers' markets authorized by the California WIC Agency were geocoded and mapped to ascertain the level of participant access as well as to facilitate farmers' market manager survey sampling stratification. A sample of the maps generated from this analysis are included as Attachment 1.

Farmers' Market Manager Survey: Market manager surveys were conducted via phone between October and December 2014. Twenty of the 48 markets selected for survey chose to participate, a response rate of approximately 42%. Survey instruments were tailored for Farmers' Market Nutrition Program (FMNP) only and FMNP and FVC markets. Each of the surveys contained four sections including: i) basic market and manager characteristics, ii) perception of the authorization procedure, iii) perceived demand for FMNP and/or FVC authorization by farmers and participants, and iv) perceived costs for or barriers to FMNP and/or FVC authorization by farmers.

For this summary, the focus was on the responses from the managers whose markets are authorized to accept both FMNP and FVC vouchers in order to isolate responses that compare the two programs. Comparing responses across the two sections clearly indicates that market managers perceive the FVC program's authorization process as more difficult than its FMNP counterpart. For example, 80% of market managers strongly agree or agree that receiving FVC authorization is difficult, compared to only 10% giving a similar response when asked about the FMNP. Market managers also perceive that farmers' cost and/or difficulties associated with obtaining reimbursement from California WIC are more substantial for the FVC Program, when compared to the FMNP. Training employees how to properly redeem FVC is also regarded as more challenging than vouchers for the FMNP.

Examining these concerns in more detail, although the authorization procedures for the FMNP and FVC programs are somewhat similar, the FVC program's process does impose more of a burden on farmers and markets. For both programs, the California WIC program must authorize both the market and the individual farmer vendors in that market. Each must also be certified by the California Department of Food and Agriculture. In addition, farmers' market managers and farmers seeking authorization must attend in-person or interactive training sessions given by California WIC staff. Different training sessions are required for each program, and the FVC authorization requires additional training compared to FMNP and reauthorization every three years.

As to the reimbursement process for FMNP vouchers compared to FVCs, authorized farmers can deposit FMNP checks into their bank accounts and checks can be deposited any time on or before December 31st of each year. FVCs, however, must be redeemed through a dedicated online portal, a process that requires specific training, and the timeline to submit FVCs for payment is much tighter. Vendors have only 45 days from the "first day of use" indicated on the check to redeem it. Given that FVCs are issued to participants on a monthly basis and expire every 30 days, i.e., the participant has 30 days to redeem it, the farmer may in some cases have as few as 15 days to submit checks for reimbursement.

Another interesting facet of the market manager survey was the differences in perception by the managers regarding the economic potential of the FMNP and FVC programs at their markets. As noted, the annual value of FVC dwarfs that for FMNP. Managers, however, mostly agreed (80%) with the proposition that FVC checks were too low to justify authorization and that there was a lack of FVC customers (70%) at their market compared to 70% and 10% agreement on the same questions regarding FMNP.

Authorized Farmer Survey: To ascertain authorized farmers' opinions on the WIC farmers' market redemption programs, a survey instrument was designed and targeted to all farmers authorized to redeem FVCs, 149 in total at the time that the survey was designed. Surveys in both English and Spanish were mailed to all FVC-authorized farmers in January 2015. After initial contact and one follow-up, 61 completed responses were returned, a response rate of 41%.

Given that all farmers were authorized to accept FMNP and FVC vouchers, farmers were asked to provide opinions on both aspects of the WIC program in three broad categories: i) ease of administration, ii) participant demand, and iii) advertising and promotion.

Farmer survey responses confirm that the authorization process is significantly more challenging for FVCs compared to the FMNP program. Forty-three percent of respondents indicated (strongly agree or agree) that the FVC authorization process and administrative activities surrounding redemption are difficult. When asked the same question regarding the FMNP program, only 26% of respondents offered a similar opinion. Comparably, when asked whether accepting FVC (FMNP) vouchers was too confusing/difficult to justify the effort, 35% (12% strongly agreed) agreed with the statement. Based on farmer responses, it appears that the most significant challenge with FVC program is the reimbursement process. Fifty one percent of farmers say that receiving reimbursement for FVCs is too confusing and/or difficult to justify the effort, compared to only 27% of respondents strongly agreeing or agreeing with the same statement relating to the FMNP.

When asked about participant demand, participating farmers were evenly split on whether there were too few FVC customers to justify the effort, but more disagreed than agreed with the proposition that the dollar value of the FVC was insufficient to justify participation in the program. In general, farmers were less pessimistic than market managers about the economic value of participating in the FVC program.

In the area of promotion and advertising to communicate with WIC participants, 25% of farmers indicate they believe that the amount of advertising surrounding FVC and FMNP redemption is not

sufficient. Yet, 59% (70% of farmers) indicate that they individually promote that they accept FVC (FMNP) vouchers.

Participant Survey: Despite repeated attempts to work with the clinic agency in charge on the development and administration of a participant survey, ultimately they were unwilling to facilitate this process. The information that was received from the market manager and farmer surveys, coupled with the additional analysis of the redemption data detailed in the subsequent paragraphs provided sufficient information that the integrity of the project is not compromised.

A potential benefit to WIC participants from redeeming their FVC at farmers' markets is greater ease in fully utilizing the full dollar value of the voucher. Results from the farmer survey indicate that 40% of authorized farmers provide participants with more fruits and/or vegetables than the dollar value of their voucher. To test if FVCs redeemed at farmers' markets are more fully utilized than when redeemed at other authorized WIC vendors, participant-level data was analyzed from June 2014 thru February 2015. These data indicate the vendor at which the FVC was redeemed and the dollar value that the vendor requested for reimbursement.

California WIC divides vendors into peer groups including: i) farmers' markets, ii) above-50 (A-50) vendors who derive more than 50% of their food sales from WIC redemptions, iii) full line grocers delineated by number of cash registers to proxy for size, and iv) non-full line grocers. A regression model was estimated to determine how the participant's choice of vendor type influenced the probability that the voucher would be fully utilized.

Regression estimates indicate for both the $6 and $10 FVC at farmers' markets, the reference category in the regression, have the highest probability of WIC participants fully utilizing their FVCs. The coefficient estimates for all of the other peer groups are negative and statistically significant at the 1% level. Further, chi-square tests for coefficient equality indicate that the coefficient estimates for each peer group are statistically different from the farmers' market estimate (reference category). The marginal effects provide probability estimates when data are evaluated at their means. Thus, for the $6 FVC, the probability that a participant will fully utilize the FVC value at a farmers' market is 99.1%, compared to a probability of only 66.8% if the FVC is redeemed at a full-line grocer with 6 - 9 cash registers. For both FVCs redeemed by participants, the highest probability of full utilization occurs when a participant redeems at a farmers' market.

California WIC redemption data also show that participants who do visit farmers' markets to redeem FVC generally don't return. Project staff considered the six month period from June 2014 through November 2014 and tracked where participants redeemed their $8 FVC. The period from June to November was isolated, as this is the season when the most farmers' markets are operating, have the greatest amount of specialty crops for sale, and are months when the most FVC are redeemed at farmers' markets. Among 2,524 participants who redeemed an FVC at a farmers' market during the six month window, 76% did not return to that market or another farmers' market during that time period. In contrast, at more traditional food retailers, the overwhelming majority of participants return to the same vendor to redeem WIC benefits, including fresh-fruits and vegetables, at least twice during a six-month period.

Of the remaining 24%, 426 participants (13%) redeemed FVCs at farmers' markets twice during the six month window. Only 11% (344 participants) redeemed FVCs at farmers' markets more than three times. Because participants are entering and exiting the WIC program on a continuous basis, project staff wanted to confirm that attrition was not being driven by participant exit from the WIC program. Thus the focus was on the 2,524 participants who only visited a farmers' market once and asked whether or not they were redeeming FVCs at other WIC authorized vendors during the six month period. The vast majority (97% or 2,451) remained in the WIC program and redeemed FVCs at other WIC-authorized vendors (i.e., not farmers' markets), meaning that for most the failure to continue patronage at a farmers' market was not due to exit from the program.

Dissemination of Results: A manuscript received a favorable first review in Renewable Agriculture and Food Systems. Although it is expected that the paper will be accepted for publication, a response has not been received to the revision of the Journal. Once published, the manuscript will be sent to all those market managers and farmers who, as part of the survey process, indicated they were interested in the results.

The overall scope of the project did not benefit commodities other than specialty crops.

The project had three "partners". The principal investigator (PI) on the project was involved in all facets. In particular, the PI was involved in the market manager and farmer survey design and sample stratification, advising all data analysis, and took a major role in drafting dissemination materials. The project scientist at UC Davis and collaborator on the project, was responsible for all coding and data analysis, coordinating graduate student researcher (GSR) help in survey dissemination and data entry, and conducted all GIS work. Finally, one GSR was employed on this grant. That individual was responsible for conducting the market manager surveys via phone and for mailing and entering the responses associated with the farmer survey.

## Goals and Outcomes Achieved

Data: The data necessary to determine purchase shares and trends for farmers' market for redemptions as well as the attrition measures and FVC utilization analysis described in the previous section was collected on an ongoing basis from the California Department of Public Health WIC Program spanning October 2009 – February 2015.

Surveys: In order to execute the surveys both had to be developed and submitted to the UC Davis institutional review board for approval. Once this was complete, the market manager surveys were conducted via phone interview, while the farmer surveys were packaged and mailed (provided in both English and Spanish). Upon receipt of completed surveys, handwritten responses were entered into a machine-readable format (excel) so analysis could later be performed.

All of the goals associated with the project were accomplished with the exception of conducting the WIC participant survey. While project staff had been communicating on an ongoing basis with WIC Agency personnel regarding this task/goal, the Agency remained concerned about the workload that this could potentially add to local vendor liaisons in the Los Angeles area where there is the highest concentration of authorized farmers' markets, and thereby the largest WIC participant population that would have experience with this aspect of the program. Fortunately, the information that was garnered from the market manager survey regarding participant behavior can fill in the gaps created by not surveying participants directly.

The major goal of this project was to identify the barriers that have historically prevented the FVC program from succeeding and expanding. The baseline data on redemptions is provided earlier in this report in the "Project Approach" section. What follows are the challenges/impediments that were identified.

Despite the potential of the FVC program to increase the revenue of participating farmers and to provide fresh, locally grown specialty crops to WIC participants, analysis of the current redemptions of FVCs at farmers' markets and survey responses from participating farmers and market managers indicate that significant barriers stand in the way of the program's success in California. One factor is the limited number of markets authorized to date to accept FVCs. An issue in this regard is that no supplemental federal funds are provided to state WIC Agencies to facilitate the redemption of FVCs at farmers' markets. Thus, the costs of training, authorization, and monitoring markets must be paid from the general Agency administration budget.

With markets available to only a small subset of WIC participants, it is difficult for the California WIC agency to provide widespread information to participants of their opportunity to redeem benefits at farmers' markets without causing confusion among participants who lack access. Moreover, state agencies are precluded under food and nutrition service (FNS) regulations from taking actions that appear to favor one type of vendor relative to another. Publicizing the availability of redemption of FVCs in areas with participating farmers' markets could be construed as a violation of this regulation. Thus, even when participants have access to an authorized farmers' markets, they may be unaware of such markets' existence and that they are able to redeem their FVCs at those locations.

However, as results of analysis of the redemption data demonstrated, redemptions are only marginally higher in counties with one or more participating markets than the statewide average, indicating the presence of other barriers to participation. Market managers indicate that most WIC-eligible customers at their markets are not interested in redeeming their FVCs at farmers' markets (80% of market managers surveyed say "uninterested" or "very uninterested").

Another challenge may be overcoming market manager perceptions of the benefits associated with WIC authorization. Only 20% of market managers considered the FVC program important to bringing new customers to the market or increasing the sales at the market generated by existing customers. It is unlikely that market managers holding such views will actively pursue FVC authorization. As noted, however, research does suggest that participation in WIC fruit and vegetable programs does increase overall participation at farmers' markets.

Another major challenge in terms of increasing redemptions of FVC at farmers' markets is apparent dissatisfaction of WIC participants who shopped at farmers' markets with the experience, as indicated by a 76% attrition rate. One factor likely contributing to participant dissatisfaction is that under current federal regulations WIC participants must use their FVCs at a single farmer vendor. WIC regulations do not allow participants to visit a central point-of-sale location at the market and get smaller dollar-value denomination scrip or tokens to then use at different vendors at the market. Thus, depending on the market and on the farmer vendor, participants may have limited product choices (e.g., apples or grapes, but not both), further discouraging participation.

In addition to identifying the challenges, summarized above, pathways were developed for the California WIC agency and market managers and farmers to make the program more successful.

Various factors have limited market managers' interest in having their markets authorized, farmer vendors have found little benefit in their own authorization, given limited sales and a high administrative burden from participation, and most participants who have tried the program have apparently not been satisfied, given the high attrition rate revealed here. Such dissatisfaction limits the potential for the program to expand via "word-of-mouth" endorsements.

Suggestions center on achieving a "critical mass" of farmers' markets authorized to accept FVCs such that participant access is expanded, and also obtaining a greater rate FVC redemptions at authorized markets. A comprehensive strategy is necessary to solve the simultaneity of "chicken or the egg" problem of disinterest among farmers and markets because demand is so low, and lack of information and interest for participants because few markets are participating.

Additional dedicated resources from either the federal or state level are needed to support development and expansion of the farmers' market portion of the WIC Program. Program administrators currently face a tradeoff between allocating scarce budgetary resources to expansion of the farmers' market program or to other program objectives. Until the program reaches a threshold level of adoption among farmers markets wherein the state agencies can effectively publicize the farmers' market option to participants, most participants, market managers, and farmer vendors will likely remain uninformed and/or uninterested.

Because WIC participants must visit WIC clinics to pick up their vouchers, the clinic can be a source of information about farmers' markets. Responses from market managers and farmers indicate that the acceptance of WIC FVC is being advertised at participating markets and in most instances at each individual farmer stall. Yet the vast percentage of program participants likely remains unaware of the farmers' market option, even when it is accessible to them. Thus, it is imperative that information also be disseminated at the clinic level, or more broadly at the agency level, in order to make participants aware of availability of farmers' market as a choice for redemption of their FVC.

The California WIC agency has recently made some significant changes that have streamlined the authorization process, and thereby expanded the number of markets authorized and vendors approved to accept FVCs. These changes and others may merit widespread adoption among state agencies. In cases where individual farmers at an FVC-authorized market are not authorized, the market manager can now accept and redeem FVCs on behalf of the farmer who sells WIC-eligible food items to a WIC participant. Allowing market managers to act as an intermediary expands the farmers from whom participants can choose to redeem their FVCs and likely expands their product choices as well. This also alleviates some of the administrative burden and cost associated with the program from farmers' perspectives, as they no longer have to undergo training and ongoing re-authorization on an individual basis.

Ultimately, these efforts all need to happen in concert in order to generate the largest possible impact for California WIC participants and California farmers. Although the challenge is great, so too are the prospective benefits for both California farmers and WIC participants.

## Beneficiaries

The beneficiaries include California farmers who are direct marketing their WIC authorized food items at WIC authorized farmers' markets, as well as California WIC participants who will have increased access to fresh, locally grown specialty crops.

While participants are receiving FVCs at no cost, and thereby don't receive pecuniary benefits, they do stand to benefit from increased food access. WIC participants who shop at farmers' markets are able to obtain fresh, locally grown specialty crops and possibly expand the purchasing power of their FVC checks. Contrary to common perception, farmers' markets are price competitive with supermarkets for fresh fruits and vegetables sold in season. Moreover, participants may be better able to fully redeem their FVCs when shopping at farmers' markets compared to traditional retail outlets where transactions costs may present a barrier to full redemption.

Expanding the number of markets authorized to accept FVCs may also help address concerns surrounding participant access to healthy foods. Farmers' markets have the potential to expand participant healthy specialty crop options in food-desert areas. Further, research suggests that ease of access significantly affects consumers' choice to shop at farmers' markets and this will likely be a more significant factor for low-income WIC participants who are more constrained in terms of their access to transportation.

In addition to a direct expansion of sales, increased WIC FVC redemptions at farmers' markets can potentially expand the consumer base of farmers' markets. In fact studies show that the FMNP has increased participant awareness and use of farmers' markets and that farmers who participated in the FMNP program reported increased market sales. Expansion of FVC redemptions at farmers markets could have even greater influence on participants' propensity to patronize farmers' markets than the FMNP research suggests, given that FVC checks are part of a participant's regular monthly benefits and the annual aggregate dollar amount is much larger. Moreover, farmers who engage in direct marketing receive the full value of FVC redemptions whereas markups by market intermediaries decrease the farm share for FVCs redeemed at commercial retailers. For example, the farm shares for fresh fruits and vegetables sold at retail in 2013 were 35% and 27%, respectively. Thus, a farmer may receive only $2.70 to $3.50 in value when a $10 FVC is redeemed at a traditional food retailer, instead of the full $10 at a farmers' market.

The results from this work have been accepted for publication in Renewable Agriculture and Food Systems and will be in press in 2017. Thus, the conclusions and recommendations from this project are now widely available to researchers, WIC agency personnel, and farmers' market managers throughout the U.S. This is a highly visible outlet for these findings and an avenue by which decision makers in this arena will have access to this information. During the project and publication process, the Principal Investigators worked closely with California WIC agency staff that is responsible for the farmers' market program in California. It is impossible to predict with any accuracy the number of beneficiaries from this research. Potential beneficiaries include (i) researchers with an interest in food-assistance programs, (ii) officials at state WIC agencies who operate farmers' market programs or seek to implement such programs, (iii) farmers market managers who serve WIC participants or seek to serve them, (iv) WIC participants who would like to redeem fruit and vegetable vouchers at farmers markets in order to receive high-quality produce, and, potentially, more favorable prices, and (v) farmers market vendors who could increase revenues if their markets were authorized to accept WIC vouchers.

## Lessons Learned

Overall the project went smoothly and was a positive experience. Significant staff and administrative personnel turn over during the performance period of the grant made it challenging to collect data from the WIC program regarding participant purchase decisions.

Despite repeated attempts to work with the chosen agency on the development and administration of a participant survey, ultimately they were unwilling to facilitate this process. The information received from the market manager and farmer surveys, coupled with the additional analysis of the redemption data detailed in the subsequent paragraphs provided sufficient information that the integrity of the project was not compromised.

Even though the participant survey was not completed as planned, project staff secured and analyzed redemption data that could fill in the majority of the gaps in knowledge of the WIC participant experience at farmers' market. Secure more data than you believe is required to complete the project.

## Additional Information

See Attachment 1

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 14 | **Project Title:** Recovering Returns on Sonoma Valley AVA Winegrapes | |
|---|---|---|
| **Grant Recipient:** Sonoma Valley Vintners Association | **Grant Agreement No.:** SCB13014 | **Date Submitted:** December 2015 |
| **Recipient Contact:** Maureen Cottingham | **Telephone:** (707) 935-0803 x4 | **Email:** maureen@sonomavalleywine.com |

## Project Summary

Sonoma Valley Vintners Association (SVVA) represents nearly all growers/vintners in the American Viticultural Areas (AVAs) of Sonoma Valley (SV) in Sonoma County. The economy hurt returns as consumers switched to non-AVA labeled wines; the average winegrape prices for SV dropped 6.19% since 2009 due to lower wine prices. Research showed consumers pay more if they see value; a 2009 Wine Opinions study showed SV wines are well valued in the wine community but a need existed to promote Sonoma Valley wines to consumers and the trade. This project helped create economic opportunities for specialty crop producers through market development activities that focused on local, regional, or international markets. The goal was to grow consumer acceptance of premiums for SV AVA labeled wines, helping recover recent wine and grape price declines. The aim was not to increase consumption, or total sales at the expense of other growers, but to boost the demand and premium for SV AVA labeled wines and shift volume back from bulk and other lower value sales through website redesign, social media and email campaigns, and print and online ads.

This project was important and timely for the winegrape growers of Sonoma Valley; if the downward wine price trend was not reversed, winegrape growers would continue to see declining grape prices. Sonoma is an expensive area to grow grapes and bottle wine compared to many regions of the state and SV growers depend on a strong premium to remain financially viable as California specialty crop producers.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Website – The website was redesigned to increase consumer/trade engagement and interaction with the Sonoma Valley brand to optimize distribution and viral sharing of new and existing assets. The integration of the new CMS system, new content and the kick-off of the Extended Family drove more Sonoma Valley wine enthusiasts to the SonomaValleyWine.com which ultimately educated the consumer on the product and in the long term creates ambassadors and customers for life. While the program goal was to reach 45,000 unique visits per month, and an average of 15,000 visits per month was reached, this was not a fail. The improved website and engagement programs and content continue to increase the amount of time each consumer spends on the website in general and specifically on each page which ultimately drives more traffic to the individual grape growers and vintners.

Social Media – The implementation of the social media programs was another success overall. The development of content for the social media outlets to continuously tell the story of the premium product and provide an outlet for Sonoma Valley grape growers to gain exposure will ultimately elevate their prestige in the marketplace and allow them to charge more for their product. The goal for social media was to increase measurable engagement throughout all social media channels. The goals for social media

were re-assessed and revised mid-project for more realistic goals. At the end of the project, results were Facebook increased by 85%, Instagram by nearly 20,000%, Pinterest by 64% and Twitter by 58%.

Email – An email campaign to promote purchases as well as brand advocacy that nurtured relationships with wine lovers was successfully developed. The Blackboard, the title of the email that engaged the wine enthusiasts, garnered over 42,000 subscribers. A very important, yet time consuming, piece was developing the content featured in these newsletters to keep consumers engaged and interested wine drinkers to subscribe. This program was hugely successful and continues to be the most successful way for the Sonoma Valley brand to tell its story to those that will purchase the end product.

Advertising – A very successful advertising campaign ran in nationally known publications that reinforced the brand message, encouraged readers to subscribe to the email blast for current information and follow the social media channels for daily updates. This program positioned Sonoma Valley labeled wine in front of the target audience on a national level.

This project only benefitted specialty crops. The project directly and exclusively promoted of winegrapes produced by the winegrowers in the Sonoma Valley.

## Goals and Outcomes Achieved

Implemented the strategic plan for Facebook, Twitter, Instagram, Pinterest and YouTube integration of digital assets and consumer engagement that focused on increasing awareness and fan base and to support seasonal campaigns, which highlighted the grape to glass stories, personalities of Sonoma Valley winegrowers, chef inspired food and wine pairings, and contests to win trips to Sonoma Valley. For the web specifically, Extended Family was built, which is a core element of the social media campaign that allowed users to interact with the loyalty program and web application. The function of the program was for users to register, post photos of Sonoma Valley wineries and receive points for participation. The user registration was built to dovetail with the CRM (customer relationship management) system in place, and the point system was built around activity such as registering (subscribing for the database), posting a photo, sharing the photo on Facebook, Twitter, Instagram and Pinterest and referring friends (driving the subscription numbers). The web application was also built to provide tracking and reporting on users' activities tying back to the goals originally set within the road map of the social media plan. The email campaign was launched with rich content tying in and highlighting stories of the vintners, winegrowers and wine region within Sonoma Valley. The email campaign, The Blackboard, lives within the blog section of the website: www.SonomaValleyWine.com. The content was delivered through several media styles – video (posted via YouTube.com), photo slides, as well as stories.

The ultimate outcome was to increase in the average price/ton from $2,300.88 to $2,372.21 for Sonoma Valley wine grapes by 2017. As of February 2015, the average price/ton increased slightly to $2,314/ton which is the second highest return. The price per ton has increased by just under 1% in less than one year of effort.

- Website: Started in April 2014 with google analytics as the primary tracking method; unique visitors started at 1,342 with an increase of 10% (15,863) as an average per month by February 2015.
- Social Media: The following information was collected at the end of the project:
    - Instagram: 20,000% increase in fans

  - Facebook: 85% increase in fans
  - Pinterest: 64% increase in fans
  - Twitter: 58% increase in fans
- Email Campaign started with subscriber base starting at 22,000 subscribers in the database; at the end of February 2015, the Email Campaign had over 42,000 subscribers.
- Member wineries were surveyed in October 2013 to develop baseline information for visitors to wineries within Sonoma Valley. Member wineries were surveyed again in February 2015 to show an overall increase of 25% in tasting room visitation.

| Objective | Start | Proposed | Actual - Feb 2015 |
|---|---|---|---|
| Increase the average price/ton by 3.1% | $2,300.88/ton | 2,372.21/ton | $2,314/ton (increase of 1%) |
| Increase unique visitors to 45,000/mon | 1,342 | 45,000 | 15,863 (increase of 10%) |
| Increase Instagram followers to 3,000 | 26 | 3,000 | 5,250 |
| Increase Facebook followers to 15,000 | 3,004 | 15,000 | 15,000 |
| Increase Pinterest Followers to 2,500 | 300 | 2,500 | 2,500 |
| Increase Twitter Followers to 5,000 | 1,026 | 5,000 | 2,500 |
| Increase email subscriber base to 100,000 | 22,000 | 100,000 | 42,000 |
| Increase Tasting Room Visitation by 25% | 802,500 | 1,010,000 | 1,010,000(25% increase in visitation) |

## Beneficiaries

Primary beneficiaries are the winegrape growers and vintners (most of which are also growers) in the now five Sonoma Valley AVAs – Bennett Valley, Sonoma Mountain, Los Carneros, Moon Mountain District and Sonoma Valley.

Primary beneficiaries are 140 winegrape growers and 110 vintners (most of which are also growers) in the Sonoma Valley AVAs. The Sonoma Valley is a wine-tourism destination; according to the Valley Profile provided by the Sonoma County Economic Development Board, 65% of the jobs in Sonoma Valley are related to the wine industry. For every bottle of wine produced in Sonoma there is an economic impact generated in the valley, county and state. The wine and grape industry is responsible for more than 28,000 jobs in Sonoma from manufacturing, agriculture, tourism, transportation, research, restaurants and retail (source: Valley Profile by Sonoma County Economic Development Board). The impacts are both direct and indirect, from job creation and tourism to tax generation and agricultural growth; the wine industry benefits multiple business sectors across the entire Sonoma Valley/Sonoma County economy. According to the Sonoma County Tourism Board, wine-related tourism welcomes more than one million visitors to the Sonoma Valley each year, generating more than $1.36 billion annually in tourism spending. Sonoma Valley winemakers support a broad network of related industries through significant investments, long-term jobs and market opportunities in Sonoma Valley communities; accordingly every dollar spent in the Sonoma wine economy stimulates more jobs, more revenue and more taxes. The large and growing economic impact of Sonoma Valley's wine and grape industry will continue to spread across many sectors of the economy as the demand for higher value wine increases. The project objective to recover winegrape prices by 3.1% by December 2017 will increase the total winegrape value in the Sonoma Valley by over $10 million per year, a direct benefit to growers.

## Lessons Learned

Several unexpected outcomes as a result of implementing this project:

1. The Sonoma Valley AVA organization became a leader amongst other AVA groups in Sonoma County and outside of the region. Other AVA groups asked project staff to speak to their membership on the method of developing social media and online campaigns.
2. Relationships with Food & Wine magazine, a leading publication in the country in the food and wine world, were created. Those relationships continue to drive the value of the specialty crop as the perception with the consumer group continues to grow with the continued support received from the publication and key editorial staff. These relationships have also been noticed by other publications such as Sunset magazine and the Williams-Sonoma brand team, and continue to open doors for the marketing of the specialty crop and will in the future drive up the value of the product.

While increases in social media and website goals were realized, the goals were not completely achieved. Lessons learned throughout the process and when identifying metrics for social media and a website are:

1. The biggest lesson learned is that it takes an incredible amount of staff support and time to manage all contractors to ensure all programs and efforts are integrated. For example, social media should be aware of what web is doing and vice versa to gain as much benefit as possible.
2. When determining metrics, remember that results of marketing web and social exposure are measured, and the method of capturing those results are always increasing and improving. However, that doesn't mean results will be higher.
3. Any budget that has to do with social media should be increased by double. Social media is now a pay to play. In addition to advertising within the different channels, it is expensive in terms of time and talent to flip content and reallocate for each outlet. It can be very effective, though expensive.
4. Project staff found investing in content development will had the biggest return on investment. Consideration should be given to the outlets when developing stories and design materials.

## Additional Information

Links to web presence:
Website – www.SonomaValleyWine.com
Consumer E-Blast - http://sonomavalleywine.com/the-blackboard/#.VhREVd9Viko
Facebook - https://www.facebook.com/SonomaValleyWine?ref=hl
Twitter - https://twitter.com/SVGrapesWine
Instagram - https://instagram.com/sonomavalleywine/
Pinterest - https://www.pinterest.com/sonomavalley/

Extended Family is available on the Sonoma Valley Wine website: www.SonomaValleyWine.com

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 15 | **Project Title:** Food System Multipliers for Specialty Crops in the Sacramento Region | |
|---|---|---|
| **Grant Recipient:** Sacramento Area Council of Governments | **Grant Agreement No.:** SCB13015 | **Date Submitted:** December 2016 |
| **Recipient Contact:** David Shabazian | **Telephone:** (916) 340-6231 | **Email:** dshabazian@sacog.org |

## Project Summary

The economic benefits of specialty crops are often overlooked by policy makers, economic development practitioners and others due to a lack of data and tools and poor understanding of how growing specialty crops creates jobs and incomes both on and off the farm. Without such supporting data and tools, much of the economic development and planning practice in the Sacramento region to date has focused on converting agricultural land into other uses. And the few data available to document agriculture's economic output have tended to look just at the farm, not the larger food system, and did not distinguish the unique economic contribution of specialty crops.

In response, this Food System Multipliers for Specialty Crops in the Sacramento Region project not only documents the direct contribution of specialty crop farms to the Sacramento regional economy, it goes even farther to illustrate the ways in which the economic impacts of specialty crops then ripple throughout the larger regional economy through a multiplier effect. In doing so, the project has completed a set of tools and data to also test future conditions in specialty crop agriculture, helping facilitate the development of effective strategies, investments, and policies supporting specialty crop production.

Prior to this study, this suite of data and tools did not exist for Sacramento region specialty crop agriculture. In short, the project has provided the means to analyze the economic value of specialty crop agriculture from field to table, helping reinforce political and financial commitment to previously overlooked specialty crop industries.

The project is both highly important and timely. Like many other regions, greater Sacramento has faced enormous pressure to urbanize, especially in the last several decades. Indeed, in the thirty years between 1988 and 2008, the six-county region lost an estimated 250,000 acres of farmland and open space. Without an agricultural perspective and adequate tools for research and policy making, the effects of these changes have not been fully understood and, in many cases, not appropriately addressed.

Yet after decades of planning and policy focusing primarily on urbanization, the role of specialty crop agriculture is witnessing a renaissance in the region. In 2008 the Sacramento Area Council of Governments (SACOG) launched the Rural-Urban Connections Strategy (RUCS) to bring to the forefront how the Sacramento region can leverage, preserve and better manage its rural assets to create new economic value. As this and many other vital efforts have taken hold, the region stands in need of a corresponding and appropriate set of tools to consider specialty crop agriculture on par with other economic uses.

The project could not be timelier in that the region's economic development entities have now come full circle to recognize specialty crop agriculture and its contribution to the regional economy, yet lack the tools and data

to develop effective strategies and policies supporting investment in specialty crop production and infrastructure. This project responds to that gap, helping position the region to better capitalize on the recent resurgence of support for specialty crop agriculture in metropolitan Sacramento. This work focused on specialty crops in the Sacramento region also may help enhance the marketability and competiveness of specialty crops for all California producers by serving as a case study for similar issues in the state.

The project built on work funded by 2011 Specialty Crop Block Grant Program Project 39: *Food Bank as Food Hub: Building a Local Food Systam*, which delved into the economics of infrastructure to support specialty crops produced for the local market. That project's food hub assessment calculated the number of jobs created at a single food hub facility, but due to the unavailability of sufficient tools did not develop the connection from the facility to increased production levels on supplying specialty crop farms, and to further the economic activity generated by the food hub. Likewise, the case study component of the project noted the substantial increase in economic returns from local specialty crop production, but did not then link this increased farm output to the larger specialty crop cluster. The work of 2011 SCBGP Project 39 helped lay the foundation for this project by exploring individual elements of the specialty crop value chain. This Food System Multipliers for Specialty Crops in the Sacramento Region project enhanced that previously completed work by connecting the specialty crop farm to a larger specialty crop cluster, to show the full economic contribution of specialty crop production.

## Project Approach

The project's work plan consisted of three primary tasks: data collection, specialty crop stakeholder outreach, and model development to produce economic impact multipliers. First, the project undertook an unprecedented data collection effort, including over 100 interviews with local specialty crop farmers, processors and distributors. The project team also delved into numerous supplemental data sources to complement the primary data collection. The team held a series of survey workshops with specialty crop producers, processors and distributors in developing the primary multiplier data, which formed the cornerstone of the outreach component of the project. The project also conducted outreach with policy makers and the economic development community to better demonstrate how they too are specialty crop stakeholders. Finally, the team incorporated the data collection and outreach findings into a set of integrated modeling tools to produce a series of multipliers for current and various future conditions in the specialty crop cluster. The project's final deliverables (included in attachments) discuss in much greater detail the substantial work performed to complete these tasks. The Specialty Crop Cluster Assessment: Sacramento Region deliverable delves into the economic data collection to connect specialty crop production to core specialty crop processing, support and distribution industries. The technical Food System Multiplier for Special Crops in the Sacramento Region deliverable describes outreach with local specialty crop growers through the project survey instrument, and then defines the modeling activities leading to the project's final multipliers. The project's Executive Summary deliverable is meant to complement these two technical deliverables with a less technical, more policy-oriented explanation of project work and findings.

The project provides an in-depth portrayal of the specialty crop value chain that was previously unavailable within the region, producing a series of significant results. The results begin with economic indicators for specialty crop farms, the foundation of the larger impact of the specialty crop agricultural system. Overall, there are nearly 11,000 (full time equivalent) jobs on specialty crop farms in the Sacramento region that produce food worth $1.5 billion each year. The economic impact of this regional specialty crop production has soared to record levels in the past several years—between 2008 (the beginning of the recent national

recession) and 2014 (the latest year with data), the value of the regional specialty crop production doubled, far outpacing the regional economy as a whole. This outcome leads to more wealth and economic opportunity within the region, as well as more jobs. While most sectors of the economy have still not returned to their pre-recession employment levels, specialty crop farmers in the region have added around 800 jobs. Indeed, specialty crop production has been a leading driver in the region's recovery from the recent recession.

While the look at specialty crop farms shows significant findings on the growing economic importance of specialty crops to the Sacramento regional economy, the project's multiplier analysis shows how this is just the first step in a much larger specialty crop food system. The full specialty crop cluster in the Sacramento region consists of 17,200 jobs and $1.2 billion in annual value add. The multiplier model then estimates over 31,000 jobs created by specialty crop businesses, $2.4 billion in value add contribution each year to the regional economy, and almost $6 billion in total output value. From an economic multiplier perspective, this translates into an employment multiplier of 1.82 (every job in specialty crops generates another 0.82 jobs in other areas of the regional economy), and a value added multiplier of 1.90 (each dollar of the specialty crop cluster's direct contribution to gross regional product also generates $0.90 in additional value added across other industries).

Major accomplishments in the project include the successful development of a highly technical specialty crop modeling toolkit that provides an unprecedented level of data and economic findings tailored to a lay and policy-oriented audience. Secondly, the project has accomplished its outreach goals with specialty crop stakeholders, including growers themselves, but also new groups such as policy makers and economic development professionals who now better understand how specialty crops are an economic driver in the region. Furthermore, the project has been able to demonstrate how specialty crop jobs are widely spread throughout the region, so that all jurisdictions—both rural and urban—gain economically from this vital cluster.

Next, the project has made major findings concerning default methods to measure specialty crop agriculture that apply not only to this study, but to economic impact analysis in general. The project finds that the default 'IMpact analysis for PLANning' (IMPLAN) model, which is the most widely used economic model to estimate multiplier effects, does not accurately characterize expenditure patterns for specialty crop industries in the Sacramento region. In particular, an in-depth evaluation of the data underlying the IMPLAN model identified that key parameters for specialty crop agriculture are based on national benchmark data provided by the Bureau of Economic Analysis (BEA). As such, the default IMPLAN model multipliers are not representative of specialty crop agriculture in the Sacramento region. Instead, this project drew on a customized model based on surveys and supplemental local data to produce multipliers that more accurately represent the region's specialty crop system. For example, the project team found the base default multipliers underrepresented the actual contribution of specialty crops in the Sacramento region by upwards of 20 percent, depending on the measure. This undercounting translates into thousands of specialty crop jobs and hundreds of millions of dollars not accounted for using the default data. This finding affects not only prior analyses conducted on the Sacramento regional economy, but likely any other application of the default model to measure specialty crop agriculture in the region, California, or nationally. Finally, the project discovered several limitations in creating custom sectors in the base IMPLAN model which also would affect other economic impact analyses. This highly technical finding is explained fully in the project's technical appendices.

In short, the project has produced a surfeit of data, indicators and findings that more accurately describe the larger economic contribution of specialty crops in the Sacramento region. The project also produced recommendations for future work that would use standard economic impact models. Finally, the project recommends future work to expand the analysis of the specialty crop food system to include wholesale, retail, and consumption activities.

The project's scope clearly limited analysis and project work exclusively to specialty crops. To include only specialty crops for data analysis, the project developed and then implemented a methodology combining standard industry classification coding with the project's customized model to focus solely on specialty crop industries. First, the project organized incoming data by relevant North American Industry Classification System (NAICS) codes. NAICS is the standard grouping scheme used by federal statistical agencies to categorize business establishments and collect statistical data related to the economy. The first step project staff took was to group those NAICS codes at the most detailed level that were exclusively specialty crop, and remove all NAICS codes with no specialty crop activity. While this step helped organize the vast majority of the 1,100 industry codes, several industries remained that included both specialty and non-specialty crop activity (for example, farm labor contractors are organized in NAICS into a single industry that includes business services provided to specialty crop producers, but also other crop production). To isolate the specialty crop component of these industries the project team used the primary and supplemental data developed over the course of the project to model and thus isolate only specialty crop activity for analysis. The appendices to this project's deliverables include a further explanation of this technical methodology. The result was that specialty crop, and only specialty crop economic activity was included in the project, so that funds were used to solely enhance the competitiveness of specialty crops. While this result is important not only in meeting the requirements of the grant program, but also supporting specialty crop production, the project team believes it is important to note that total agricultural production was not studied therefore total industry impacts are still likely being underreported due to the aforementioned limitations of the IMPLAN model.

The regional partners made essential contributions to the success of this project. Partners in the economic development community (such as Valley Vision, Sacramento Metropolitan Chamber of Commerce, and Greater Sacramento Area Economic Council) provided a key bridge to expand upon outreach activities. In turn, this project also provided a bridge back to economic development practitioners, showcasing specialty crops as a regional economic driver and providing the data and indicators to substantiate. The Los Rios Center of Excellence provided a highly detailed Economic Modeling Specialists International (EMSI) dataset on the six-county SACOG region covering the period of 2008 to 2014 which was invaluable in showing the growth of specialty crop industries through time.

Next, through survey workshops the region's specialty crop growers, processors and distributors provided the primary data that was vital to present this more accurate portrayal of the regional specialty crop cluster. This contribution of local specialty crop proprietors was the essential element that underpinned the economic model. Finally, the project team also worked with researchers at UC Davis who shared both survey instrument and aggregate data, which helped this work more efficiently hone in on segments of the specialty crop cluster not covered in other data sources. Likewise, elements of the UC Davis survey instrument were incorporated into the data collection survey, which saved development time which could then be spent on other project work.

## Goals and Outcomes Achieved

This project has been an essential element in SACOG's RUCS program to provide data and tools and build capacity so that rural and agricultural issues are treated on par with urban and other economic activities. To move toward implementation of this goal, one of the measurable outcomes was of a total of 100 specialty crop establishments participating in the project. The project exceeded that goal, working with 116 specialty crop growers, processors, distributors or support groups to acquire detailed primary data on the connections in the region's specialty crop cluster (these 116 groups have each participated multiple times, leading to a total of 307 direct project communications with specialty crop businesses). As part of this outreach, the team has also developed and conducted a survey to serve as a benchmark on the regulatory role in specialty crop economic output. The team also surveyed local jurisdictions at three points in the project through presentations to local elected officials representing both rural and urban jurisdictions.

Further outreach efforts build out the work to meet the performance goals and expected outcomes. The project team has worked with diverse organizations such as UC Davis, Valley Vision, GSAEC (Greater Sacramento Area Economic Council), the Metro Chamber, and the Los Rios Center for Excellence to explain the role of specialty crops as a driver of the Sacramento regional economy. Examples of the audiences of these presentations include participants at the National Good Food Network conference held in Atlanta, Georgia (400 participants), a regional workforce convening around the food system (50 participants) and local elected officials in the six-county Sacramento region (15 participants).

This project has been a critical component of SACOG's long term effort to support and enhance specialty crop viability in the Sacramento region as an economic development strategy that embraces agricultural heritage and capitalizes on food system capacity. SACOG will continue to disseminate, share, and work with specialty crop farmers, stakeholders, investors, economic development practitioners, and policymakers to leverage these new tools, data, and capacity in support of the region's specialty crop agriculture sector.

The goals for this project included final calibration and validation of the economic model; model documentation and scenario results; final deliverables describing project outcomes in non-technical language; and, presenting project findings to the various stakeholder groups developed through this project. First, the project completed an integrated toolkit that quantifies the economic impact of specialty crops from farm to table. Next, the project produced three deliverables to summarize the toolkit methodology, data collection, and findings. The first two of these deliverables are more technical in nature, describing the specialty crop cluster of production, processing, distribution, and support, and also the multiplier effect of the cluster. A final executive summary deliverable synthesizes project results using non-technical language. Finally, as discussed above in the performance goals section, project staff have worked to share these important results with a broad group of stakeholders. Key to the project communication strategy has been engagement with the region's economic development community, as the project has provided highly detailed and previously unavailable data and tools to document the economic impact of specialty crop agriculture.

Prior to this project there was no economic multiplier specific to specialty crop agriculture in the Sacramento region. Yet the project went much further through its primary data collection to more accurately describe specialty crop industries and their multiplier compared to default modeling techniques and data. For example, the project found the multiplier for the region's fruit farming to be 20 percent higher than default model outputs that use base input data. Other examples of how the project more accurately describes specialty crop multipliers compared to default base data include tree nut farming (25 percent higher), vegetable farming (21

percent), nurseries (5 percent), olive oil mills (17 percent), tomato canning (5 percent), and produce shippers (4 percent). In all, the project developed over 20 custom specialty crop industry multipliers. Together, these specialty crop industries show the full economic impact of specialty crop agriculture and provide the baseline data for the project—over 31,000 jobs, $2.4 billion in annual value add, and $5.8 billion in total output value each year to the Sacramento regional economy. In multiplier terms, this translates into an employment multiplier of 1.82 (every job in specialty crops generates another 0.82 jobs in other areas of the regional economy) and a value add multiplier of 1.90 (each dollar of the specialty crop cluster's unique contribution to gross regional product also generates $0.90 in additional value added across other industries).

The data developed as part of the project has also helped show progress toward achieving targets of supporting sustained economic growth and job opportunities in the region's specialty crop cluster. In addition to employment gain, the value of regional specialty crop production has also grown despite the recession, as specialty crop production grew by over 100 percent in total value between 2008 and 2014. Even when adjusted for inflation, this remarkable growth far outstripped the larger regional economy. Indeed, specialty crops accounted for 95 percent of the growth in total agricultural production value in the Sacramento region during the study period. Looking forward, SACOG will continue to track employment and value indicators to measure progress in supporting the specialty crop cluster.

The first successful outcome of the project is the completion of a single integrated economic model that measures the larger economic impact of specialty crop production. This analytical framework and tool did not exist prior for specialty crops in the Sacramento region. The tool has national significance since the IMPLAN model was dissected and re-specified to more accurately describe the economic contribution of specialty crops in the region, with an increase in multiplier estimates upwards of 20 percent over default model data depending on the industry. Overall the project's custom model estimates over 31,000 specialty crop jobs in the Sacramento region. These jobs lead to nearly $6 billion in sales each year in the regional economy. The work also shows how employment and output value in these specialty crop industries has been growing the last several years, a finding even more notable in that this period coincides with a major economic recession. Finally, the project has been successful in its outreach, surpassing the goal of engaging 100 specialty crop stakeholders directly through the workshop survey instrument, with another estimated 500 stakeholders engaged through project outreach efforts.

## Beneficiaries

This project and resulting tools benefit specialty crop farmers, processors, distributors and others participating in specialty crop markets given the significant improvements to the IMPLAN model and its ability to better represent the economic and employment activity related to specialty crop production. The tools developed through this project demonstrate a valuable asset to public and private stakeholders by providing the needed data to first highlight the overlooked and significant economic contribution of specialty crops to the Sacramento regional economy, and then facilitate the development of effective policies and strategies that support specialty crop agriculture. The first of beneficiaries consist of the region's 1,200 business establishments that grow, process, distribute and provide support functions for specialty crop production. Through this project these businesses have updated data to better showcase the important impact of their activity in supporting further jobs and economic growth in the larger economy. This information is also of use for the region's economic development and policy makers. By better demonstrating the economic impact of specialty crop lands and related food industries, there can be more incentive by these stakeholders to invest in specialty crop production and food chain infrastructure, in turn enhancing the marketability and

competiveness of specialty crops. In particular, the region's larger economic development entities benefit from this updated work. Three key project partners that benefit from the project and embody the renewed focus on specialty crop agriculture include the Greater Sacramento Area Economic Council, the Sacramento Metropolitan Chamber of Commerce, and Valley Vision. Additionally, through SACOG's Board of Directors the study spreads the data and outreach efforts to local elected officials and economic development departments, providing the tools and updated analytics to help inform data-driven decision making. this project and resulting tools benefit farmers and others participating in specialty crop markets given the significant improvements to the IMPLAN model and its ability to better represent the economic and employment activity related to specialty crop production.

The work affects nearly 1,000 specialty crop growers, processors and distributors, 1,200 business establishments, and 31,000 related employees in the specialty crop cluster. The region's six agriculture commissioner offices, five farm bureaus and five farm advisors all benefit from the study with improved data and analytics. Yet unlike prior agency work, this project has expanded the focus of specialty crop agriculture from the farm to the full value chain. As such, the study also benefits the local economic development practices of the 22 cities and six counties within the Sacramento region.

The economic impact of the project has been stated above—better demonstrating the economic contribution of the over 30,000 jobs created by regional specialty crops. In addition to describing current conditions, the project also provides a series of scenarios to forecast future economic conditions in the cluster. For example, the study estimates the increase in jobs, value add and taxes by attracting a peach processing facility in the region. The project's integrated tools show how more economic activity that currently flows out of the Sacramento region could stay in the area if this hypothetical scenario is implemented, with a net increase of 600 jobs and $146 million in total output value. Notably, these 600 additional jobs consist of employment opportunities across the region, be it on the farm, at the processing facility or in the community in general. This one scenario can be expanded upon in future work to show even further job creation and economic growth opportunity from investments in the regional specialty crop food system.

## Lessons Learned

Overall this project has been critical in SACOG's efforts to support data-driven decision making and investments benefiting the regional specialty crop food system. The first lesson learned is that expanding the focus of the impact of specialty crop production from just the farm to the larger multiplier effect greatly increased the interest, relevance, and number of partners participating in the project. Through this project, the project team have been able to demonstrate the job and economic value of specialty crops to both rural and urban communities in the Sacramento region, in turn helping raise the regional understanding of the economic contribution of specialty crops to be on par with other segments of the regional economy. Securing the interest and buy-in of the larger economic development entities improved project outreach efforts, allowing the project team to also tap into the larger network of these agencies. Likewise, the team reached out to local associations and farm bureaus before implementing survey workshops to build credibility in the specialty crop grower community. While this effort did help, the team did find it challenging to collect the detailed primary data from local specialty crop proprietors needed to underpin the study's customized model. This finding is not surprising given the time commitment and sensitive nature of financial data compiled through the data collection. It is important to note the resources expended by the project to secure the necessary specialty crop grower response. To mitigate this challenge and assist in the data collection effort, the project team engaged in two important tasks that ultimately improved efficiency. First, the project worked with researchers at the

University of California, Davis to access recently completed survey data on specialty crop growers in the four counties of Sacramento, Yolo, Yuba and Sutter. Next, the team worked with partners at the community college system to access an aggregated data set providing a time series of specialty crop industries back to 2008. These activities highlight not only the outreach value of building partnerships but also the potential to leverage partner resources and research for a more efficient use of project resources.

One negative result for the project was the finding that the base IMPLAN model data for the Sacramento region does not accurately describe the economic impact of specialty crops. To combat this shortcoming in the standard model data, the team shifted final calibration and the project's scenarios to the project consultants. This shift led to a more efficient and effective use of project resources. On a related note, through the project's final deliverables the project team worked hard to develop language, graphics and summaries that describe the mountain of highly technical methodologies and results in a non-technical framing, which continued to be a challenge for the project. Improvements were made in this area, though future work can continue to refine the key takeaways and findings for a broader audience.

The key unexpected outcome, as mentioned above, is that the base data used in the default IMPLAN model for the Sacramento region does not accurately describe the role of specialty crops in the regional economy. This finding is surprising in that the IMPLAN model is the most widely used economic multiplier model across sectors and industries. An in-depth evaluation of the data underlying the IMPLAN model identified that key parameters for default data come from national benchmark data coming from the BEA. While IMPLAN utilizes detailed county-level data to define the output values associated with given industries, the model estimates total value added based on the national benchmark data, not localized data. As such, the model's trade flows are imposed on the specialty crop agriculture sector in the Sacramento region, while the survey of specialty crop businesses found that these national averages are significantly different than actual practices. To overcome this issue the project team has created custom specialty crop sectors in the project's model that draw on local primary and supplemental data. However, future analyses using the IMPLAN base data should consider this issue. Overall, this unexpected outcome has state and national implications of how specialty crop agriculture impact analyses are conducted.

The goals and measurable outcomes laid out at the onset of the project have been met.

## Additional Information

The project's three deliverable are attached as part of this final report. First, the Specialty Crop Cluster Assessment (Attachment 1): Sacramento Region defines the core specialty crop cluster of production, processing, support and covered distribution industries. Notably, this cluster definition does not include the economic activity of specialty crop food at the point of consumption, be it restaurants, grocery stores, or institutions. Also, the distribution activities covered in the cluster are limited to those industries with sufficient data. The companion Sacramento Region Specialty Crop Multiplier Study deliverable estimates a multiplier effect for this cluster definition. Each of these technical deliverables contain the methodology and appendices explaining the project's data collection and analysis efforts. To translate these technical findings for a more lay audience, the project team has also completed an Executive Summary (Attachment 2) that synthesizes project work into a more graphically oriented story framing. Finally, the project has produced an updated and customized modeling toolkit (Attachment 3).

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 16 | **Project Title:** Inbound Marketing and Mobile Gardening Application | |
|---|---|---|
| **Grant Recipient:** California Association of Nurseries and Garden Centers | **Grant Agreement No.:** SCB13016 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Chris Zanobini | **Telephone:** (916) 448-3900 | **Email:** chris@agamsi.com |

## Project Summary

The purpose of this project was to reach a younger demographic of novice gardeners and non-gardeners in order to promote the benefits of gardening and develop a sustainable market for California nursery crops, as older more avid gardeners downsize and spend less on landscaping. While the benefits of gardening (creating wildlife habitat, growing your own food) were qualities that resonated with Millennials, as a group they did not have as much experience with or exposure to gardening first-hand. Retail trends show that today's consumers make most of their purchases online or via mobile devices. Due to the nature of the nursery business and the variability in product selection this is not an ideal business model. Therefore, this project aimed to attract and introduce gardening to a new set of consumers through the utilization of modern marketing techniques and mobile media.

The nursery industry was utilizing traditional "outbound" marketing messaging platforms such as television, radio and direct mail at a time when consumers purchasing behaviors were shifting. Consumers often researched plants and products before making a decision. An overwhelming number of consumers use the internet for this research, on PC's at home and an increasing number from mobile devices. In order for the nursery industry to engage with these potential gardeners, it was important to reach them where they already "lived," on mobile devices. Also, the timing of this project became even more pertinent due to the negative impact of the California drought on nursery crop sales through gardening limitations and uncertainty created by watering restrictions and public messaging to limit outdoor water use.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Before development began, social media research and data mining was completed to determine the campaign content that would best resonate with the target audience. A consultant analyzed over 1 million conversations related to gardening across online news sources, blogs, forums, and social media platforms, taking into account the keywords and hashtags used, whether the tone was positive or negative and how influential the author was. The survey revealed which topics were trending or emerging and informed the project selection.

The California Association of Nurseries and Garden Centers (CANGC) and the consultant were able to apply these results directly to the next phase of the project and developed the garden projects listed below with a focus on 'Do it yourself' (DIY) and options for gardening in small spaces. Each project was accompanied by a one to three minute video tutorial, materials list, and step-by-step instructions. Videos were conceptualized and shot to bring each garden project to life in order to capture the attention of users on social media and drive them to read more.

The content was tailored to offer the most relevant information for young, urban novice gardeners in California. Affordable DIY gardening projects such as *How to Make a Vertical Herb Garden* suit the needs of urban dwellers. Garden tips such as *Healthy Soil* and *Fertilizer Basics* offer useful information to address the concerns of younger novice gardeners. Some of this content, such as *Irrigation: When & How Much to Water*, highlighted water wise gardening practices which became increasingly important during California's fourth year of drought.

Projects included:

- Create a Small Space Butterfly Garden
- Plant Your Own Cocktail Herb Garden
- How to Plant a Small Space Vegetable Garden
- Convert Your Patio Garden to Drip Irrigation
- The Incredible Edible Patio
- How to Make a Vertical Herb Garden
- Make Your Own Container Water Garden
- Growing Citrus in Containers
- How to Host a Succulent Garden Party
- How to Maintain Your Garden Organically
- Houseplants that Clean the Air

New gardening projects and tips were conceptualized and developed in 2016. This new content aimed to encourage return visitors and keep the audience interested, each of the projects also had an accompanying video. These projects included:

- Creating a Hummingbird Habitat
- Recycling indoor water in the garden
- Growing edible flowers

Tips included:

- Vertical gardening
- Water wise plants for California
- Avoiding and controlling invasive plants

Social media platforms (Facebook, Pinterest, and YouTube) were established and the mobile application (app) development were completed in the first year of the project once the inbound marketing campaign had been developed. The mobile app, Plantable, was launched in June 2014, slightly behind the originally planned launch date of March 2014 due to a longer than anticipated development phase. Within that same year the competing mobile app, GrowIt! was also launched which focused on gardening socially, offering a similar platform to Plantable. This unforeseen competition offered a more advanced social engagement component, which, coupled with an overall smaller pool of app users provided unforeseen challenges to growing Plantable's mobile user audience. Despite using social media research and data mining to inform the campaign delivery mechanisms in order to promote California nursery crops and hit the target millennial demographic, initial media outreach did not return anticipated audience reach or engagement. Therefore, the

project team began to place a greater focus on providing enticing and relevant content for the projects various media outlets.

CANGC partnered with CA GROWN to have a Plantable booth in the CA GROWN Pavilion at Sunset Magazine's Savor the Central Coast event in September 2014. An estimated 10,000 people attended this event where the project team promoted Plantable and the corresponding social platforms. The team also collaborated with the Sunset Magazine garden editor, and incorporate Plantable's project focused on installing drip irrigation systems to help consumers protect their plants and save water during California's historic and continuing drought into their gardening education program.

This project solely enhanced the competitiveness of California nursery crops.

Plantable's progress and launch was communicated to the CANGC Board on various conference calls, as well as to members in the CANGC newsletter. Partnerships with CA GROWN and Sunset Magazine helped to increase Plantable's exposure to new audiences on social media and at events. The consultant performed the data mining, set-up social platforms, met with industry, set-up a website and developed the iOS app and gardening content.

## Goals and Outcomes Achieved

The primary expected measurable outcome of this project was increased sales at California retail nurseries. Creation of social media platforms for the California nursery industry increased the visibility of gardening, and offered a voice to communicate the benefits that plants provide. These platforms became increasingly important as people with limited knowledge of the critical benefits of gardening to both humans and wildlife, faced the challenges brought on when gardening during a drought with a for limited water use on landscape.

The garden projects developed for Plantable resonated with the target audience as intended, with an emphasis on young, mobile users in California. 59% of users were within the target age group of 25 – 54 and more than half of those users were under 44. Over half of the views were on a mobile device, demonstrating the projects overall success in reaching mobile users in spite of the app's setbacks. The top ten cities with the most visitors to the site were located in California. The insight gained from the initial research continues to inform CANGC's outreach strategy.

This project also assessed its reach to the public by measuring website and social media traffic as well as mobile app use. Visits to plantable.org increased significantly once social media platforms were established in April 2014, Facebook remained the top referral source. After the home page, the Projects page was the most visited followed by the 'Find a Nursery or Garden Center' locator. September 2014 saw the most visitors to the home page per month. While the mobile app was not as successful as hoped, there was however, a considerable spike in downloads when Plantable was promoted at Savor the Central Coast during the last weekend of September 2014. Facebook was the primary social platform utilized reaching 113 pages liked in the first three months. To date the Facebook page reached 215 likes. Since the YouTube channel was created in May 2014, there were 2,647 total views of the gardening project videos. Two of the most popular videos included, *How to Make a Vertical Herb Garden*, and *How to Make a Patio Water Garden*. As of this report, the Pinterest page had 269 followers and 140 likes and a steady growth. With no advertising budget, all reach on social channels was organic.

Progress was made toward reaching the long-term goal of introducing non-gardeners to the benefits of planting. Based on the anecdotal responses received on social media and in-person at events, millennials have been inspired to try gardening through fun, approachable projects that engaged them to learn more and set them up for success.

Engagement with potential gardeners was successful through social media, a key component of the proposal. Engagement on the mobile app which was anticipated to be a large driver of audience growth, did not materialize as planned. The multimedia content created hit the mark with younger and less experienced gardeners without a lot of space, time or money. To further the project, videos and photos were created in order to enhance the available content and bring garden projects to life to continue to spark an interest in gardening with Millennials. The project team successfully executed strategic outreach at partner events, increasing the reach to their more established audiences.

CANGC received plant sales data from retail nurseries during the year preceding the launch of Plantable.org (June 2013 – June 2014) and the year following the launch (July 2014 – July 2015). Based on retail sales data, the average total plant sales decreased by approximately 2%. While not achieving the goal of a 3.3% increase in nursery sales, this decline was indicative of California entering its fourth year of drought the year following the launch. The Governor's Executive Order mandating watering restrictions went into effect on April 1, 2015, at the beginning of the spring quarter, which impacted what was typically the industry's strongest quarter thanks to a spike in planting. Subsequently, the California nursery industry experienced stronger sales, thanks to more rain which lead to a lift on mandated restrictions and greater confidence in the availability of water for landscape. Without the efforts to market nursery crops to a younger demographic, it is expected that the decrease in sales would have been more significant.

The content created for Plantable was a major driver of audience growth and engagement and an asset for retail nurseries. The gardening projects inspired novice gardeners to consider incorporating plants into their lives and the videos drove users to learn more about the projects. The high resolution photos of each gardening project, plants and gardening equipment were also essential to promoting gardening visually.

## Beneficiaries

The primary beneficiary of this project were California retail nurseries, wholesale nurseries also benefited indirectly. It was learned that smaller independent garden centers without the resources or budget for marketing, were most likely to share the gardening projects.

Based on feedback from CANGC members, this project benefited many of the 10,000 California nursery locations by reaching new customers.

## Lessons Learned

One lesson learned was the importance of being able to adapt to unforeseen developments. The drought had not fully materialized when this project proposal was written; as a result, the project concepts were updated to reflect increased awareness and limitations on irrigation.

Another lesson learned was the need to incorporate a funding source for promotion for any future marketing projects. This project enabled the development of content and platforms for inbound marketing of gardening, but did not provide resources to promote these unknown resources to California consumers. For example,

Facebook algorithms shifted since the beginning of this project to where pages now have to "pay to play". Essentially organic reach is very limited for page posts, requiring regularly boosting posts with core content to guarantee engagement.

The Plantable mobile app was not as successful in the marketplace due to the launch of a similar app, GrowIt! with more social engagement components and an overall smaller pool of app users. At the time of this project proposal no gardening apps existed and the mobile app market had not yet peaked, so these challenges were unforeseen at the beginning of this project.

## Additional Information

Please find links to the Plantable home page, a description of the mobile app and social media properties respectively.

1. http://www.plantable.org/
2. https://itunes.apple.com/us/app/plantable/id888430089?ls=1&mt=8
3. https://www.facebook.com/Plantableapp/
4. https://www.youtube.com/channel/UC9vMKnrUVEybARbFmvA0Wpw
5. http://www.pinterest.com/getplantable/

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 17 | **Project Title:** California Farm Academy Incubator Program Development | |
|---|---|---|
| **Grant Recipient:** Center for Land Based Learning | **Grant Agreement No.:** SCB13017 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Mary Kimball | **Telephone:** (530) 795-1520 | **Email:** mary@landbasedlearning.org |

## Project Summary

The purpose of this project was to fulfill a critical industry need to recruit, train and support new and replacement specialty crop growers. In addition, this project meshed with an incredible opportunity for California farmers to fill direct and niche markets and meet consumers' growing demand for fresh, affordable regionally grown produce.

The promotions of the food system, along with projections by the Sacramento Area Council of Governments that the region's population will double by 2050 point to both the need and opportunity for specialty crop growers to provide more food locally. Given that the average California farmer is near 60 years of age, it is clear that there is a need for new farmers to meet this increasing demand over the coming decades. The proposed California Farm Academy Incubator Program Development project increases the capacity of the Center for Land-Based Learning (CLBL) to support the farmers that go through their high quality training program. The expanded and strengthened California Farm Academy (CFA) Incubator program will provide additional land, staff, equipment and market opportunities to beginning farmers during their most vulnerable early years of farming as they develop their production and marketing skills.

This project would actively publicize and recruit qualified prospective specialty crop growers, and train new farmers with the necessary knowledge and skills in sustainable food production, and provide them with access to affordable land, equipment and ongoing technical assistance; identify and help develop additional regional markets for beginning growers, including researching branding opportunities; and assist new farmers in increasing their sales and distribution to a greater variety of local consumers.

The average California farmer is approximately 60 years old and it is clear that a need for new farmers to both revive the aging farmer population, and also grow and take advantage of the ever increasing demand for locally grown produce. There is a diverse demographic of prospective farmers who would like to farm but lack the resources, especially raising specialty crops and value-added products for local and regional markets. The California Farm Academy Incubator program provides the training and support that is needed to become full-fledged farmer and make farming goals into a reality. It is prospective farmers as such, who will help to revive an aging farmer population and strengthen the Sacramento regions food system.

The CFA was built upon the 2010 Specialty Crop Block Grant Program (SCBGP) Project 32: *Sacramento Valley Beginning Farmer Training and Incubator Program.* This project purpose was to educate, mentor and provide land opportunities for the next generation of specialty crop producers. In the 2010 SCBGP project, CFA established the specialty crop Training Program. The seven month program included classes, workshops and farm tours (theoretical component and guided on field sessions (experiential component)). Also the program provided the first steps which were necessary to an aspiring beginning farmer that would enter the farming industry. The current incubator project, through the support and services it provides, was the natural

next step. The experiences from the 2010 SCBGP project were put into practice in the current incubator program. In encouraging the participants to run self-owned farm enterprises, the project team was able to put into practice the learnings from the 2010 project.

## Project Approach

Work Plan Activities Accomplished:

| Activities | Results/Accomplishments | Notes |
|---|---|---|
| Recruit, review crop plans and business plans of prospective incubator farmers (2014 and 2015 seasons) | Reviewed 38 prospective incubator farmers crop and business plans | Twenty training farm participants in 2014.<br>Eighteen training farm participants in 2015. |
| Identify and lease (or receive in-kind) additional acreage for CFA Incubator farm | A total of 16 acres of land was leased to CFA for the incubator farm program. | |
| Complete and/or renew 2014 and 2015 incubator farmer licenses | The program has grown from four farmers in 2013 to 22 farmers in 2016. Leases have been signed with all of these farmers. | |
| Conduct market research and assessment | Fourteen produce buyers and five farmers interviewed for the research. Research results helped to develop and establish 36 market linkages that included farm stands, farmers markets, and chef/grocery stores | Research findings were presented at the CFA advisory board. Research report (Attachment #1). |
| Purchase supplies necessary for additional incubator site(s) | Sixty-five tractors leased (In-Kind Lease).<br>Chisel plow, walk behind tractor (In-kind donated) and small tools purchased.<br>Irrigation system put in place at all sites – One in Winters, one in Davis and four in West Sacramento. | |
| Report on incubator program successes and challenges at regional winter conferences | The incubator program concept presented at Eco Farm conference, California Small Farms conference, Farmers Veteran Coalition conference, Farmers Guild meeting and at the National Incubator Farm Training Farm Initiative (NIFTI) annual conference. | |
| Ongoing training, supervision and support of Incubator farmers | Advanced training workshops, monthly meetings, as well as individual check-ins with each incubator farmer to assess goals, and offer continued training was completed. | |

| Activities | Results/Accomplishments | Notes |
|---|---|---|
| Daily logistics, repairs, scheduling, trouble-shooting, and answering production questions | Daily logistics, repairs, and troubleshooting, by Program Manager greatly increased the effectiveness of the program, and the success of the farmers. For example, a Food Safety Plan was completed for the farm site as a model for incubator farmers. | |
| Market, sell, distribute specialty crops to local, regional and under-served markets | Marketing relationships developed by incubator farmers, as well as the CFA.<br>Ten major buyers buying or committed to buying from incubator farmers. | Market research was useful in identifying buyers and markets |
| Present findings of Beginning Farmer Market Assessment | The Graduate Student Researcher presented the findings of the marketing study to the CFA Advisory Committee. This study, final report, and supporting documents were distributed to the incubator farmers and were extremely useful for them to approach new sales venues. | Research Report Completed (Attachment #1). |
| Assist Incubator farmers who are ready to transition to off-site farms, ag jobs or own farmland | Incubator farmers transitioning out of the program were met with individually in an exit interview in which additional areas of support were clearly defined. Farmers were encouraged to reach out to program staff for support, and staff continues to assist farmers when needed. | Exiting farmers have bought property, transitioned into farm management positions, and leased acreage nearby. |
| Identify and develop 2-3 of marketing and/or branding opportunities identified by Graduate Student Researcher | Developed relationships with major grocery stores, farmers markets, food banks, and restaurants. | Farmers have started to supply produce to grocery stores, 850 pounds total. Three farmers participated in a farmers market in 2016. 3,000 pounds supplied to food banks. Three farmers supplying produce to a farm shop. |

| Activities | Results/Accomplishments | Notes |
|---|---|---|
| Conduct incubator program evaluation and improvement | A comprehensive survey of all program participants was completed. Additionally, a program evaluation, final report, and a final meeting with each participant is accomplished each year, and improvements are made to the program. | The evaluation is an ongoing process and helps CLBL to guide program participants towards the right direction, such as areas which need improvement in production, right scales and types of markets necessary. Evaluation also helps the program in terms of how to do effective initial screening to identify participants who will be successful. It also helps to streamline the services CFA provides, and how the incubator farm space (land, equipment and infrastructure) can be effectively shared among the participants. Early signs indicate that the farmers are increasing gross sales, which is likely due to advanced level training, marketing support, and mentorship, as well as increased infrastructure. An example of a Final Report from 2015 is in Attachment #2. |

The project benefitted only specialty crops growers. There were instances where individuals approached the project team for assistance with small-scale livestock. Those inquires that were non-specialty crop related were referred to the appropriate organizations, or farmers with experience in those enterprises. The time spent on responding to these enquiries was expensed through other funding and not through the SCBGP funding.

The CFA incubator program worked closely with selected partners, as such relationships were crucial to the early stage development of the program and will contribute to its future success. The role and contributions of some of the partners/partnerships are listed below:

CFA worked closely with University of California Sustainable Agriculture Research and Education Program at the University of California Davis. Through this collaboration the project team achieved the following:

- Interviewed 14 produce buyers and five farmers
- Presented the findings to the CFA Advisory Committee.
- This study and final report and supporting documents, including contact information for each grocer or retail outlet, were distributed to the incubator farmers
- Produce currently sold at or supplied to grocers, farm stands, farmers markets, and a food bank.

CFA collaborated with Sierra Orchards and California FarmLink. The former has provided land for the incubator program and the latter is helping facilitate land linking and land purchase financing for beginning farmers. The partnerships are ongoing and expected to continue well beyond the life cycle of the grant.

CFA worked closely with National Center for Appropriate Technology (NCAT) and University of California Cooperative Extension. These partners helped develop the workshop and courses for the incubator program.

CFA also worked with the Yolo County Agriculture Commissioner, Yolo County Health and Human Services, the City of West Sacramento, UC Davis Student Farm, the Sacramento County Office of Education, and many more entities. The partner's roles included:

- Helping to match incubator farmers with available farmland
- Assisting with farming job opportunities in specialty crop production
- Providing land for lease
- Market for produce
- Financial support for incubator farmers

In particular, a partnership with the city of West Sacramento helped to initiate the urban farm program. The partnerships helped many incubator farmers to expand, grow and supply specialty crops to urban markets.

Eighteen regional farm businesses support the CFA program directly to provide consulting and mentorship to the incubator farmers.

## Goals and Outcomes Achieved

Outcome 1: Thirty incubator farmers on 15 acres in the CFA incubator program and marketed to local and regional outlets.
Activities completed to meet this:

- Continued the CFA incubator program.
- Put in place equipment and infrastructure at the incubator farm facilities to support the incubator farmers
- Provided ongoing training, supervision, mentorship and support to the incubator farmers
- Increased acreage in incubator program through partnerships with grocers, City of West Sacramento, City of Davis
- Identified regional and local marketing opportunities and markets for incubator farmers and connected the farmers with buyers.

Outcome 2: Seventy-five additional specialty crop farmers having received technical assistance from the incubator program.

- Provided technical assistance to non CFA specialty crop farmers
- Shared best practices with other incubator programs supporting new farmers
- In person or phone technical consultations with farmers and/or landowners

Outcome 3: Three additional marketing relationships for beginning specialty crop growers researched and developed, with 12 or more CFA farmers participating directly.

- Conducted market research in partnership with UC Sustainable Agriculture Research and Education Program
- Disseminated the results of study to incubator farmers

- Involved in managing a farmers market
- Established farm stand in four sites in West Sacramento, and one in Davis
- Started an aggregated CSA for a community in West Sacramento
- Facilitated supply of specialty crop produce to grocers
-

The goal of this project was to increase the number of specialty crop growers in California, especially in the Sacramento Valley. This was and is the long term aim of the CFA incubator program.
The aspects that are critical to achieving this goal are:

- Providing the appropriate pathways and right first steps to aspiring new farmers
- Reaching out to a wider cross section of people who are interested in farming
- Identifying new and non-traditional markets that specialty crop growers can cater to economically sustainable farming enterprises

The CFA training program from the 2010 SCBGP Project 32 attracted a wide cross section of people who were interested in farming as a vocation. This included veterans, urbanites, career changers and immigrants. It also helped the individuals to narrow down a farming dream to what can be realistically achieved in the first three years, thus acting as a pathway. The incubator program helps beginning or new farmers take the appropriate first steps. The nature of this program (low risk) helps beginning farmers to make mistakes and learn from lessons rather than being negatively impacted and discouraged. Both these aspects, along with the market linkages that the program provides, helped to create a greater number of well informed, knowledgeable and capable specialty crop farmers. The incubator farmers will go on to establish successful farm enterprises in the region and be the next generation of farmers that will lead to up-coming food and farming systems.

The project was able to accomplish all its grant duration targets, except one, the number of projected farmers in the incubator program.

- CFA had projected 30 farmers in the program, but the project team was able to achieve 22 farmers at the incubator farm sites. This was not due to a lack of participants, but because some of the training program participants already had access to owned or leased land, hence the farmers did not need to start a farm enterprises at the incubator farm sites. CFA continues to support these farmers with business planning and technical knowledge which is just as beneficial.
- At the start of the project the incubator program had access to only two acres, today that acreage has increased to 16 acres
- Technical assistance was provided to 103 specialty crop farmers in the form of phone or in person consultations which is well above the 75 participant target.
- Four farm stands, 11 farmers markets and 21 groceries/restaurants/other direct markets have been developed as part of this project. Some of these marketing outlets were developed by CFA program, while others were established by the farmers as a result of participation in the CFA incubator program. The target was to reach three marketing relationships and this was achieved beyond the target goal.

As highlighted in the previous sections the project team met all targeted outcomes and achieved excess numbers in two of the outcomes. Please see a recap below:

- CFA had four farmers at the start of the project (baseline data) that increased to 22.
- CFA had access to two acres for the incubator project in 2013, which rose to 16 at completion of the project

- CFA was able to provide guidance and assistance to 103 farmers from throughout the region (baseline data zero)

The market research helped CFA to establish local and regional markets, 37 in all. Notable among these markets were the linkages the project team was able to establish with two major grocery stores. It is very rare to see such large grocery chains purchase directly from small scale specialty crop growers and this development was a major highlight of the project. Another highlight in the marketing space was CFA helping to manage and reinvigorate the a farmers market. CFA is in charge of coordinating vendors for the market and in the process providing a market outlet for the incubator farmers.

The project team were able to increase land by 14 acres and number of sites from one to six within a short period of time (two years), this helped to support a greater number of specialty crop farmers. The West Sacramento sites also helped to raise the awareness about specialty crops in urban areas apart from providing access to fresh, local produce in these area that were otherwise food deserts.

The establishment of the Cannery Farm in Davis was another highlight of this project and this initiative is ongoing at the time of writing this report. This partnership was a first of its kind which involved a farm organization, property developer, and a city. The developer established an urban farm with the necessary infrastructure on seven acres of land within the housing development site. CFA will be providing the farmer(s) and ongoing management of the farm site. The farm site is in the process of being taken over by the city from the property developer. This model will serve as an example of how farming can be incorporated into housing development.

The incubator farmers produced and supplied $128,115 worth of produce to local markets. In the process four new farm stands were established (Davis and West Sacramento) and the project was involved in managing a farmers market.

## Beneficiaries

During the course of implementing this project CFA worked with other groups or organizations that proved to be mutually beneficial.

West Sacramento Chamber of Commerce - the partnership was established with the Chamber of Commerce to revive the farmers market. The Chamber hopes to bring economic activity and benefit to the city hall area of West Sacramento by establishing farmers markets in the area.

City of Davis / Property Developer – This establishment is the first of its kind, modeled were urban development incorporates farming space in its design. This will serve as an example for how to build sustainable communities in the future.

The direct beneficiaries of this project were:

a) Twenty-two beginning farmers who acquired the knowledge and skills to establish self-owned farm enterprises.
b) One hundred three specialty crop growers who have gained further technical and production skills through the one on one and phone consultations.

The farmers primarily produce for local and regional markets, thereby generating local economic benefit and growth. Further, through services, inputs, and infrastructure that the farmers purchase or benefit from local sources. This program helps new farmers to keep the economic benefits within local communities and towns.

The 16 acres currently in production generated approximately $128,115 worth of specialty crop produce. One of the farmers also leased six acres outside of the incubator program that generated $59,420 in sales.

The markets established by this project help to connect farmers with consumers in the region. Thereby contributing to the "Farm to Fork" mandate of Sacramento. A CSA program has also been established in West Sacramento to serve 35 families in the area.

The potential economic benefits achieved through the accomplishments of this project are twofold:

1) As more beginning farmers continue to establish farms it will help to revive the aging farmer population. Beginning farmers mainly grow for local and regional markets, while there are limited studies on the precise economic impact of this trend, the theory is that it is and will contribute a vibrant local economy. This is further corroborated by the growth in farmer's markets and CSA's over the last 10 years.
2) The market linkages that this project initiated with large scale grocery chains has the potential to expand and support more beginning farmers as it provides access to a broader consumer base beyond CSAs and farmers markets. This is a consumer base that many beginning farmers have not been able to tap into or do not have the capacity to supply. There will definitely be a wider economic impact, which has to be measured in the future.

## Lessons Learned

The implementation of this project helped to streamline the services and support structures that could be offered to beginning farmers. While the learning needs of beginning farmers are broad in year one and two, and ranges from business planning to source inputs, it is next to impossible and ineffective to teach all the aspects of farming. Staff was able to narrow down the aspects that were critical to a beginning farmers success and focus on those needs. This helped the project team to not only be effective, but also to stretch the financial resources further.

The needs of beginning farmers are individually specific, i.e. learning and on the ground working style are very personalized. The project team was constantly faced with the prospect of setting supports, mainly around infrastructure and equipment needs, for individual farmers to meet individual needs. The project team realized that it is impossible to cater to all the needs, and at the same time reach more beginning farmers. One of the biggest challenges is trying to establish an incubator space that fulfills both these aspects and find the right balance.

CLBL is exploring the possibilities of identifying a network of farmers who can take on beginning farmers as apprentices. The beginning farmers from the incubator program can be directed, in year two or three, to these farmers based on their specific needs. This will help the project team to reach out to a greater number of beginning farmers as the network is now much wider. The project team believes this method is a more effective approach/strategy than trying to make the incubator program cater to individual needs, which will be challenging.

The incubator program was envisaged as a stepping-stone that will help beginning farmers establish self-owned farm enterprises in the rural regions. This still remains the main focus of the program, but the CFA was rather unexpectedly led into urban agriculture space. Urban farm spaces that range from less than .25 - 3 acres gave the opportunity for some of the incubator participants to start micro scale farms and work in the city at the same time. The enterprises the farmers run are big enough to generate a part time or in some cases full time income. Many urban agriculture projects throughout the country are built around the community gardens/allotment plot models. The model CFA was able to initiate is very unique because it has an ability to provide livelihood and is income generating. Currently there are five sites (West Sacrament and Davis) with seven farmer's actively growing and marketing specialty crops from these sites.

The only grant outcome that was not achieved was the number of beginning farmers supported (target 30 achieved 22). As stated earlier, there was no problem in reaching out to beginning farmers but it turned out that not all of the farmers wanted to start at the incubator program level. This is not necessarily a problem as the project team were able to provide those farmers with support and guidance for knowledge-needs, which is still critical for a beginning farmers. Similarly, in order to reach more beginning farmers, support services need to be structured beyond the incubator space.

## Additional Information

The CFA incubator program garnered significant media attention, see links below.

- An article highlighting women farmers in The Washington Post (https://www.washingtonpost.com/national/women-expand-their-home-on-the-range/2016/01/23/db2b694c-bc86-11e5-99f3-184bc379b12d_story.html?platform=hootsuite)
- An article about the need for new farmers in The Reporter News (http://www.thereporter.com/article/NG/20160220/NEWS/160229996)
- An article highlighting the Cannery Farm in Sacramento Magazine (http://www.sacmag.com/Sacramento-Magazine/March-2016/The-Farmer-in-the-Hood/)
- An article on women farmers in the Earth Island Journal (http://www.earthisland.org/journal/index.php/eij/article/unconventional_agriculture/)An article highlighting two incubator farmers in the Sacramento Bee (http://bit.ly/1g90NX4)

Additionally, the following photography captures the successes of the California Farm Academy Incubator Program.

West Sacramento CFA Incubator site, Farm Stands, and Farmers Market:

Winters CFA Incubator site:

Cannery CFA Incubator site:

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 18 | **Project Title:** California Leafy Greens Industry Food Safety Training Program | |
|---|---|---|
| **Grant Recipient:** California Leafy Greens Marketing Agreement | **Grant Agreement No.:** SCB13018 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Mike Villaneva | **Telephone:** (916) 441-1240 | **Email:** mike@lgma.ca.gov |

## Project Summary

To ensure a safe food supply and protect public health, food safety training for agricultural workers in California's fresh produce industry is critical. This particularly applies to those workers who directly handle fresh produce when performing activities for harvesting and/or packing. Due to a major food borne illness associated with spinach in 2006, which resulted in multiple deaths and losses exceeding 200 million dollars, a real need existed for providing consistent and uniform food safety training for workers in California's multi-billion dollar leafy greens industry.

Formed in 2007 following the 2006 outbreak, the California Leafy Green Marketing Agreement's (LGMA) "best agricultural practices," (hereafter referred to as the metrics) requires all workers who produce, harvest, and/or pack leafy greens for LGMA members must be trained in basic food safety practices. Also during the period in which the project was conducted, the United States Food and Drug Administration (FDA), promulgated regulations (hereafter referred to as the produce rule) pursuant to the Food Safety Modernization Act (FSMA) that requires specific food safety training for field workers and supervisors.

The project is important and timely to the leafy greens industry because it has established a much needed industry wide food safety training program that fully complies with mandatory food safety training requirements prescribed in LGMA's metrics, FDA's produce rule and other specific food safety training for field workers and supervisors required by buyers of leafy greens.

Providing effective, uniform and consistent food safety training as required is challenging. On any given day during the year, there can be as many as 500 individual harvesting crews with thousands of field workers harvesting and packing leafy greens. While the industry does provide some degree of training for workers, the content, frequency, setting, and teaching skills of those providing the training varies widely. As the industry expands and is burdened with new training requirements, the need for a uniform and comprehensive food safety training continues to grow.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

The project developed six stand-alone, standardized food safety training programs for field workers, based upon recognized "train-the-trainer" training methods. Course 1 is a two day Train the Trainer course, which is a pre-requisite for all instructors who are responsible for teaching the curriculum. The other five courses cover activities associated with the production of leafy greens, including Course 2) Cleaning and Sanitizing Harvesting Equipment; 3) Managing and Supervising Harvesting Operations; 4) Sampling and Testing Techniques; 5) Worker Hygiene and Handwashing; and 6) Animal Intrusion. A standard process with established steps was followed to produce all courses.

Step 1: Project Core Team, included contractors and LGMA staff, would meet to; 1) select the topic; 2) develop a timeline for completing the course(s); 3) develop a draft outline of the course narrative; 4) identify photo and video needs; and 5) identify special needs and/or considerations unique to the topic.

Step 2: Develop draft narrative of course that includes; 1) course lesson plan; 2) learning objectives; 3) case studies; 4) group activities; 5) power point slides; and 6) quiz.

Step 3: Develop shoot list for photos and written narrative on video needed to meet course goals and learning objectives.

Step 4: Shoot all videos and perform initial editing of raw video footage

Step 5: Arrange with "industry partners" to provide access to fields, harvesting operations, worker training, etc. to shoot needed photos and video.

Step 5: Contractor submits completed draft course to LGMA staff for review and any subsequent revisions.

Step 7: Recruit a select group of industry food safety professionals to "beta test" the course for feedback, recommendations, etc.

Step 8: Incorporate results from "beta test" and develops final version of course which includes USBs containing all videos and PowerPoint slides as PDFs.

Step 9: Final version sent to vendor to reproduce course manuals with all materials.

This project only benefitted California leafy greens. Workshop attendees were limited to personnel associated with LGMA handlers, growers and harvesting companies and verified by LGMA staff.

The project partnered directly with three consultants, to design, develop and in specific circumstances, implement the program. The partners provided critical input and expertise relative to their technical abilities and expertise.

A consultant in the food safety industry is a recognized leader in developing and conducting food safety training for the Hispanic workforce. They provided critical technical expertise for; 1) for developing course curriculum that understood and accepted by this culture; 2) filming various "how to" videos in several courses; 3) creating "draft" manuals used for beta testing courses and as a sample for printing final course manuals; 4) translating course materials into Spanish; and 5) developing a bi-lingual instructor to teaching all courses once fully implemented in April, 2017.

Another consultant developed and conducted; 1) industry survey to establish industry training need for topic, type, length and number of courses offered; and 2) real time evaluation on effectiveness and acceptance of training course for attendees. Survey results were very helpful in designing the courses, while the visual assessments made during the presentation provide data that led to adjustments in course delivery and emphasizing key sections of the curriculum.

The last consultant shot all photos and video clips for the six training courses to promote group interaction and adult learning techniques. They brought years of experience working with the agricultural industry in the Salinas Valley, which contributed to obtaining pertinent media that greatly enhanced the quality of all training courses.

## Goals and Outcomes Achieved

The project intended to improve outcomes in several categories, including; 1) number of training sessions provided by LGMA handlers; 2) number of training sessions provided by LGMA Tech; 3) number of training sessions provided by harvesting companies; 4) reduction in number of violations issued for non-compliance with metrics; and 5) compliance rate for audits versus citations issued.

In all cases, project staff reviewed historical data available for the described categories to establish baselines before the project began and the changes after the project was completed. Project staff also asked for pertinent data from its membership in these categories to expand the available data to compare and contrast as a way of assessing the effectiveness of food safety training before and after the project was initiated.

A survey was conducted to establish baseline numbers on worker training data. This approach also attempted to establish baseline data for training provided by harvesting crew supervisors, in order to assess any measurable changes to frequency of training and variety of training topics for crew supervisor training.

Outcome measures were not long term directly; however, project staff expect the data could provide for the ability to measure long term improvements if the baseline data for the current level of food safety training was accurate, an analysis of those measureable changes that occur over time could be made to draw conclusions on the effectiveness of the training.

The project aimed to increase training activity, specifically in the areas of workshops and training for field workers and supervisors by LGMA handlers through their food safety professionals having training responsibilities. In general, project staff feel that those activities to be examined did improve, though not to the levels projected in all categories. Those projections include:

- Increase # of workshops in 2012/13 from 10 to 20 per year and 25% annually thereafter, using 15 as the baseline
    - In 2014/15, LGMA conducted 17 workshops.
- Increase # of supervisors trained annually by 25%, using 128 as baseline.
    - In 2014/15, LGMA trained 118 supervisors.
- Increase # of training sessions for harvest workers conducted by growers, handlers and harvesting companies by 20% annually using crop season 2012/13, using 250 as baseline.
    - No baseline data gathered for this outcome, see the information below.
- Increase # of harvest workers trained by growers, handlers and harvesting companies by 25% annually.
    - No baseline data gathered for this outcome, see the information below.
- Reduce # of N/C issued for crop season 2012/13 by 25%, using 843 as baseline.
    - 702 N/C issued in 2014/15

A major contributor that led to not achieving certain project goals was the lack of reliable and sufficiently detailed data to establish; 1) training hours accumulated for supervisors; 2) specific topics taught during training; 3) training materials used to provide training; 4) attendee evaluations of training provided; and 5) steps taken to improve field worker training.

More accurate data for these categories could have been gathered by conducting a simple phone survey with individuals responsible for food safety training at LGMA handlers, leafy greens growers and harvesting companies. A few standard questions posed verbally would have provided more useable baseline data versus the limited data gathered using mail surveys.

The number of LGMA workshops conducted from crop years 2012/13 to 2014/15 did increase. It was assumed that any changes in training patterns during these years could reasonably be contributed to the increased and targeted training of food safety professionals through the LGMA workshops for LGMA handlers, leafy greens growers providing product to LGMA handlers and leafy greens harvesting companies. As noted, project staff were not able to gather sufficient baseline data to measure any progress in worker training provided to LGMA handlers staff, leafy greens growers and harvesting companies. A better approach would have been to select a small number of companies representing a cross section of the industry and analyze their data. It would have been more manageable and provided more accurate information as to industry trends in this area. But, project staff feel the limited results in this category reflect a strong support for worker training, particularly through the LGMA training curriculum. Further, it suggests that LGMA, by maintaining a strong presence as a provider of food safety training for the industry, can motivate the industry to provide more internal food safety training for workers. But beyond pure numerical measurements of this type of pre- and post-project date, project staff suggest that an appreciation and/or respect for the value and importance of quality food safety training at the field level far exceeds measurable improvements in the quantitative measurement of actual food safety trainings conducted

There were three major accomplishments from the project that stand out; 1) completing Course 1, Train-the-Trainer; 2) developing separate training materials in English and Spanish; and 3) highly favorable evaluations from students attendees who noted the high quality and effectiveness of the course materials and positive response from LGMA members and other industry entities on the value, quality and applicability of the course training curriculum.

Accomplishment (1): Successful completion of Course 1, Train-the-Trainer, filled a critical void by being able to provide this level of training with accomplished instructors and course curriculum to the industry. Multiple “buyers” of leafy greens were requiring that food safety professionals delivering food safety training attend a three day course costing more than $2,000 as a condition of doing business. The LGMA’s (1.5) day Train-the-Trainer course developed through the grant was previewed by multiple buyers and accepted as meeting their requirements for an acceptable Train-the-Trainer course. This resulted in a significant savings to the industry in terms of costs associated with attending the course, per-diem for travel and lodging and time away from assigned duties to attend the course.

Accomplishment (2): The leafy greens workforce is predominantly Hispanic, and it is critical that all training materials be presented in Spanish. Having materials, including course narrative, PowerPoints and videos translated into and presented in Spanish as a stand-alone course greatly enhanced the learning experience and was very much appreciated by those attending the courses. To that end, the LGMA is not aware of any formal

food safety training programs designed for presentation in formal settings that offer both English and Spanish versions of materials, which are completely self-contained.

Accomplishment (3): Upon completion, all attendees were asked to complete a course evaluation. Categories included; 1) course strengths and weaknesses; 2) length; 3) quality of teaching materials; 4) balance of time between activities and presenting course materials; and 5) value of course activities. In nearly all cases, these evaluations were very favorable in all categories.

**Beneficiaries**

Based on the organization and function of the California leafy greens industry, three groups benefited from the completion of the projects accomplishments; 1) LGMA handlers; 2) growers of leafy greens and 3) leafy greens harvesting companies. By definition, LGMA handlers are those entities who deliver leafy greens into commerce under their label and are responsible for ensuring that the product complies with the LGMA metrics. Growers of leafy greens are responsible for producing leafy greens that comply with the metrics and produce rule, and in those cases, any additional requirements that are conditions of sale to buyers of leafy greens. Harvesting companies, which includes contract labor companies as an independent source and stand-alone harvesting companies which are part of “fully integrated” handler and grower systems that are common in the leafy greens industry.

There are currently more than 100 LGMA handlers who place leafy greens directly into commerce, and will derive the most direct benefits from the project. Whether they themselves are also the growers, and/or rely upon outside growers for the leafy greens, they are responsible for ensuring that all workers associated with the growing, harvesting and packing are adequately trained in recognized food safety practices. Project staff are confident that LGMA handlers will positively benefit by having these training modules available for their use and participation.

LGMA handlers pay an assessment fee to support the LGMA program, and it is expected that participating and fiscally supporting the LGMA training program will occur. The LGMA Advisory Board unanimously supported LGMA Tech to conduct all of the courses beginning 8/1/16 on thru to 2/30/17 in order to; 1) fine tune the courses; 2) accurately assess industry support and commitment; 3) determine potential costs for establishing and maintaining a long scale food safety training program; 4) determine appropriate fee structure for cost recovery; and 5) develop a group of qualified instructors that can effectively deliver the courses.

But the primary goal of improved food safety training for the leafy greens industry provided by this training curriculum is to reduce and/or minimize the opportunity for another major food borne illness outbreak. The costs associated with major outbreaks cannot be minimized, so increased training with proven materials and methods that will contribute to that positive outcome are nominal. Conversely, the positive image in the eyes of regulatory agencies and consumers that the leafy greens industry is fully committed to ensuring a safety product by training its workforce is invaluable.

One example from the regulatory agency perspective is the acknowledgement by the FDA, who is implementing and enforcing the produce rule, that this targeted food safety training program is setting the standard for field worker training. There will be a significant savings to the industry, accrued by not being subject to routine audits by the FDA for compliance with the produce rule. This, along with other entities in

the food distribution who recognize the effectiveness of the expanded training program, will also reduce the demands for food safety audits.

## Lessons Learned

Positive results from the project include: 1) acceptance that food safety training for field workers is important; 2) willingness of industry partners to participate in the project; 3) enthusiasm expressed by attendees on the value of the training courses; and 4) recognition from other sectors in the "food distribution system" on the value of LGMA's food safety training curriculum

The training curriculum developed through this grant will provide excellent training tools for the industry. During the process, it was clear that high quality training materials and qualified and motivated instructors were well received. Incorporating train the trainer techniques into a stand-alone course and highlighting the importance of the harvesting crew supervisors of being qualified to train were major positive outcomes from, the project. The ability to reproduce all training materials provided as PDFs on USBs will allow for LGMA members and other leafy greens industry sectors to create proven and high quality training materials at minimal cost to train their field workers and other staff involved with these activities.

Negative results from the project included; 1) perceived resistance to visually observe "tail-gate" training being conducted in the field; 2) lack of comprehensive data on field worker food safety training at multiple levels; and 3) realization that carving out time during the work day for training is and will continue to be a problem.

Training personnel is expensive and time consuming, so meeting training needs with these constraints will be an ongoing challenge. Another concern is having the ability to visually observe and evaluate the effectiveness of field training. This is an important part of accurately evaluating the training materials and will take a concerted effort to establish a working environment that will be open to this type of site evaluation of field training activities. Project staff are however, confident that these particular challenges can be addressed, so that access to field training can be achieved to see first-hand how this type of training is developed and performed and how these and other training materials can be developed to improve and enhance this important process.

One mandatory training being asked by a major buyer of leafy greens was requiring LGMA handlers and/or growers to send individual(s) responsible for training to a three day Train-the-Trainer course. This course cost more than $2,000 and three days of time away from critical oversight duties. After reviewing LGMA's Train-the-Trainer course (1.5 days, free) developed through the grant, the buyer accepted attending and completing the course satisfied their requirements. This resulted in a significant saving to the handler(s) who enrolled staff into the course, which more accurately represented the training challenges in the leafy greens industry. Though project staff were able to offer the training for free through the grant, a mechanism will be developed for cost recovery that includes a registration fee for entities not LGMA certified and possible registration fees for LGMA members to ensure recovery of costs associated with conducting and updating the training materials.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 19 | **Project Title:** Online Continuing Educational Resources for Ornamental Specialty Crops Producers | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis | **Grant Agreement No.:** SCB13019 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Nicole Clark | **Telephone:** (530) 757-8526 | **Email:** ndclark@ucdavis.edu |

## Project Summary

For twenty years, University of California (UC) personnel have presented the "ABCs" workshops in English and Spanish on basic horticultural topics to serve the continuing educational needs of the ornamental specialty crop plant production workforce. During the recent economic downturn, ornamental specialty crop producers (nursery and floriculture) reduced their workforce to levels that do not easily allow time for attending off-site training workshops. UC faculty and Cooperative Extension (CE) personnel have fewer resources to allocate to these in-person workshops. To date, the majority of producers have still not recovered from the economic recession that began in 2008. Profit margins for all sectors of the nursery industry were impacted and still have not returned to pre-recession levels.

Of the current 324 University of California Cooperative Extension advisors and specialists, 50% are estimated to retire in the next six to eight years, creating an interim gap in personnel with expertise in the California ornamental specialty crop producers. Also, the University of California Nursery and Floriculture Alliance (UCNFA) website metrics indicate that the ornamental specialty crop producers are turning to the internet for information which demonstrated the need for more online educational content. Producers have equested online educational material since they cannot always attend an ABC workshop scheduled in their area.

UCNFA website metrics for July 2014 through June 2015 showed 1,881 users did 6,796 pageviews during 3,176 sessions averaging 157 users per month. Fifty-four percent of the users were "new" visitors. Seven of the top 10 site pageviews (28% of all pageviews) were of the educational programs provided by UCNFA. The website pages devoted to the online tool for generating pest control best management practices for individual nurseries accounted for 5% of the total pageviews.

In addition, UCNFA news website metrics for July 2014 through June 2015 showed 19,626 users did 29,697 pageviews, which is a 20% increase over the previous year, in 23,204 sessions averaging 1,636 users per month.

UCNFA addressed these timely issues by leveraging technology to adapt workshop content to a web-based format in order to reach a broader producer audience within the demands of their work schedules. Previous ABCs presentations were selected and updated with narration from current UC experts and maintained as learning modules on the UCNFA website.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Originally, four ABC workshops (English and Spanish, total eight workshops) were chosen to be reviewed and updated by UCNFA presenters: ABC's of Horticulture, ABC's of Plant Pathology, ABC's of Nursery and Greenhouse Pests, and ABC's of Fertilizers and Plant Nutrition.

Of the four ABC workshops, only three (Horticulture, Plant Pathology, and Nursery and Greenhouse Pests) were reviewed, updated, presented in person (six workshops, English and Spanish), and were videotaped by the Project Director.

ABC's of the Fertilizers and Plant Nutrition workshop was cancelled due to insufficient registration. Unfortunately, this workshop could not be re-scheduled due to conflicts with presenters, and therefore could not be accomplished in the grant timeline.

The Project Director edited the three English workshop PowerPoint presentations in preparation for transcribing into finalized PowerPoints.

Raw videotaping was completed for ABC's of Horticulture, Plant Pathology and Nursery and Greenhouse Pests by the Project Director. Post-editing and review of the videotape for Horticulture determined that the videotape quality of the workshop was not high quality and that it was too time consuming to professionally edit and produce a quality deliverable. Online interactive quizzes could not be accommodated in-house, therefore, Project Investigator (PI) made the decision to suspend editing the two remaining workshops: Plant Pathology and Nursery and Greenhouse Pests.

In May 2015, the Project Director informed the PI of retirement in July 2015. This was unexpected, and at that time, the PI could not take on project management duties due to outside work load. The PI could not find and hire a qualified Project Manager, so in the fall of 2015, PI assumed the Project Director duties with no project fund support. The PI hired an undergraduate student to transcribe raw videotape for the Horticulture, Plant Pathology and Nursery, and Greenhouse Pests English workshops and embed "draft" script directly into PowerPoint slides.

Upon transcription completion, draft English PowerPoint embedded scrips for the three workshops were sent to the UCCE English presenters for final editing. Concurrently, the PI contacted UC Davis Academic Technical Services for technical services to assist in creating web-based, interactive, online educational modules with quizzes.

The PI contacted UC Agricultural and Natural Resources (ANR) Communication Services and contracted work for creating PowerPoint presentations with embedded videos of the presenters for ABC's of Horticulture (English and Spanish), Plant Pathology (Spanish), and Nursery and Greenhouse Pests (Spanish only). The PI cancelled the English Nursery and Greenhouse Pests due to no response back from the UCCE presenter. The PI also cancelled the English Plant Pathology due to the UCCE speaker request and UC ANR internal peer review of English script, and unfortunately, this could not be accomplished in the grant timeline.

The final online PowerPoint presentations were accomplished with corresponding mediasites and have assigned website links for access via the internet:

a. ABC's of Horticulture (English and Spanish)

b. ABC's of Plant Pathology (Spanish)
c. ABC's of Nursery and Greenhouse Pests (Spanish)

ABC workshop PowerPoint presentations were approximately 1.5 hours in length and each workshop presentation had a mediasite for access once UCNFA develops the webpage and online link access which will take place after this grant project and with outside funding. The PI will develop a communication plan for promoting online educational PowerPoint presentations for the respective ABC workshops.

Each workshop was videotaped into topics and each PowerPoint topic can be updated and re-taped in the future without videotaping the entire PowerPoint presentation. Unfortunately interactive quizzes for workshop topics were not accomplished due to insufficient time. However, the process and cost for creating future online educational content with interactive quizzes is still anticipated past this grant project.

Having never designed and created online interactive learning modules before, the PI recommends conducting a thorough review of other agricultural or horticultural products online. Once a product is identified, meet with professionals to assist in identifying project requirements so an accurate timeline and cost estimate can be provided upfront. Online interactive learning modules require professional expertise to design and develop an effective online educational tool.

Project grant funds benefited only specialty crops.

## Goals and Outcomes Achieved

ABC's workshops for Horticulture, Plant Pathology, and Nursery and Greenhouse Pests were designed, delivered in person, and videotaped in English and Spanish. Videotaped workshops were transcribed into English PowerPoint presentations. English PowerPoint presentations and script were edited prior to being translated into final Spanish PowerPoint presentations.

Four online educational modules from ABC workshops have been completed (one in English and three in Spanish). A webpage on the UCNFA website has been created where all modules will be hosted. Each workshop is divided into topics and can be accessed and viewed separately from the entire workshop presentation. Each workshop topic is connected to a specify survey which allows for specific topic feedback. Each workshop topic can be edited and updated separately.
http://ucnfa.ucanr.edu/Grants_and_Projects/ABCs_online_workshops/

A communication plan is currently being designed and developed which will be done past this project term with outside funding. Surveys will be implemented once online educational modules have been reviewed by producers. Feedback from viewers will be reviewed and utilized by UCNFA for improving each ABC module.

Initial expected measurable outcome was a targeted increase of 100% to 200% in the number of online participants (14-21 per month/166-249 per year) that would demonstrate the success for providing continuing education in an online format for other topics to increase the competitiveness of California's ornamental specialty crops producers. The modules are now online, and project staff are promoting. Promotion of the modules by in person presentation or by other communication methods did not take place within the project

period due to delays and time restraints.
http://ucnfa.ucanr.edu/Grants_and_Projects/ABCs_online_workshops/

The goal for this project was to design and develop online educational resources for producers with quizzes that would assess user comprehension and performance; and with online surveys that would promote user feedback to content improvement and understanding the effectiveness of the online learning resource. The quizzes could not be completed due to delays and time restraints during the project time period.

Eight ABC workshops were originally planned (four in English and four in Spanish) for the project. Actual accomplishments were four workshop presentations (one in English and three in Spanish) that the nursery and floriculture industry can access via the UCNFA website. Online surveys were developed to promote user feedback to assess the learning resource effectiveness and recommendations for improvements. There was not enough time left in the grant period to achieve the stated grant deliverables, so the grant was amended to create PowerPoint audio-video learning modules for four ABC workshops. Creation of the PowerPoint audio-video learning modules was more cost effective than online learning modules with interactive quizzes. With limited time remaining in the grant, the PI was able to create four PowerPoint learning ABC workshops (one in English and three in Spanish) along with surveys to get feedback.

The success outcomes were the design and development of four workshop online educational modules that can be accessed by ornamental specialty crop producers via the internet. Each workshop was broken down into sub-topics and can be accessed separately from the entire workshop:

1. ABC's of Horticulture (English): ABCs of Horticulture
a. ABCs of Horticulture - Plant structures and functions
b. ABCs of Horticulture - Physiological processes
c. ABCs of Horticulture - Plant hormones
d. ABCs of Horticulture - Plant essential nutrients
2. ABC's of Horticulture (Spanish): ABCs de la Horticultura
a. ABCs de la Horticultura - Estructuras del Plantas y sus Funciones
b. ABCs de la Horticultura - Procesos Fisiológicos
c. ABCs de la Horticultura - Vegetales
d. ABCs de la Horticultura - Nutrientes Esenciales de Plantas
3. ABC's of Plant Pathology (Spanish): ABCs de Fitopatología
a. ABCs de Fitopatología - Introducción a los Principios de Fitopatología y Hospederas
b. ABCs de Fitopatología - Triángulo de las Enfermedades: Agente Causal
c. ABCs de Fitopatología - Triángulo de las Enfermedades: Medio Ambiente
4. ABC's of Nursery and Greenhouse Pests (Spanish): ABCs de Plagas de Viveros e Invernaderos
a. Introducción a Plagas de Artrópodos
b. Clase Insecta, Orden Hemiptera, Suborden Sternorrhyncha
c. Clase Insecta, Orden Hemiptera, Subordenes Auchenorrhyncha y Heteroptera
d. Clase Insecta, Órdenes Dictyoptera, Thysanoptera, Coleoptera, Diptera y Lepidoptera
e. Clase Arachnida

## Beneficiaries

California's nursery and floriculture specialty crops growers working at 3,013 locations throughout California are the main beneficiaries of this project. UC professionals also benefit as they now have a process and

template for developing future online educational resources for nursery and floriculture growers throughout the state. Other specialty crop growers who have attended these workshops have benefitted.

There are over 3,000 specialty crop nursery and floriculture producers in California who will benefit from these online educational resources. The economic impact will be over $3.5 billion farm gate value for the industry and currently ranks 5th in California agriculture.

## Lessons Learned

1. UCNFA should utilize professional technician for creating online educational resources versus in-house, since UCNFA does not possess the in-house expertise.
2. Audio-video recording of workshops and design and development of online learning resources with quizzes should be done by professional technical resources.
3. Professional software is needed to deliver online educational resources.
4. Project team could not deliver the proposed deliverables in the grant timeline and for the costs proposed since professional services were needed for videotaping and project director retired.
5. PowerPoint presentations with embedded video can be cost effective, but these educational resources will not include quizzes for assessing participant performance.
6. Project requirements should have been more clearly defined as part of the final grant proposal.

Unexpected Outcomes:

1. Project Director unexpectedly retired causing delays in the grant timeline.
2. Workshop speakers could not deliver transcribed PowerPoints.
3. Creating online educational resources by in-house untrained personnel was not feasible and caused delay in timeline. Professional services had to be found and employed.
4. Professional software and technical resources are needed for effective design, development and implementation of online educational resources.
5. Could not complete online learning modules either PowerPoint audio-videos or interactive online learning modules with quizzes (8 total workshops in English and Spanish) as per grant outcomes.

In order to design, develop and implement effective online educational resources, professional software and technical resources were needed to be employed. Attempting to develop educational modules with interactive quizzes was deemed not possible in-house and it resulted in having to change scope and direction by employing professional services late in the grant timeline. There was not enough time left in the grant to achieve the stated grant deliverables, so the grant was amended to create PowerPoint audio-video learning modules for four ABC workshops.

## Additional Information

Promotion of the four ABC online educational workshops (Horticulture in English and Spanish; Plant Pathology in Spanish; and Nursery and Greenhouse Pests in Spanish will be communicated via:
UCNFA website (http://ucnfa.ucanr.edu/)
UCNFA online newsletter (http://ucnfanews.ucanr.edu/)
UC ANR News & Information Outreach in Spanish (NOS) (http://ucanr.edu/sites/Spanish/Noticias/)
UCNFA Blogosphere (http://ucnfa.ucanr.edu/?blogasset=10592&start=4)
UCNFA Facebook (https://www.facebook.com/UCNFA/
California Nursery Conference (Pests, Diseases & Water Issues) on October 25, 2016 in Watsonville, CA

Non-profit industry trade organization, California Association of Nurseries and Garden Centers' (CANGC) weekly e-newsletter (http://cangc.org/media/index/enews)

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 20 | **Project Title:** On-Farm Food Safety Plans for Small-Scale Specialty Crop Growers | |
|---|---|---|
| **Grant Recipient:** Community Alliance with Family Farmers | **Grant Agreement No.:** SCB13020 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Dave Runsten | **Telephone:** (530) 756-8518 ext. 125 | **Email:** Dave@caff.org |

## Project Summary

Though large-scale commercial produce farms have already implemented food safety practices, this is not the case with many small, organic, biodynamic, diversified, or direct-market farms. In a recent survey of such farms on California's north coast, fewer than 20 percent had any experience with food safety issues and even fewer had written food safety plans. Since such a plan is increasingly a requirement for participation in commercial markets, these specialty crop farms are at risk of being shut out of markets. As a result, the project purpose was to reach out to the many thousands of farmers who do not have the funds to hire private consultants, do not sell in markets that currently require food safety plans, and require one-on-one assistance to create customized, written, and auditable farm food safety plans. All farmers face some potential risk from pathogenic bacteria, and hence the Community Alliance with Family Farmers (CAFF) believes that every farm needs a food safety plan appropriate to the risks on that farm.

The project team made significant progress on implementing food safety on small and medium-sized specialty crop farms in California. The combination of the trickle-down effect of the Federal Drug Administration (FDA) Food Safety Modernization Act (FSMA) and state laws mandating Good Agricultural Practices (GAPs) for direct marketing have meant that small specialty crop growers are increasingly anxious to start in on food safety.

- Spoke to over 1,000 people in food safety workshops, answered questions from almost 400 farmers, and assisted about 100 farmers with devising and implementing a food safety plan for their farms.
- Developed materials that help specialty crop growers assess the risks on their farms and devise food safety measures appropriate to their scale and risks. Translated many of these materials into Spanish and are available online.
- Held workshops and worked one-on-one with many low-income and socially disadvantaged farmers, including African American, Latino, Hmong, Mien, and Native American specialty crop growers. The project team learned important lessons about reaching these populations and have developed partnerships of personnel who work with them.
- Extended the reach of the work into new regions, such as the southern San Joaquin valley, San Diego, and northeast California.

The previous two-year period of the work on food safety was funded by the 2011 Specialty Crop Block Grant Program Project 5: *A Family Farm Food Safety Outreach Program for California Specialty Crop Growers*. Lessons learned were used in the outreach effort to expand the groups and the geography reached. CAFF developed new material that was found lacking in the previous project, including a variety of templates that growers could adopt as part of their food safety plans.

## Project Approach

Developed materials for famers to implement food safety plans and placed them on the website. Handed these materials out at workshops as part of the packets of food safety material that are distribute to attendees. Record-keeping templates were created at the request of farmers. The core materials that are currently being used can be found at: http://www.caff.org/programs/foodsafety/templates/. Links to other material are continually added to the website at http://www.caff.org/resources/foodsafety/ .

All three of the partners in this project worked on developing new material.

- Created a *Land Use Action Plan* that growers can use to determine the pathogen risks of wildlife, flooding, and water quality on their farms. The plan is tied to the FSMA Produce Rule, which will enable CAFF to insert it into more extensive material on FSMA in the future.
- Worked on post-harvest washing and the various approaches to sanitizing that smaller growers might utilize. The project received many calls from growers about this subject, so another funding source has been secured to continue working with the partner on developing simplified materials for growers. In the interim, a PowerPoint is on the website.
- Modified food safety training resources for urban production farms to reflect specific urban food safety risks such as soil contamination. These materials are available to other UC Cooperative Extension advisors.

Binders and packets of food safety material were distributed to at least 600 specialty crop growers. The materials included have evolved over the course of the project as CAFF became aware of the need for specific templates and other documents that growers needed.

Project staff envisioned updating the small farm GAPs placed on the direct marketing website as guidance in response to a requirement in recently passed state laws, however, it was decided to wait until FSMA was finalized to update these GAPs. Due to this and staff changes, this has been put off until 2017.

All of the material from the packets was translated into Spanish. This translated material is being added to the website. Project staff collaborated with Hmong groups in Fresno on the translation of some material into Hmong that was used in presentations to Hmong growers. However, most Hmong farmers do not read Hmong, so it is more important to engage in simultaneous translation in workshops than it is to provide written Hmong materials. A binder of food safety material from a previous grant was translated into Chinese for a group of Chinese growers who farm south of San Jose.

Project staff have worked with an agricultural consultant on materials about how to co-manage food safety requirements with conservation plantings on the farm. In the previous SCBGP project the team co-produced the publication A Farmer's Guide to Food Safety and Conservation: Facts, Tips, and Frequently Asked Questions, which has been put on the website. CAFF distributed this in the packets to all farmers worked with. In addition, the consultant developed new material on FSMA and land use risks, as noted above.

The food safety section of the website was completely restructured. CAFF developed a series of documents and templates for farmers to implement food safety plans and placed these core materials at: http://www.caff.org/programs/foodsafety/templates/. This material was translated into Spanish at the end of the grant period and is in the process of adding the information to the website. Project staff have continually

added links to other material on the website at http://www.caff.org/resources/foodsafety/ . Other items from this project that are currently being added include a PowerPoint on food safety in post-harvest washing, *Land Use Action Plan*, and summaries of the FSMA Produce and Preventive Controls Rules.

CAFF has a list of food safety auditors (of which CAFF has met with the majority of over the years) on the website at http://www.caff.org/programs/foodsafety/thirdparty/. Project staff met with two during the grant period in order to understand their new program and to be able to recommend their services where appropriate.

CAFF held 40 food safety workshops for 1,008 specialty crop attendees. Workshops were held in the following 18 counties: Humboldt, Sonoma, Monterey, Santa Clara, Sacramento, Alameda, Santa Cruz, San Francisco, San Mateo, San Diego, Nevada, Fresno, Amador, Modoc, Yolo, Stanislaus, Shasta, and Mendocino.

Staff directly assisted 97 specialty crop growers with food safety plans, sent materials to another seven specialty crop growers, and answered questions from 388 additional specialty crop growers.

Two mailings were sent to all direct-market specialty crop growers in California during the project period; one in October 2014 and the other in April 2016. These letters discussed timely issues related to food safety and offered the assistance of CAFF in preparing on-farm food safety plans. The most recent letter walked through the FSMA exemptions and qualified exemptions, as well as what crops and activities are covered. The mailings have gone to approximately 3,500 specialty crop growers.

The National Sustainable Agriculture Coalition's (NSAC) Food System Integrity Committee is the committee charged with food safety policy. This committee has regular calls and through this committee, CAFF shared many experiences with other member groups within the coalition. The project director attended the annual winter meeting of NSAC and shared experiences there. The Executive Director of the Carolina Farm Stewardship Association visited California and the project manager shared CAFF's materials and approach with them.

NSAC has joined with a consultant to submit a proposal to the FDA for a cooperative agreement that would be focused on food safety in local and regional food systems. If this project is approved, many NSAC organizations will join together to develop food safety materials, and CAFF will directly share the results of this project with them.

Project staff presented a workshop on food safety each year in both the California Small Farm Conference and the EcoFarm Conference.

The project manager attended one Produce Safety Symposium in Southern California

All workshops were advertised for specialty crop growers, and only specialty crop information was presented at these workshops. The farmers CAFF worked with were screened to ensure they were specialty crop growers.

Project Partners:

- One organization created a *Land Use Action Plan* that growers can use to determine the pathogen risks of wildlife, flooding, and water quality on their farms. The plan is tied to the FSMA Produce Rule, which will enable CAFF to insert it into more extensive material on FSMA in the future. In addition, the consultant participated in a number of food safety workshops with the project manager and the project director, with their presentations focused on co-management of food safety and conservation practices
- The second organization worked on post-harvest washing and the various approaches to sanitizing that smaller growers might utilize. (CAFF put the PowerPoint on washing onto the website.) In addition, they reviewed various materials that staff prepared and responded to particular questions that growers had. They also prepared the simplified melon GAPs.
- The last organization modified food safety training resources for urban production farms, to reflect specific urban food safety risks such as soil contamination. They made these materials available to UC Cooperative Extension advisors. When the second project manager was hired, the consultant shared food safety materials, and invited them to several of their workshops. The consultant conducted nine food safety workshops involving 158 specialty crop growers, including many minority growers.

## Goals and Outcomes Achieved

CAFF held 40 food safety workshops for 1,008 specialty crop growers.

The project team directly assisted 97 specialty crop growers with food safety plans, sent materials to another seven specialty crop growers, and answered questions from 388 additional specialty crop growers.

Over the last five years CAFF has conducted 70 workshops on food safety in California, reaching over 2,000 farmers and assisting 200 farmers with on-farm food safety plans. However, the demand for food safety assistance keeps growing, particularly now that the implementation of FSMA is beginning. CAFF's overall goal is to have every farm in the state that grows FSMA-covered produce implementing food safety practices appropriate to the risks on that farm. This means that even farms with a qualified exemption from FSMA would implement GAPs.

The National Association of State Departments of Agriculture (NASDA) estimates that 35,000 farms in the United States will be subject to the FSMA Produce Rule and that an additional 75,000 farms will be covered but have a qualified exemption. Over half of these farms are located in California; therefore there is a high need for this type of food safety work with growers. Although the acreage of immigrant and minority farms is relatively small, they comprise more than 20% of all California farms, and their contribution to California's crop diversity, their value in terms of specialty commodities grown, their role in the provision of culturally relevant foods for California's diverse population, and their role in preserving green space around the periphery of expanding California cities, all render them an essential component of California agriculture and a key target of our outreach.

The goal was to hold 40 workshops for 1,000 attendees. The results were 40 workshops for 1,008 attendees. The workshops consisted of: workshops organized by partners in which CAFF participated, and also workshops organized and carried out by a subcontractor as part of this project.

The goal was to assist 100 specialty crop growers directly with on-farm food safety plans. The results were: 1) ninety-seven specialty crop growers directly assisted with food safety plans; 2) sent materials to another seven specialty crop growers; and 3) answered questions from 388 additional specialty crop growers.

Baseline data showed significant need for these services and resources. CAFF met or exceeded all goals for outcome measures and farmers served.

## Beneficiaries

The more than 1,000 specialty crop growers included people growing all kinds of specialty crops: tree nuts and fruits, strawberries, bush berries, melons, vegetables, and herbs. Some diversified direct market farms in California grow as many as 100 different crops and project staff assisted a number of them. The growers were also highly diverse in terms of size and ethnicity. Project staff assisted a farm that sold $13,000 of herbs per year at a farmers market, and highly diversified organic farms that sold more than $5 million of produce. Specialty crop growers, were white, Latino, Filipino, Sikh, Hmong, Mien, Native American, and Chinese.

CAFF held 40 food safety workshops for 1,008 specialty crop growers.

The project team directly assisted 97 specialty crop growers with food safety plans, sent materials to another seven specialty crop growers, and answered questions from 388 additional specialty crop growers.

In addition, an unknown number of other specialty crop growers accessed the material on the website.

## Lessons Learned

One lesson learned is the need to schedule trips in clusters. California is a big place and it becomes too costly to drive all over to meet with one farmer. Both workshops and field visits should be grouped to the extent possible.

A lot of the work can be done by phone. Webinars and e-mail are also useful, although sometimes there is no substitute for walking around someone's farm with them and pointing out the issues that a food safety auditor would take note of. Project staff's willingness to meet with farmers, if they wanted this, distinguished the program from other programs that did not offer to visit them.

CAFF found that workshops are best held at a farm that has implemented food safety practices. Several hours of lecture and discussion followed by a farm tour is the most effective learning experience.

Food safety practices can't all be implemented at once. It is a process and it takes time to create habits. A farmer's food safety plan needs to start with a risk analysis. What are the biggest risks on that farm? These are the priorities for implementing food safety.

One obstacle to operating a program on food safety for small, minority, or socially disadvantaged farmers is that once a food safety specialist is trained and experienced, he/she is an attractive hire for the private sector.

Workshops for farmers are a seasonal activity, best done in the winter. One problem confronted was that so many different organizations are presenting workshops on various topics in the winter that there is

competition for the limited time of the farmers and workshop fatigue. This is one reason that training farmers in food safety is going to take quite a few years.

No unexpected outcomes have been noted that effected the implementation of this project, or hampered its goals.

The goals and outcome measures were achieved or exceeded.

## Additional Information

All material generated by the project is available on the CAFF website: www.caff.org

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 21 | **Project Title:** Invasive Species Education | |
|---|---|---|
| **Grant Recipient:** California Foundation for Agriculture in the Classroom | **Grant Agreement No.:** SCB13021 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Judy Culbertson | **Telephone:** (916) 561-5625 | **Email:** judy@learnaboutag.org |

## Project Summary

California produces half the nation's fruits, nuts, and vegetables. Unfortunately, the same agricultural abundance people enjoy is equally attractive to invasive species. The damage caused by invasive species can devastate specialty crops, eliminate jobs, threaten California's food supply, and cost billions. California experiences quarantines to control and eradicate invasive species. The invasive species project educated California teachers and students about invasive species and methods for control and prevention.

The invasive species fact sheets provided teachers with the agricultural content needed for student understanding, and provided teachers with the kind of lessons they need to meet education standards and busy schedules in quick, 30-minute lessons using hands-on, real-life applications.

The goal of this project is to prevent pests and diseases through education, minimizing economic and environmental harm to specialty crop growers. California Foundation for Agriculture in the Classroom (CFAITC) created and distributed six new fact sheets, focusing on species that pose the greatest threat to specialty crops including; Asian citrus psyllid, Mediterranean fruit fly, oriental fruit fly, false codling moth, varroa mite, and European grapevine moth. The set was disseminated throughout California. As students learn about the harm caused by invasive species, they will appreciate the need for preventing the introduction and establishment of invasive species and will understand the basic precautions they can take to support prevention and eradication measures. This understanding will lead to increased productivity, benefits to California's economy and the environment, and an increased appreciation for the healthy, nutritious and useful products provided by specialty crop producers.

The project was important and timely in terms of the need to ensure that future generations possess a basic understanding of invasive species and in terms of recent changes in educational standards adopted by the California Department of Education. With the recent adoption of Common Core State Standards, which address English Language Arts and Math, California's National Science Standards have undergone a major renovation and the Next Generation Science Standards were adopted as well in 2013. This creates a perfect synthesis for providing teachers with standards-aligned resources focused on invasive species.

On a recent survey of teachers using Agriculture in the Classroom materials,

- 80% said they were likely or very likely to use CFAITC's Agricultural Fact and Activity Sheets (344 responses)
- 90% said they were likely or very likely to use short, 30-minute activity plans (396 responses)
- 93% said that the use of hands-on and real-life applications were very important or extremely important when selecting curriculum (396 responses)

This project builds upon previously funded Specialty Crop Block Grant Program (SCBGP) projects, but has not been submitted to or funded by another Federal or State grant program. This project differs from the 2010 SCBGP Project 20: *What's Growin' On*? and the 2012 SCBGP Project 28: *Tasting California Specialty Crops in the Classroom*. This project added to CFAITC's growing cadre of specialty crop resources available to teachers. 2010 SCBGP Project 20 was a 16-page student activity newspaper that was distributed to more than two million readers during the project period with distribution continuing as part of CFAITC's ongoing availability of resources. It remains available for download from CFAITC's website and has become part of a packet of specialty crop resources that CFAITC provides to the 500 teachers participating in the taste test project. The Invasive Species Fact Sheets will be added to this core group of resources focused on California specialty crops providing a well-rounded, comprehensive set of specialty crop resources at all grade levels.

## Project Approach

CFAITC worked with agency professionals and experts to identify six invasive species to feature in the fact sheet set. Content was developed including background information, descriptions of the pest, habitat, how invasive species spread, why they are a problem, effect on California specialty crops, and how people can help. The back side of the fact sheets include lesson plan ideas, fun facts, an informational graphic, and a main lesson plan. These pieces were developed during the writing team meeting which included teachers from urban and rural schools that teach in grades five through twelve. Graphic designs for each of the selected invasive pests, designs for the informational graphics, and the front cover design of the booklet were developed.

During the expert review of the fact sheets, it was determined that two of the invasive species identified did not relate to specialty crops. Newcastle disease and yellow starthistle were replaced with the false codling moth and oriental fruit fly. Edits were made to the fact sheets and replacement graphics were created. Evaluation of the original four fact sheets took place during the first year of the project. An evaluation consultant was hired, questions were developed, and surveys and fact sheets were distributed to 19 educators. Feedback from teachers was positive and no changes were made to the fact sheets.

During the second year of the project, the final two fact sheets (False codling moth, Oriental fruit fly) were added to the initial four fact sheets (Asian citrus psyllid, European grapevine moth, Mediterranean fruit fly, Varroa mite) and the set was aligned to current California Education Standards for grades 6-12, including Common Core English Language Arts, Common Core Math, and Next Generation Science Standards. The two replacement fact sheets were sent to 15 educators reaching a total of 296 students. Feedback was positive and no additional changes were made to the fact sheets.

The fact sheets were put together into a multi-page booklet titled "Stop the Invasion." The booklet was printed and distributed at CFAITS's exhibit at the 2015 California Science Teacher Association (CSTA) Conference held in Sacramento, California. There were approximately 1,800 that attended the conference for science educators in grades K-12. A workshop was also presented titled, "STOP the Invasion! Learn about Invasive Species that Threaten California's Food and Ecosystems." Workshop participants (approximately 50) consisted of classroom science educators in grades 4-12, learned about invasive species during the program and did hands-on activities from two of the fact sheet lessons, the Sugar Shake Simulation from the Varroa mite fact sheet and Fly Fragrances from the Mediterranean fruit fly fact sheet.

The fact sheets were also featured and distributed at the 2015 CFAITC conference held in Long Beach, California, with 130 educators in attendance. The project team shared and provided copies of the resource during University Student Teacher Program presentations to CSU Monterey Bay, CSU Stanislaus, and UC Davis as well as during workshops at the San Mateo County Science, Technology, Engineering and Math (STEM) conference, Soil Born Farms Garden Symposium, and the San Diego County after school STEM conference. In addition, the project team shared the resource at the World Ag Expo in Tulare, California, both at CFAITC's exhibit and California Department of Food & Agriculture (CDFA) exhibit. The resources were shared at CDFA's booth at Capitol Ag Day and at Yolo County Farm Connection Day to more than 3,000 school children, teachers, and volunteers. The fact sheet resource was distributed to members and partners of the California Environmental Education Interagency Network (CEEIN) at the January 2016 meeting. In April, California Geographic Alliance organized a Bio Blitz which project staff participated in with a table to share the Invasive Species fact sheets with teachers and students. Project staff had a spin wheel as well as a student activity to create "Stop the Invasion" headbands. In June, CFAITC presented a workshop at the California Agriculture Teachers Association (CATA) conference featuring the resource and using the lesson plans. Teachers participated in the Sugar Shake Simulation, Fly Fragrances, and created a Public Service Announcement about Invasive Species. Also in June, the project team shared the resource with nearly 500 teachers and Ag in the Classroom staff from around the country at the National Agriculture in the Classroom conference in Arizona. CFAITC also shared the resource at El Dorado County Farm Day, San Joaquin County Ag Day, and Merced County Farm Bureau.

Postcards to promote the fact sheet set were printed and mailed to teachers in February 2016. The "Stop the Invasion" booklet, "The Invaders!" activity page (adapted from page 12 of What's Growin' On? edition 12, the invasive species page), and an introductory letter was mailed to every school principal in California in February as well, stressing the importance of teaching about Invasive Species. The "Stop the Invasion" booklets, "The Invaders" page, and letter were also sent to 52 state Ag in the Classroom programs, 53 county Farm Bureaus, and 55 Ag Commissioners in California.

The fact sheet set was put on CFAITC's website in October 2015. There is an average of 3,500 website viewers per month. Educators are able to download or order packets for their classrooms and during this time there were 580 downloads and 600 hard copies ordered. The monthly electronic Cream of the Crop newsletter promoted the new fact sheet set in March 2016 and the fact sheets have been promoted throughout CFAITC'S social media from October 2015 through July 2016. The posts have reached and engaged audiences on Twitter, Facebook and Instagram, boosting awareness of the resources and sparking conversations. Although all engagement has been positive, the posts have received limited success in driving traffic to the website. CFAITC has studied the two tweets that have been a success in driving traffic to the website and is striving to use similar strategies when crafting future social media posts.

Through collaboration with the Art Institute in Sacramento, an art class created six designs of Invasive Species costumes. The draft drawings were sent to a costume designer and six costumes were created. A mask designer created six masks to coordinate with the costumes also. The costumes and masks will be used at conferences and other education outreach events to draw attention to invasive species and provide the free resource to educators. Invasive species face masks were also printed for teachers to use in their classrooms. After teaching the lessons from the fact sheets, students will take their masks home and share with their families about invasive species and how they can prevent the spread.

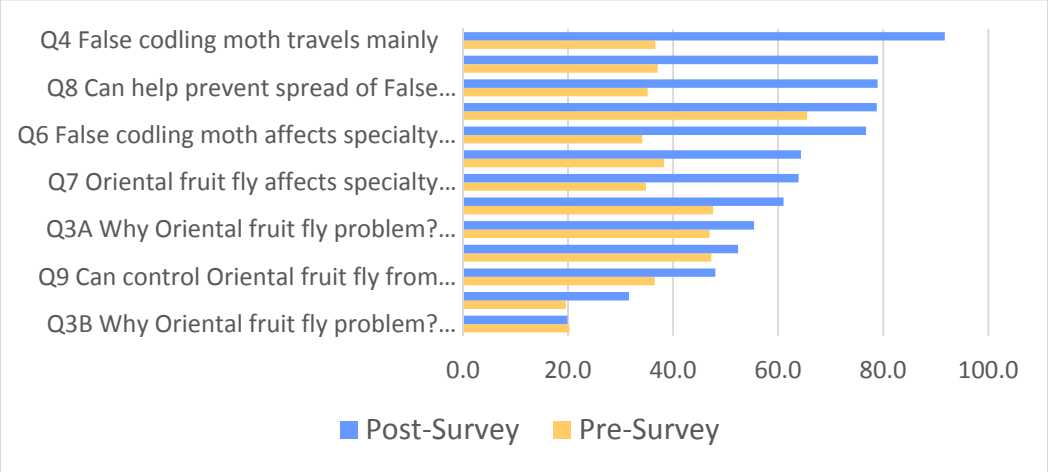
CFAITC worked with invasive species experts from Bayer CropScience, CDFA, and California Farm Bureau Federation (CFBF) throughout the development of the Invasive Species Fact Sheets to review technical information for accuracy.

## Goals and Outcomes Achieved

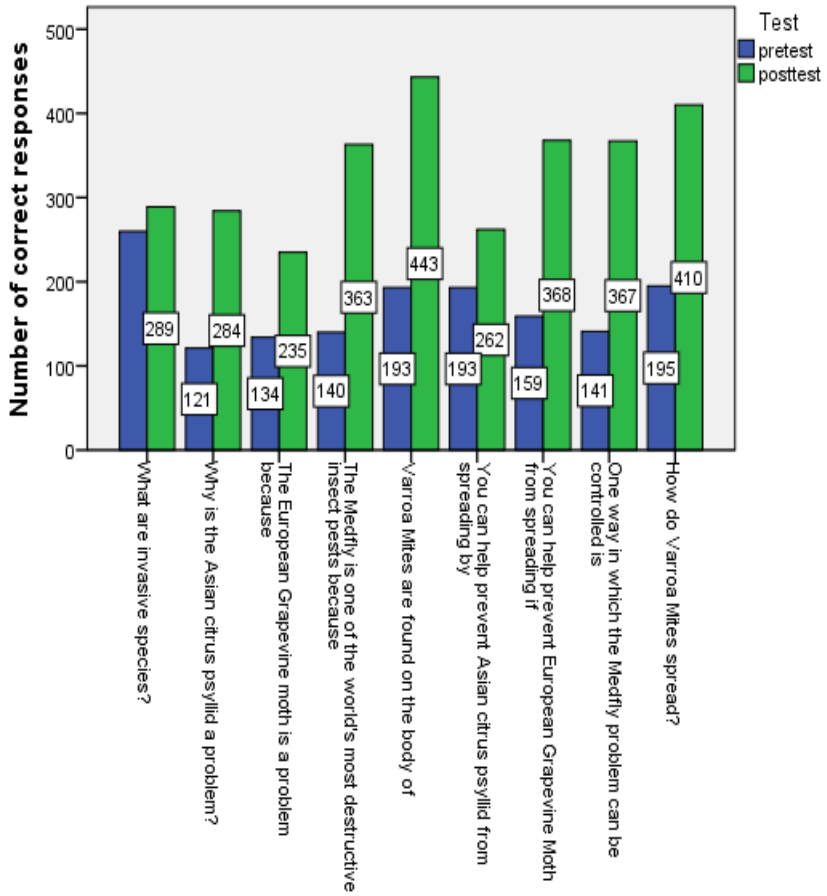
In order to achieve the performance goals identified in the project, CFAITC developed six invasive species fact sheets that affect specialty crops. Fact sheets were illustrated and matched to current California Education Standards. Fact sheet sets were tested in classrooms with teachers conducting pre and post tests to measure any increase in student understanding. Fact sheet set activities were taught at various workshops, the booklets were featured at conferences and sent to all principals in California as well as Ag commissioners, county Farm Bureaus and state Ag in the Classroom programs.

The following graphs show an overall increase in student understanding. Graph 1 shows the false codling moth and oriental fruit fly results. Graph 2 shows the initial four invasive species.

Student Survey Results False codling moth & Oriental fruit fly (Graph 1)



Student Survey Results for Asian citrus psyllid, varroa mite, European grapevine moth, and Medfly (Graph 2)




Each year CFAIC's resources reach approximately 750,000 students and educators. The outreach to teachers and educators through presentations at conferences and university student teaching programs (reaching 390 future teachers), exhibits, mailings to all schools, Ag commissioners, Ag in the classroom programs, and county farm bureaus, as well as promotion on the website and social media has the potential of reaching an even broader audience.

The goals included distribution to all California schools and providing a workshop at the CATA conference. The accomplishments far surpassed the goals. Not only did project staff mail the resource to 14,200 school principals, the resource was also mailed to 53 county Farm Bureaus, 55 Ag Commissioners, and 52 state Ag in the Classroom programs. Six costumes and masks were created, have featured the resource on social media, and shared the resources and activities at a Bio Blitz (a learning activity) in Sacramento.

In the final two fact sheets evaluation, baseline data from the preliminary student and teacher surveys, showed that 72% of the teachers answered questions correctly and 50% of the students answered questions correctly. Teachers from grades 4-12 taught the material to 296 students. Teachers were required to conduct the pre-surveys with their classes. Then teachers were directed to teach all areas of the fact sheets and the lesson plan from the fact sheets. After completing the instruction, teachers were to conduct the post-surveys with their classes, as well as take the post-survey themselves. All surveys were administered through Survey Monkey.

Post survey results indicated teachers answered the questions correctly 84 % of the time and students answered the questions correctly 79% of the time.

Overall, students and teachers showed an increase in knowledge after instruction with the fact sheet sets as indicated in the evaluation- teachers showing 84% understanding and students showing 79% understanding. Success has also been shown with 350 downloads and 568 page views, as well as 600 hard copy orders. 14,200 "Stop the Invasion" booklets were mailed to school principals throughout California, 18 conferences, workshops, and events were attended and the resource shared, and 16,000 people reached through the monthly e-newsletter. This resource was recently shared at the State Fair in the Insect Pavilion as an example of ongoing successful outreach.

## Beneficiaries

Specialty crop farmers as well as the Ag industry benefitted through the project by reaching out to farm bureaus, Ag commissioners and Ag in the classroom programs. For example, Mariposa county Farm Bureau had a workshop and provided the invasive species fact sheets; their response was that "people loved them."

76,400 farmers and ranchers in California benefitted from the project's accomplishments, as well as all California school teachers (nearly 300,000) and more than six-million students and their families.

## Lessons Learned

The initial project lead took another position and the new lead came in during the final year and had to learn the project, complete the final two evaluations of the replacement fact sheets, and complete a final report. Finding that two of the fact sheets did not relate to specialty crops was another important lesson learned. Expert review is an essential part of any project.

Unexpected outcomes or results that were an effect of the project would include the enormous support of educators and industry. At education events, teachers are excited and encouraged to receive free resources. Conducting the lesson plans and activities with teachers always prompts questions and ideas in terms of what they didn't realize and how they can use the resource in their classrooms. In surveys, teacher responses are always enthusiastic to share the resource with their students and other educators. Industry is supportive in terms of assisting with review of the resources as well as sharing the resources and offering suggestions of additional outreach opportunities.

The goal of 65% increase in knowledge of Invasive Species was based on the premise that teachers and students would know less than 35% about the invaders. As seen from preliminary data, teachers had some knowledge, as well as students. This only allowed for an increase in knowledge of 12% and 29% respectively. Ultimately, the goal was successful with teachers and students having approximately 80% understanding of invasive species.

## Additional Information

- Please see Attachments 1-3
- Stop the Invasion Fact Sheet Set at http://learnaboutag.org/resources/fact_invasion.cfm

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 22 | **Project Title:** Establishing and Scaling Up Safe and Profitable Cottage Food Operations by California Specialty Crop Growers | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis | **Grant Agreement No.:** SCB13022 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Shermain Hardesty | **Telephone:** (530) 752-0467 | **Email:** shermain@primal.ucdavis.edu |

## Project Summary

The new California Cottage Food Act that became effective on January 1, 2013 allows processing in home kitchens of certain low-risk food products that do not require refrigeration, and selling up to $35,000 of such products during 2013 (and increased to $50,000 in 2015) under a limited set of marketing conditions. The Act has been praised for empowering people who are unable to start a food business because they cannot afford to establish their own or rent time in a commercial kitchen. However, access to a kitchen is only one step. Specialty crop producers often lack food safety, food processing, business and marketing skills needed to establish successful cottage food operations. The training by the California Department of Public Health (CDPH) for registered cottage food operators (CFOs) that was required in the Act failed to materialize due to lack of funding. Instead, CDPH is referring new CFOs registrants to online Food Handler courses, which do not teach individuals how to safely process foods such that they can be preserved for future consumption.

Maximizing the potential viability of a CFO requires food processing expertise and sound food safety practices, as well as marketing and business planning skills. This project provided such training to specialty crop producers and others who aspired to become CFOs or Specialty Food Producers (SFPs). During the first project year, the workshops covered food safety and food processing, while also providing information about the Cottage Food Act's specific restrictions and requirements and related zoning and environmental health regulations. Workshops during the second year provided information about regulations, marketing and business planning, so that CFOs and SFPs can maximize their viability, and potentially expand their businesses by having their own registered food processing facilities or obtaining services from co-packing firms. This project's primary objective was to provide specialty crop producers with the knowledge needed to process part of their production into cottage foods both safely and legally, and to market these products effectively. This project also expanded demand for California's specialty crops by educating individuals who are not farmers but who took the classes and purchased California-grown specialty crops to produce cottage foods or specialty foods.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Workshops #1 and #2: The Project Director (PD) and collaborators developed curriculum, presentations and binders to provide education for specialty crop producers and others in the requirements and operations of California Cottage Food Operations. The curriculum was approved by the University of California Cooperative Extension (UCCE) Food Safety Specialist collaborator. At least one CFO made a presentation at each workshop. The 207-page binders were divided with tabs into the following categories, with the number of pages in each category indicated in parentheses:

- Introduction (2)
- Cottage Food Law (31)
- Food Safety (32)
- Canning Basics (18)
- Fruit Butters, Jams, Jellies & Preserves (64)
- Honey & Tree Nuts (8)
- Dried Fruits, Vegetables & Herbs (22)
- Vinegar & Baked Goods (14)
- Managing a Cottage Food Business (16)

The Project Team promoted and held 2-workshop (workshops #1 and #2) series at six different locations in northern California between May 1, 2014 and July 9, 2014; most attendees were present at both workshops. 211 participants attended these workshops, not including the presenters. 100 (47%) of them were specialty crop producers. Twelve of them were already registered/permitted CFOs. In 2015, the PD and UCCE collaborators organized, promoted and held two additional Cottage Food workshops in two Southern California locations, using the already-prepared curriculum. There were 105 attendees at these Southern California workshops.

Website: The PD, Project Coordinator (PC) and UCCE collaborators developed and published a website containing all the prepared materials and links to other resources of use to potential CFOs in California. The website is http://ucanr.edu/sites/cottagefoods/. Much of the information from the workshop binder is included on this website.

Workshops #3: The PD organized five sessions of workshop #3 (Starting a Specialty Food Business) at different Northern California locations in 2015, and one session of the workshop in 2016. The PC and collaborators helped promote the workshops and the PC assisted with logistics. Participants in workshops #1 and #2, other specialty crop producers, urban farmers and others were invited to participate in workshop #3. A total of 176 participants (not including speakers) attended one of the 6 sessions of workshop #3. Topics covered in workshop #3 included: Food Safety & Regulations, Marketing Specialty Foods, Getting Product on the Shelf, Processing & Packaging Options, Pricing for Profit, and Business Financing Options. Evaluations showed significant increases in knowledge levels for all topics. The Workshop #3 materials are posted on the UC Small Farm Program website at http://sfp.ucdavis.edu/marketing/Specialty_Foods/

Case Studies: The PD and the PC interviewed two specialty crop growers who are also SFPs to learn the details of their business planning, business development, production process, regulatory compliance process, expenses, income and future plans. The PD and PC then wrote up their responses as two case studies, sent each to the grower for verification, and completed final versions for publication. The case studies are posted on the UC Small Farm Program website specialty food section (http://sfp.ucdavis.edu/marketing/Specialty_Foods/), and were shared with participants at the 2 workshops #4

Workshops #4: The PD developed curriculum, selected locations and arranged facilities for two sessions of workshop #4 (Developing a Business Plan for your Specialty Food). The PC promoted these workshops to participants of the earlier workshops in this project, and to registered CFOs in the regions where the workshops were to be held. The PD conducted workshop #4 in Davis and in Oakland. A total of 29 participants, not including speakers, attended one of workshop #4. The Davis Workshop #4 materials are

posted on the UC Small Farm Program website at http://sfp.ucdavis.edu/marketing/Specialty_Foods/. Both farmers who were profiled in the case studies attended each session of Workshop #4 and gave presentations about their business planning and development. Their presentations were very well received by the participants, many of whom said in workshop evaluations that the case studies and personal presentations were the most valuable parts of the workshops.

Final Project Outcomes report: The PD and PC contacted all participants who had attended at least one Cottage Food or Specialty Food workshop, had provided an email address and had not unsubscribed from the project email list. Each was invited to complete a form asking if and when they had become registered CFOs or permitted SFPs, whether they planned to become either, and also asked for processing and sales data from those who had become CFOs or SFPs. The invitation was sent to 491 people. Seventy-five unique complete responses were received, for a response rate of 15.3 percent. The responses are summarized in an answer to a later question below.

For all workshops and educational materials, the PD ensured that all of the workshop curricula were designed to cover only specialty food products or cottage food products with specialty crops comprising at least 50% of the total weight of all of the ingredients. The CFOs and Specialty Foods business owners who spoke at all workshops produced only jams, jellies, candied fruit and nuts, cured olives, pickles, relishes, salsas, honey, olive oil, and tomato-based sauces.

The PD and UCCE project team members drafted the curriculum materials for Workshops#1 and #2 and finalized them after the Food Safety Specialist Project Collaborator approved them. UCCE collaborators worked with the PD and PC to organize, promote, conduct and evaluate results from the Cottage Food workshops in eight different California locations. One UCCE project collaborator developed the online Registration Form for the workshops. This effort was not included in the work plan, but it required major effort.

The PD and PC had the primary responsibility for organizing and conducting the six Specialty Food workshops (Workshop #3). A UCCE Food Safety Specialist made a Keep It Safe and Legal presentation at all six Specialty Food workshops. The PC had primary responsibility for creating the existing UCCE Cottage Foods website, http://ucanr.edu/sites/cottagefoods/. An independent contractor made two presentations, Getting Your Product on the Shelf and Pricing for Profit at all six Specialty Food workshops; he provided information that is essential to ensuring the financial viability of specialty food businesses that utilize specialty crops. Additionally, project partners included 10 specialty food business owners who process specialty crops into specialty foods; they made presentations at the six Workshop #3 that were very well received by workshop attendees.

The PD and PC had the primary responsibility for organizing and conducting the two Specialty Food Business Planning workshops (Workshop #4). This included finalizing the contractual agreements to conduct interviews with the two specialty crop growers who are also SFPs, interviewing them, and writing the case studies about the development of their specialty food businesses. The PD then worked with the two specialty crop/SFPs to ensure that their presentations were comprehensive and accurate.

The PD developed the curriculum outline for the rest of the workshop. They also developed and presented materials regarding the following topics: Importance of Business Planning and Business Plan

Formats, Assessing Your Specialty Food Business Readiness, and Let's Get Started on Your Business Plan.

The PC had primary responsibility for updating the existing UCCE Cottage Foods website, http://ucanr.edu/sites/cottagefoods/, and adding the Specialty Food Business presentations to the UC Small Farm Program website, http://sfp.ucdavis.edu. An independent contractor made two presentations, Getting Your Product on the Shelf and Pricing for Profit at this workshop; he provided information that is essential to ensuring the financial viability of specialty food businesses that utilize specialty crops.

The PD and PC conducted the request for information from all project workshop participants. The PC compiled the results of the responses and drafted a project follow-up report.

## Goals and Outcomes Achieved

Outcomes Measurement Process
An invitation to participate in outcomes measurement with a link to a follow-up form was sent three times by email in May 2016 to all of the 491 people who participated in at least one of the Cottage Food or Specialty Food workshops offered through this project. Seventy-five unique complete responses were received, for a response rate of 15.3 percent.

Summary of responses

- Specialty Crop Producers: 29.3 percent of respondents (22) identified themselves as Specialty Crop Producers. Extrapolating this percentage to the full number of workshop participants results in an expectation of 144 Specialty Crop Producer participants in the project
- Cottage Food Operations: 17.4 percent of respondents (13) had registered as Cottage Food Operations, either Class A or Class B. Extrapolating this percentage to the full number of workshop participants results in an expectation of 85 Cottage Food Operations among project participants.
- Specialty Foods Producers: 8 percent of respondents (6) had received permits to operate as SFPs. Extrapolating this percentage to the full number of workshop participants results in an expectation of 39 Permitted SFPs among project participants.
- Total Sales Revenue: 17 respondents (17 of the 19 respondents who identified themselves as either CFOs or SFPs) reported annual gross sales revenue totaling $148,788, or an average of $8,750 gross annual sales per respondent who reported sales. When this average gross sales revenue figure is multiplied by the expected number of workshop participants who are either CFOs or SFPs (124), the expected total annual gross sales revenue is $1,085,000
- Value of Specialty Crops processed: 16 respondents (16 of the 19 respondents who identified themselves as either CFOs or SFPs) reported a retail value of specialty crops processed as ingredients totaling $106,036, or an average of $6,627 value retail value of specialty crop ingredients processed per respondent who reported this value. When this average specialty crop ingredient value is multiplied by the expected number of workshop participants who are either CFOs or SFPs (124), the expected total retail value of specialty crops processed as ingredients is $821,748.

- Website visits since creation of website: 6,845 (3,806 during the past 12 months)
- Sales venues for Cottage Foods Operations and SFPs: The 19 respondents who are CFOs or SFPs reported selling their products at these venues:
    - 63 percent (12) sell at farmers' markets or fairs
    - 32 percent (6) sell at their own farm stand
    - 26 percent (5) sell at grocery stores
    - 47 percent (9) sell at specialty stores
    - 10 percent (2) sell through distributors or brokers (= 33.3 percent of the 6 SFPs)
    - 37 percent (7) sell online
- Types of products produced: The 19 respondents who are CFOs or SFPs reported producing these types of products:
    - 32 percent (6) produced fruit butters, jams, jellies or preserves
    - 5 percent (1) produced tree nuts or nut butters
    - 16 percent (3) produced dried fruits, vegetables or herbs
    - 32 percent (6) produced baked goods
    - 26 percent (5) produced oils or vinegars
    - 5 percent (1) produced pickles, relishes or fermented vegetables
    - 10 percent (2) produced candy or confections
    - 5 percent (1) produced sauces
    - 5 percent (1) produced fruit or vegetable juices or smoothies
    - 16 percent (3) produced granola or grain products
    - 16 percent (3) produced other products

Future plans: The 18 respondents who are currently CFOs or SFPs reported the following plans for their businesses over the next five years:

- 72 percent (13) plan to expand or diversify their product line
- 44 percent (8) plan to hire more employees
- 39 percent (7) plan to invest in buildings or equipment
- 18 percent (3) plan to maintain the current level of operations
- 6 percent (1) plan to scale back or reduce production
- none plan to close the Cottage Food or Specialty Food operation

Future Plans to become CFOS: Of the 56 respondents who were not currently CFOs, 37.5 percent (21) plan to become registered CFOs within the next 12 months. Extrapolating this percentage to the full number of workshop participants who are not currently CFOs (406) results in an expectation of 152 project participants who intend to become registered CFOs within the next 12 months.

Future Plans to become permitted SFPs: Of the 69 respondents who were not currently permitted SFPs (including the 13 CFOs), 30.4 percent (21) plan to become permitted SFPs within the next 12 months. Extrapolating this percentage to the full number of workshop participants who are not currently SFPs

(452) results in an expectation of 137 project participants who intend to become permitted SFPs within the next 12 months.

Utilizing the previously reported average annual revenues and annual specialty crops processed, these 289 future CFOs and SFPs would generate $2,728,750 in total annual sales revenues of processed food products and would utilize an additional $1,915,203 worth of specialty crops to produce their processed food products.

Goals accomplished:

- Number of specialty crop producers attending workshops – the expected number of specialty crop producers was 150. The actual estimated number, extrapolated from the follow-up questionnaire responses, was 144. There were at least 491 people who attended at least one project workshop; many of them are currently or plan to become CFOs or SFPs using specialty crops as their primary ingredients.
- Number of workshop participants who became CFOs – the expected number was 90. The actual estimated number, extrapolated from the follow-up questionnaire responses, was 85.
- Retail value of specialty crops processed – the expected value was $450,000. The actual estimated value, extrapolated from the follow-up questionnaire responses, was $821,748, plus the additional $1.9 million used by workshops who plan to become CFOs or SFPs.
- Total cottage food sales – the expected total cottage food sales was $1,200,000. The actual estimated gross sales of both cottage foods and specialty food by project participants, extrapolated from the follow-up questionnaire responses, was $1,085,000, plus the additional $2.7 million in revenues estimated to be generated by attendees planning to become CFOs or SFPs.
- Changes in levels of knowledge – The expected increase in knowledge level for relevant topics at each workshop was an average of at least 20 percent. This goal was exceeded in all cases, as demonstrated by the following summary of workshop participants' self-assessment:

**Evaluations for UCCE Cottage Food Workshops Held May 1-July 9, 2014**
**Average Ratings or Percentages**

| **Average Ratings, 1-5 scale** | **All locations (n=78)** |
|---|---|
| Workshop #1 meet expectations | 4.3 |
| Workshop #2 meet expectations | 4.5 |
| Understanding of Law before workshop | 2.1 |
| Understanding of Law after workshop | 4.5 |
| | |
| Manual Easy to Use (% Yes) | 95 |
| Used Manual (% Yes) | 88 |
| Contacted Local Environmental Health Office (% Yes) | 25 |
| **Since Workshops, likelihood of becoming a CFO (%)** | |
| Equally likely | 42 |
| More likely | 33 |
| Less likely | 25 |

Instead of asking the participants to assess their current level of understanding of a variety of knowledge areas related to cottage foods on a 5-point scale both before and after the workshop, the Project Director measured changes in knowledge attributable to the workshops were measured using TurningPoint software. At the beginning and end of each workshop, a series of 10 questions related to key cottage foods concepts were displayed. Attendees were asked to use their clickers to indicate the correct multiple-choice answer. The average percentage of attendees with correct answers increased from 48% before the workshop to 87% after the workshop--representing an 81% gain in knowledge.

Knowledge gained from Specialty Foods Workshops (3 workshops#3)
At the three Workshop #3 sessions conducted in Spring 2015, changes in the attendees' knowledge levels were measured through Pre- & Post evaluations. On a scale from 1 (little or no knowledge) to 5 (extremely knowledgeable), the pre- and post-knowledge levels increased by the following average amounts:

| | Pre-workshop | Post-workshop | % Increase |
|---|---|---|---|
| Food Safety & Regulations | 2.52 | 4.10 | 59 |
| Marketing Specialty Foods | 2.13 | 4.03 | 89 |
| Getting Product on the Shelf | 1.88 | 3.95 | 115 |
| Processing & Packaging Options | 1.95 | 4.90 | 100 |
| Pricing for Profit | 1.92 | 4.12 | 115 |
| Business Financing Options | 1.55 | 3.82 | 150 |

There were significant increases in knowledge levels; the goal of a 20% increase was clearly exceeded for every knowledge area. The overall quality rating for the workshops averaged 3.67 (with 4 being excellent).

Knowledge gained from Specialty Food Business Planning Workshops (two workshops #4)
At the two Workshop #4 sessions, changes in the attendees' knowledge levels were measured through Pre- & Post evaluations. On a scale from 1 (little or no knowledge) to 5 (extremely knowledgeable), the pre- and post-knowledge levels increased by the following average amounts:

| | Pre-workshop | Post-workshop | % Increase |
|---|---|---|---|
| The importance of Business Planning | 3.4 | 4.7 | 39 |
| Business Plan Formats | 2.2 | 4.1 | 88 |
| Preparing a Projected Income Statement | 2.3 | 4.1 | 75 |
| SBDC Resources | 1.7 | 4.0 | 144 |
| Case Studies of Sp. Food businesses | 1.8 | 4.6 | 156 |
| How to start a business plan | 2.3 | 4.3 | 85 |

The table on the next page summarizes the data reported on the previous pages. The 7-fold increase in the number of CFOs from the baseline to the end of the project is remarkable. If all 152 who plan to become CFOs actually do so, the overall project impact would be a 20-fold increase in the number of CFOs. The projected 3.5-fold increase in SFPs is also impressive. Similarly, the projected 2.3-fold increase from the end of the project in the values of specialty crops used by these producers also reflects the payoff of educating the attendees about cottage food and specialty food production, marketing and business management.

| | Baseline | End of Project | Planning to become Cottage Food or Specialty Food producer in next 12 months |
|---|---|---|---|
| Cottage Food Operator | 12 | 85 | 152 |
| Spec Food Producer | unknown | 39 | 137 |
| Annual Gross Sales | unknown | $1,085,000 | $2.7 million |
| Annual value of specialty crops used to produce foods | unknown | $821,748 | $1.9 million |

## Beneficiaries

- Small and mid-scale specialty crop producers, particularly growers of fruits and tree nuts, benefited from the project by gaining the knowledge and contacts needed to develop successful Cottage Food Operations or Specialty Food Production businesses. As CFOs or SFPs, they were able to add value to raw crops produced on their farms which increased revenue. Those specialty crop producers who participated in workshops but did not become food processors benefited by improved knowledge about food safety, marketing and business planning. They also benefited from the knowledge gained by attendees who were not farmers but who then became or planned to become CFOs or SFPs and process specialty crops.
- The employees of the Cottage Food and Specialty Food Operations developed through this project benefited through increased or continued employment revenue.
- Farmers' markets, grocery stores and specialty stores benefited from this project by having additional locally produced specialty crop-based products to offer to their customers.
- Consumers who purchased cottage foods or specialty foods produced by project participants benefited by having access to a greater variety of locally processed foods.
- Communities benefited because money spent on locally produced foods is likely to flow back into the communities of the producers.
- An estimated total of 144 specialty crop producers benefited by participating in at least one of the project workshops.
- An estimated total of 85 registered CFOs (including those already registered before the workshops and those newly registered after the workshops) benefited by participating in at least one of the project workshops.
- An estimated total of 39 permitted SFPs (including those already permitted before the workshops and those newly permitted after the workshops) benefited by participating in at least one of the project workshops.
- Registered CFOs and permitted SFPs who participated in the project generated an estimated total of $1,085,000 in annual sales revenue. Since the post-workshop gains in knowledge regarding marketing and various other business management areas were significant, we expect that their annual sales revenues will increase in the future.
- Registered CFOs and permitted SFPs who participated in the project processed specialty crops with an estimated retail value of $821,748 as ingredients in their processed products. The gains in sales states above should also generate increases in the value of specialty crops purchased to produce the Cottage Foods and Specialty Foods.

- Additionally, the potential economic impact of these producers is expected to increase, as 72 percent of them plan to expand or diversify their operations within the next five years.
- The potential economic impact of the estimated 152 project participants who intend to become registered CFOs and the estimated 137 who intend to become permitted SFPs within the next 12 months generates an additional $2.7 million in annual sales revenue and $1.9 million in retail value of specialty crops to be processed as ingredients.
- Data were not collected regarding the number of specialty crop suppliers each Cottage Food or Specialty Food producer was using; therefore, the total number of specialty crop producers who benefit as ingredient suppliers is unknown. However, it is reasonable to expect at least one specialty crop supplier for each Cottage Food and Specialty Food producer. This means that there were at least 124 specialty crops suppliers for these processed food producers by the end of the project, and potentially 289 additional specialty crop supplier within the next 12 months.

## Lessons Learned

Cottage Food Operation product restrictions seem to prevent many specialty crop producers from becoming registered CFOs. The goal of 90 CFO workshop participants becoming CFOs soon after the workshops was much too optimistic. Online evaluations submitted by 37% of the attendees indicate why this is the case. While 75% of the attendees reported that they were equally or more likely to become a CFO after attending the workshops, only 25% of them had contacted their local Environmental Health Office about becoming a CFO when questioned several months later. Their comments indicated that the "less likely" group was discouraged by the limited range of products that were approved Cottage Foods, and/or by the processing requirements for specific foods. For example, all jams must be made to be in compliance with the FDA's standard of identity, which requires that jams contain more sugar than fruit on a weight basis. When the attendees made strawberry jam during the workshops with the FDA-compliant recipe, they remarked that the jam was much too sweet.

Although the initial target participants for the project were specialty crop producers who would process their own crops as CFOs, many workshop registrants were not specialty crop producers. Instead they were potential CFOs or SFPs interested in purchasing specialty crops from farmers to use as ingredients in their food production businesses.

Because of the restricted list of products allowed to be produced as cottage foods, project organizers found more interest than expected in the more general category of specialty food production, including much interest from workshop participants in the options of shared kitchens, co-packers and the establishment of their own health department-approved production kitchens.

## Additional Information

UCCE Cottage Food website: http://ucanr.edu/sites/cottagefoods/
Specialty food production resources: http://sfp.ucdavis.edu/marketing/Specialty_Foods/
Case studies of farmers who developed specialty food businesses:
Penny and Vince Granberg, Rose Lane Farm, Oakley, CA – (http://sfp.ucdavis.edu/files/239615.pdf)
Courtney Smith, Bloomingcamp Ranch Bake Shop and Farm Stand – (http://sfp.ucdavis.edu/files/239616.pdf)

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 23 | **Project Title:** Food Safety Training for Supervisors and Farm Workers | |
|---|---|---|
| **Grant Recipient:** AgSafe | **Grant Agreement No.:** SCB13023 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Amy Wolfe | **Telephone:** (209) 526-4400 | **Email:** jeff@agsafe.org |

## Project Summary

Beginning in 2012, with the unanimous approval of all state handlers to extend the Handler Marketing Order to include mandatory compliance with science-based food safety practices and verified by the California Department of Food and Agriculture (CDFA) auditors, all growers, handlers, packers and distributors in the cantaloupe industry must adhere to the Cantaloupe Best Practices. Seeing the need of these groups to adhere to these newly expanded standards, AgSafe reached out to the California Cantaloupe Advisory Board (CCAB) to create a food safety program to ensure that everyone in the cantaloupe industry had access to trainings that would ensure the safety of this crop.

With recent food safety outbreaks and increasing scientific knowledge around foodborne illnesses, specialty crops have been under increased scrutiny due to the fact that they are often consumed fresh and with minimal processing. Historically, most of the focus had been on handlers; however, in a study conducted by the Arizona Leafy Greens Consortium, it was revealed through third party audits that the majority of food safety infractions occur in the field. For this reason, it was critical to develop a program to educate farm workers and supervisors on food safety protocols and commodity specific procedures. Additionally, given the fact that supervisors are tasked with training workers, by providing these individuals with the ability to pass on this knowledge and understanding to new employees, a meaningful impact in the safety of cantaloupes could be made and the reduction of foodborne illnesses could be made.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

In October 2013, project staff began to work with the CCAB to design a four hour cantaloupe specific food safety workshop specific to the guidelines that were developed by the CCAB, a four hour universal food safety workshop and a four hour train-the-trainer workshop. With CCAB guidance, project staff utilized food safety industry experts, and a bilingual, bicultural educator to help develop curriculum that addressed the language, literacy, and cultural challenges of the workers that needed to be trained.

The three modules developed are the following:

- Module 1 - Food Safety: Harvest Protocol for Supervisors and Farmworkers
    - This module provided supervisors and farmworkers with information on universal food safety protocol for hand harvested specialty crops.
- Module 2 - Cantaloupe Food Safety: Harvest Protocol for Supervisors and Farmworkers
    - This module addressed the specific food safety protocol for harvesting cantaloupe using guidelines developed by the CCAB.
- Module 3 - Food Safety Tailgate Training Essentials

- This module was developed to teach supervisors tasked with training their workers how to deliver effective training. Participants were given tools and resources to use in their operation and to develop and enhance their presentation skills with fellow course participants using tailgate-to-go training toolkits. The toolkits consisted of one set of supervisor cards and five sets of worker cards, DVD training instructions, topic outlines and activities. The toolkits are available in both English and Spanish.

In April 2014, project staff began offering Module 1 of the training by following the harvest trail and beginning in the south and working north in four locations in California. In 2015, Modules 2 and 3 were completed, and all three training modules were taught beginning in April 2015 and April 2016. The four locations were:

- Holtville, California
- Huron, California
- Firebaugh, California
- Fresno, California

This project focused only on crops that are consumed fresh, and specifically targeted cantaloupes and what makes them particularly susceptible to foodborne illnesses. Therefore, these trainings only directly benefitted supervisors and farm workers who specifically work with and harvest cantaloupes.

The CCAB, a partner in this project, was instrumental in their assistance with the following:

- Promoted tailgate-to-go toolkits and upcoming trainings to agricultural operations in the cantaloupe industry;
- Provided input on the timing of upcoming trainings;
- Provided information through their voluntary food safety audits to determine if there has been a change in behavior among supervisors and farm workers;
- Reviewed tailgate-to-go training toolkits to ensure accuracy;
- Reviewed updated curriculum based on feedback from course attendees.

## Goals and Outcomes Achieved

In order to achieve the performance goals and measurable outcomes of this project, project staff developed a three-part supervisor and farm worker training program, which included a food safety module, a cantaloupe food safety module and a train-the-trainer module, described above. Additionally, tailgate-to-go training toolkits were developed, which were designed to be used by supervisors in training farm workers. Lastly, the curriculum was developed into a webinar to enhance the sustainability of the project.

The overall focus of this project was to positively impact the cantaloupe industry through the implementation of food safety protocols throughout the production and handling of cantaloupes and reduce the potential for foodborne illness outbreaks. To date, project staff have successfully developed and implemented a culturally and linguistically appropriate training program for supervisors and farm workers in the cantaloupe industry. Additionally, a webinar series was created and tailgate-to-go training toolkits developed.

Each module was delivered, resources were given to participants as well as the CCAB, and a webinar was developed and recorded that was provided to CCAB and is also available on the AgSafe website.

Although the target number of supervisors and farm workers was not met due to the unforeseen drought and subsequent reduction in cantaloupe producing acres, through pre- and post-training assessments it was determined that more than 75% of supervisors and workers have reported an increased knowledge in their understanding of food safety procedures.

Through this project, approximately three quarters of the number of workers anticipated were reached, approximately 526 participants. Although the goal was not met, webinars developed are available on the AgSafe website for others to access and tailgate-to-go training toolkits were provided to the CCAB for future use.

Cantaloupes 2016
Progress made:

Number of CDFA Visits

| | **2013** | **2014** | **2015** |
|---|---|---|---|
| Desert | 13 | 25 | 32 |
| Valley | 40 | 75 | 59 |
| **Total** | **53** | **100** | **91** |

Number of Infractions

| | **2013** | **2014** | **2015** |
|---|---|---|---|
| Major | 4 | 5 | 5 |
| Minor | 258 | 207 | 98 |
| Minor Infractions | 94 | 67 | 86 |

Infractions include:

- Sanitary units- Unsanitary- Soiled Toilet paper- Fecal matter
- Crews not using proper hygiene-handwashing- Spitting in the field
- SOP's incomplete and/or not available for review
- SOP's not being enforced in the field
- No SOP's for employee eating areas, food trucks, personal items
- No glove policies
- Grey water leaking and cross contamination
- No foods safety plan
- Worker hygiene and training
- Training and worker hygiene/worker health
- Sanitation and training of cleaning personnel
- Assessments
- Facility maintenance/ water use
- Food safety availability 24/7
- Spitting in the field or growing areas

- Falsification of a record
- Hand wash water testing
- Feces near unharvested field
- No hazard analysis; no plan; no self-audits; no mock traceback

Progress

1. Total deviations dropped from 356 in 2013; to, 279 in 2014; to 189 in 2015
2. Deviations per audit dropped from 5 per audit in 2013 to 2 per audit in 2015

Areas still needing improvement:

- Training- on going
- Submitting CAP's in a timely manner
- Attention to detail

Through this project, approximately 526 individuals were trained. Of those, according to survey results, 50% of the harvesting workforce was through farm labor contractors. Supervisors and farm workers are trained daily by over 50% of respondents with almost 60% of those trained using videos and written materials. It was also determined that employers gave an average rating between 7.46 to 8 on a scale of 10 on their employee's knowledge in the areas of worker health and hygiene, field sanitation, food contact surfaces and proper decontamination.

Tailgate-to-go training toolkits were also developed in 11 different topics, two partnerships were establish which will enable the project to continue beyond the scope of the grant, and three webinars were created, covering hygiene, field sanitation and the Food Safety Modernization Act. The project allowed creation of a template for the tailgate-to-go training toolkits, which can be replicated and used in other specialty crops.

## Beneficiaries

This program was designed to benefit all growers, packers, handlers and distributors in the cantaloupe industry. Specifically, the project targeted supervisors, workers and farm workers who are on the front lines and where food safety practices begin. 526 participants were directly reached during the grant term.

The potential economic impact of this grant is huge as the cost to a business resulting from a foodborne illness outbreak can de debilitating. With the Food Safety Modernization Act and Produce Safety Rule, this program has prepared project staff with the tools to deliver high quality food safety training. Additionally, participants in this project will have a leg up when it comes to having to comply with these new regulations.

## Lessons Learned

Project staff started this project with the expectation that growers would be trained on food safety procedures; however, when the training courses began, there was a high number of farm labor contractors who, along with their workers, attended the trainings. Project staff have been able to help farm labor contractors become more competitive through the trainings by enabling them to be able to comply with the regulations that their grower customers face.

This project was implemented when California's drought was beginning to become severe. Many growers opted not to plant cantaloupes and instead keep water for higher value permanent crops. Those growers who did plant cantaloupes experienced a much earlier harvest than normal which kept some growers from sending supervisors and workers to the workshops. In Year 2, tailgate-to-go training toolkits were developed to provide supervisors who had taken the trainings in Year 1 the necessary materials to successfully teach proper food safety protocols to workers. The creation of the tailgate-to-go training toolkits were not imagined to be utilized outside of this grant. However, the response received in the second year of this grant was so positive, that project staff decided this model could be replicated in other safety and human resource topics. There really wasn't anything like this available for supervisors to use in the field to train which also met the cultural and linguistic needs of this workforce. Then in Year 3, with California's drought still ongoing and a lot of cantaloupes still not being produced, a webinar was created, which can be used to train supervisors and workers well beyond the scope of this project.

In conclusion, although growers and grower employees did not turn out as hoped, project staff were still able to train three quarters of the anticipated workers through farm labor contractors who focus their businesses in specialty crops.

Although there was no way to predict the changing weather patterns that were heading to California and the subsequent effects, project staff were able to come up with creative solutions to develop curriculum and resources which can be used well into the future.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 24 | **Project Title:** Revitalizing Specialty Crop Agriculture in the Valley of the Heart's Delight: a Model for Linked Urban – Rural Sustainability | |
|---|---|---|
| **Grant Recipient:** Sustainable Agriculture Education | **Grant Agreement No.:** SCB13024 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Sibella Kraus | **Telephone**: (510) 928-2972 | **Email:** Sibella@sagecenter.org |

## Project Summary

Prime urban-edge farmland can help contain and sustain cities, but only if revitalized and protected through strategic collaborative actions by urban and rural stakeholders. Farmland threatened by urbanization and with significant agronomic value - good soils, sufficient water and large parcels - is a vital resource needing urgent protection. Heritage farmland is doubly important, as tradition can nurture and help revive the cultural value of local agriculture and urban-rural connectivity. This is the case with the need and opportunity to revitalize specialty crop (SC) agriculture in the Valley of the Heart's Delight. Renowned a century ago for its fertile soils, diverse crops and fruit production that created a vast vista of springtime blossom, today the valley is mostly known as urbanized Silicon Valley. What remains undeveloped is the Coyote Valley (CV), an area of around 7,400 acres - mostly farmland - located between San Jose and Morgan Hill, California. For decades, CV looked to development for its future. However, the cessation of the CV Specific Plan in 2008 created an opportunity to reconsider a future for CV in which agriculture would be revitalized as a significant regional resource. In late 2012, Sustainable Agriculture Education (SAGE) completed a two-year, multi-stakeholder Feasibility Study, Sustaining Agriculture and Conservation in the Coyote Valley: Findings and Recommendations. Recent local general plan updates and a new Habitat Conservation Plan (HCP) confirm the Valley's resource values. Now SAGE and key stakeholders are poised to implement the Study's recommendations for Start-Up Phase activities that will initiate fulfillment of this long-term vision. The CV is home to a regionally significant agricultural resource area that contains important farmland and key habitat; supports livelihoods for its farmers, ranchers and agricultural employees; provides healthy food and a recreational amenity for Bay Area communities; and protects important ecological and cultural resources of the region.

To enhance marketability of locally grown SCs, project partners educated consumers through marketing campaigns, events and worked with farmers to increase agritourism. To enhance environmental performance, partners provided workshops, technical assistance, demos and outreach to increase SC growers' use of sustainable agriculture practices and establish new habitat enhancements such as hedgerows. To improve financial performance, the project helped growers transition to higher value SCs and increase sales to local market outlets. To expand access to SC, the project catalyzed transition to SCs from land in hay or fallow and facilitated connections between local markets, urban communities and growers. To invest in the next generation of SC operators, partners recruited and supported new beginning, immigrant, transitioning and scaling-up farmers.

This project did not build upon a previously funded Specialty Crop Block Grant Program (SCBGP) project.

## Project Approach

The activities and tasks performed during the entire grant period are as follows:

Goal #1. Increase number of SC operations by recruiting and supporting beginning, immigrant, transitioning and scaling-up farmers.

- Planned activity 1: Identify farmers interested in starting or expanding production of SC in CV.
  Results: Compiled database of all SC growers in the CV; reached out to all eight main SC growers to ascertain interest in expanding production; reached out to three main hay growers to ascertain interest in converting some land to SC (one hay grower was interested, but did not have the capacity to start vegetable production; one hay grower felt threatened by potential for rising lease rates; another hay grower is rotating some hay land with pumpkin crops grown by another farmer). Six new SC operations, four by scaling up farmers and two by beginning farmers.
- Planned activity 2: Identify private and public landowners interested in leasing or selling land for new SC production.
  Results and conclusions: Reached out to all major main landowners and some smaller landowners to ascertain interest in leasing land for SC production. There was limited availability due to long-term relationships with other leases; and unrealistic lease terms (short duration and/or unfeasibility requirements for irrigation system upgrades).
- Planned activity 3: Connect interested farmers with interested landowners.
  Results and conclusions: This was done on a one-on-one basis throughout the project with plots of land ranging from 6 acres to over 100 acres. A match that still holds promise is between IBM, which has 1,000 acres of land in the CV including 100 acres of SC ground, and an experienced, well-resourced local farmer.
- Planned activity 4: Provide technical assistance to support establishment of new farming operations, including inviting new farmers to all workshops.
  Results and conclusions: Conducted a Production 101 workshop for beginning farmers in Morgan Hill, California (next to the CV), which was attended by 21 diverse beginning farmers in the area. There was much enthusiasm about the practical nature of the material, appreciation for the resources provided, and a request to address needs/concerns of very small (~1-acre) farms in the future. Supported the Bay Area Chrysanthemum Growers Association (BACGA), with ~ 100 members (mainly growing Asian greens) with technical assistance for the organization and members, translation services to facilitate utilization of financial assistance, and a detailed action plan for accessing additional needed resources. Developed a feasibility study and business plan for a 10-acre sustainable agriculture demonstration farm in collaboration with the Ag Program of Ann Sobrato High School, which is located in the south-eastern corner of the CV. This plan has been embraced by the school and agriculture partners. The school district is currently looking at funding and staffing in order to implement. Meantime, the agriculture partners are assisting the school with program design.

Goal #2. Increase SC acreage and profitability by transitioning hay or fallow land to SC and/or by growing higher value SC.

- Planned activity 1: Identify local market demand for new SC.
  Results and conclusions: Identified demand for dozens of SC that could be produced in the CV. The demand for land and for CV-grown SCs far exceeds supply.
- Planned activity 2: Identify farmers interested in starting/expanding/upgrading SC production.
  Results and conclusions: Identified over 20 farmers interested in starting SC production, with capacity to start at 2 to 100 acres. All of the 5 main SC producers in the CV, want more land. 580 acres in new

plantings of cherries (40 acres), walnuts (280 acres) and mixed row crop operation, expansion and in new management (260 acres).

- Planned activity 3: Meet one on one with interested farmers.
  Results and conclusions: Met one on one with interested farmers to communicate market data and share information and resources about production.
- Planned activity 4: Establish research plot for SC (e.g. specialty peppers).
  Results and conclusions: Facilitated a chili pepper SC production trial in partnership with University of California, Cooperative Extension (UCCE) and a 5,000 acre family-owned farming operation located in Gilroy, California. Extensive data was collected on the 68 varieties of chili peppers. Peppers were harvested with data recorded to provide information on specific production.
- Planned activity 5: Conduct two field days for farmers at the research plot.
  Results and conclusions: Information and training were provided to other local farmers and agricultural professionals through two field days at the chili pepper SC production plots, both led by UCCE Small Farm Program Advisor. The August 19 field day targeted master gardeners and local culinary professionals. The August 28 chili pepper production seminar and field day included presentations by six experienced agricultural professionals who presented on topics of SC chili pepper varieties, their production in CV, and chili pepper marketing. Beginning farmers and Santa Clara County growers were targeted for outreach for the event, and the workshop served 25 farmers interested in improving their SC production. AgAlert wrote a feature story about the crop trial.

Goal #3. Enhance natural resource stewardship by adopting new sustainable agriculture practices and establishing habitat enhancement.

- Planned activity 1: Identify farmers interested in utilizing sustainable agriculture practices and/or installing habitat enhancement.
  Results and conclusions: Direct outreach to farmers was not productive, mainly because all row-crops farmers are leasing land. However, outreach at relevant workshops, where the audience already inclined toward sustainable agriculture, was well-received.
- Planned activity 2: Hold a workshop about sustainable agriculture practices for greenhouse farmers.
  Results and conclusions: Organized a two-part weed management demonstration project for greenhouse grown Asian greens at the site of two different growers. The same type of Asian greens were planted in both areas, with one area planted by broadcasting seeds (the traditional method) and the other area planted by seeding in rows with a seeder. Both areas were irrigated and fertilized the same way. The primary purpose of the demo project was to assess and compare these two planting methods for weed management efficiency and also to compare efficacy of two different types of seeders. It was concluded that use of the seeder proved to be more efficient, but growers were reluctant to change long-standing habits; it is essential to select partner growers who really want to learn new practices and who are willing to share findings with other growers.
- Planned activity 3: Hold a workshop for farmers about sustainable agriculture practices for row crops.
  Results and conclusions: This workshop was not held due to insufficient interest from row crop farmers, despite extensive outreach. In lieu of this workshop, a two part weed-management demo was organized instead (see above).
- Planned activity 4: Establish demo hedgerow at Ann Sobrato High School.
  Results and conclusions: Developed and implemented the site plan, plant list, land preparation plan, irrigation plan and planting days plan for a 10,000 sq. ft. hedgerow around the school's 2-acre farm.

- Planned activity 5: Establish demonstration hedgerow on CV open space preserve.
  Results and conclusions: Developed the site plan, plant list, mulching plan, irrigation plan and planting day plan for a 3,000 sq. ft. hedgerow in the CV open space preserve (that adjoins CV farmland). This has not yet been implemented due to insufficient water supplies due to the drought, but will be in the future.
- Planned activity 6: Hold a workshop for farmers about habitat enhancement.
  Results and conclusions: Held two workshops. In partnership with the National Resources Conservation Service (NRCS), organized a hummingbird habitat workshop. Conducted a hummingbird habitat workshop on April 22, 2015 with NRCS and San Benito County Resource Conservation District. Held at Ann Sobrato High, the workshop was attended by about 30 farmers and included presentation by several students about specific habitats for hummingbirds and other bird species. In partnership with the Loma-Prieta Resource Conservation District, organized an introduction to hedgerows and pollinators workshop followed by a walking tour of the Ann Sobrato High School. Participants gave strong positive evaluations.
- Planned activity 7: Develop a project to demonstrate methods for increasing irrigation efficiency in greenhouse operations.
  Results and conclusions: With support from the Santa Clara Valley Water District, organized an irrigation efficiency demonstration project, a partnership between an ecological landscaping and consulting company that specializes in water management, and a grower. The new drip irrigation system was a major improvement over the existing system. Other interested growers will need additional training in how to design, install, and maintain efficient drip irrigation systems.
- Planned activity 8: Irrigation Efficiency project workshop.
  Results and conclusions: Conducted the workshop in English and Chinese for the irrigation efficiency demonstration project. The workshop was attended by approximately 40 people including greenhouse growers, natural resources agency personnel, equipment providers, and representatives from PG&E.
- Planned activity 9: Support farmers' adoption of natural resource conservation.
  Results and conclusions: In partnership with the NRCS, presented information to farmer's at all relevant workshops about habitat establishment and management plans; provide info about Environmental Quality Improvement Program (EQIP) and other funding sources. At the high school, UCCE is establishing a manure composting demonstration project, with the finished compost destined for the school farm garden beds.
- Planned activity 10: Identify groups of volunteers interested in working with farmers to establish habitat enhancements.
  Results and conclusions: Groups of volunteers were identified to help plant the CV open space preserve hedgerow, but that project was postponed. Around 50 students were involved in planting the hedgerow at Ann Sobrato High.
- Planned activity 11: Monitor new sustainable Ag practices and new habitat enhancements; provide ongoing technical assistance to farmers.
  Results and conclusions: Conducted site visits of habitat on agriculture lands with Audubon Society staff and DeAnza College Wildlife Biology instructors; a strong interest in maintaining and enhancing on-farm feeding habitat for species including tri-colored blackbird, Swanson's Hawk and migrating raptors. Alfalfa fields have been proved to be especially good habitat; however with alfalfa production declining in the CV, the thought is to see if it might be possible to work with growers to rotate alfalfa and row crop production over several year rotation period. Obviously, this is challenging in general since growing

row crops and alfalfa are not usually combined within the one operation; and challenging in the CV in particular due to continued uncertainty about development.

- With staff from a related project, did a site visit of CV wildlife corridor camera tracking stations along Fisher Creek, in order to consider how to encourage farmers to adopt practices, such as wildlife-friendly fencing and creek clearing, to facilitate wildlife movement.

Goal #4. Increase agritourism

- Planned activity 1: Compile data about current agritourism and related recreation visitation.
  Results and conclusions: Researched information about current agri-tourism and related recreation visitation through the local Chamber of Commerce and the California Agri-tourism Program. There is no good data available; however the local Chamber said that such information would be very valuable to have.
- Planned activity 2: Hold two workshops for farmers interested in starting or increasing agritourism on their farms.
  Results and conclusions: Held an all-day Agritourism workshop, which attracted 18 presenter-participants and another 20 farmer participants. Highlights from the evaluation included: appreciation for the breadth of information presented the diversity and caliber of the presenters, and the relevance of the information to beginning farmers.
- Planned activity 3: Connect farmers with relevant technical assistance.
  Results and conclusions: Facilitated at the Agritourism workshop.
- Planned activity 4: Create and launch a 'Visit Coyote Valley', Rebirth of the Valley of the Heart's Delight campaign.
  Results and conclusions: Created a Discover Coyote Valley initiative, including a spectacular logo, lively website, interactive map of CV features, and series of monthly events. The website is regularly updated and is promoted with enewsletters.
- For a lead article in the Edible Silicon Valley about CV agriculture, was the key informant, facilitated interviews with farmers, and organized an all-day site tour.
- Planned activity 5: Organize five events promoting CV agritourism and farm products, and related recreational activities.
  Results and conclusions: Organized or partnered on seven events celebrating agriculture in the CV including: a farm tour and hike; three major festivals (for which the project staff provided educational booths); a tour of farms near the creeks; a presentation about farmland as habitat for birds and other wildlife, with a walking tour; and a walk to a CV overlook with presentation about CV agriculture.
- Planned activity 6: Create a 'Friends of Coyote Valley' group.
  Results and conclusions: Created a sign-up space on the webpage and now have several hundred participants; are participating in an I Love Coyote Valley campaign.

Goal #5. Increase sales of SCs to local market outlets

- Planned activity 1: Identify farmers interested in developing new local market outlets (through a baseline survey).
  Results and conclusions: Worked directly with all interested CV SC growers, including members of the Bay Area Chrysanthemum Growers Association, to help them refine their marketing plan to local outlets; provided contact information for key market outlets.

- Specialty peppers produced in the SC research plot were given to 10 different restaurants and chefs in the Bay Area. Chefs were given a large sampling (over 25 different types) of chili varieties and asked to experiment with the chilies in whatever culinary ways appealed to them. Result: a strong interest in a steady supply of several varieties.
- Planned activity 2: Increase promotion of CV SC farmers in Santa Clara Valley 'Buy Fresh, Buy Local'
  Results and conclusions: Included profiles of all CV SC farmers on the DCV website: http://www.discovercoyotevalley.org/agriculture/ . Adding a CV-grown sub-label to the Santa Clara Valley 'Buy Fresh, Buy Local' label proved not important; more important was direct assistance with building marketing relationships.
- Planned activity 3: Provide information to farmers about additional new local market outlets.
  Results and conclusions: Organized and facilitated in-person meetings between leading local buyers and interested CV SC farmers. To date, these meetings have not yet led to sales contracts. The most promising connection is between the leading CV SC grower, and the organization facilitating local SC procurement for San Jose's Healthy Corner-store Campaign.
- The Food Works will continue to provide opportunities for CV SC farmers to connect with market outlets in San Jose.

Project Administration

- Planned activity 1: Convene the Coyote Valley Agricultural Enterprise and Conservation (COVAEC) committee to get guidance on, and new partners for, project activities.
  Results and conclusions: Formed a COVAEC program advisory committee which includes 18 local stakeholders including representatives from organization and agencies involved in food, agriculture, as well as local farmers. The advisory committee met six times; communications with members was ongoing and essential for guidance on and support for project activities.

SCBGP funds were solely expended on activities and costs that enhance the competitiveness of eligible SCs. Project staff verified that project activities were solely for the benefit of SCs, through the following measures:

1) Project staff kept lists of farmers assisted through the program such as registration lists of workshop attendees, farmers who attend field days and trainings, farmers reached through outreach efforts, farmers who receive technical and/or marketing assistance, and farmers who participate in valley-wide events, in order to verify farmers are growers of SCs, or participating in the project in order to assist transition to SC production.

2) For any project activity that incidentally generated interest in CV as a whole, such as the valley-wide events and the "Visit Coyote Valley" agritourism efforts, project staff ensured SCs were highlighted. The logo integrated SCs grown in the Valley, and the events focused on and highlighted seasonal SCs such as cherries, strawberries, spring greens, early squash, fresh onions, and plant starts in late spring, and peppers, sweet corn, tomatoes, figs, melons, and pumpkins in early fall. Slogans and marketing materials highlighted SCs, especially fruits and vegetables. These efforts did not highlight any one brand or grower.

3) Project staff designated SCBGP funds only for the portion of activity that directly benefited SCs and secured separate support (matching funds or in-kind support) for any aspect of the program that benefited non-SCs or recreation. For example, for valley-wide event materials, all SCs and growers were listed under the category of SCs with funding designated from SCBGP.

The project formed a COVAEC program Advisory Committee, which met six times during the project to support, coordinate, advise on, and provide outreach for project activities. Members and their specific contributions and roles were as follows:

- Santa Clara Valley Open Space Authority (SCVOSA) took the lead in all land conservancy efforts, which resulted in 80 acres of fee title land being transferred to them, and in serious offers for easements for acquisition being made on over 1,000 acres of farmland. With the primary partner in major and minor public events, attracted well over 5,000 people to the CV to learn about its SC's and experience its natural beauty.
- UCCE was the lead researcher in the successful Chili Pepper Variety Trial Demonstration, and a research collaborator on the Weed Management in Greenhouses Demonstration sub-project. UCCE staff advised individual SC growers and participated in outreach efforts throughout the project.
- NRCS Hollister Office was the lead in outreach to SC growers about natural resources stewardship enhancement practices, including cost-sharing opportunities for implementation of such practices.
- Guadalupe-Coyote and Loma-Prieta Resource Conservation Districts was the lead partner for Coyote Valley Hedgerow Workshop and Tour at Ann Sobrato High School, where the project established an extensive native plan hedgerow. Supported the planning for a 10-acre sustainable agriculture demonstration farm. Provided technical assistance to SC growers throughout the project.
- Community Alliance with Family Farmers provided detailed information about local demand for specific SCs that were being grown or that could be grown in the CV.
- Santa Clara County Farm Bureau (FB) hosted the project to engage FB members with opportunities to participate in project activities, and provided outreach for such activities.
- California FarmLink provided, and regularly updated, detailed information about SC growers seeking land to farm in the CV.
- The Health Trust was a liaison between the project and the Healthy Corner-store initiative in San Jose, which resulted in direct connections being made between CV SC growers and potential new markets in San Jose.

## Goals and Outcomes Achieved

The activities that were completed in order to achieve the performance goals and measurable outcomes are described in detail on the Project Approach.

The project will have local impact in two to three years: providing land access and support for beginning farmers, new ideas for established farmers, fresh food and agritourism opportunities for diverse, nearby communities, and new ag-conservation co-management models. Over time, the project will also have regional impact: saving over 2,000 acres of farmland; adding up to $20M in agriculture value; enhancing wildlife linkages between the Diablo and Coastal ranges; and fostering infill versus suburban development.

The project will result in successful implementation of the COVAEC start-up phase activities identified in the CV Study, and will have these key outcomes: (1) 75- 150 acres of farmland with new ag easements; (2) at least six new SC farmers; (3) 25% increase in average ag production value per acre, currently ~$2,000; (4) 15% increase in farmers' utilization of sustainable ag practices; (5) at least 10 ten acres of new hedgerows with a focus on habitat for pollinators (5) 50% increase in the number of agritourism visitors; (6) 20% increase in the volume and value of CV-produced products sold within the county; (7) County-wide recognition of the CV grown-brand; and (8) 25% increase in public, philanthropic and private investment in individual enterprises and valley-wide elements.

Completion of achieving outcomes and showing the progress toward achieving set targets are as follows:

1. Increase number of SC operations by recruiting and supporting beginning, immigrant and scaling-up farmers.

Goal: Support next generation of SC growers
Performance Measure: Number of SC operations begun or expanded
Benchmark: ~44 SC operations (1/3 in nursery crops)
Target: By December 2015, there will be at least six new SC operations
Result: Six new SC operations, four by scaling up farmers and two by beginning farmers.

2. Increase SC acreage and profitability by transitioning hay or fallow land with available water to SCs and/or by growing higher value SCs.

Goal: Increase SC acreage & profitability
Performance Measure: Number of acres transitioned and/or with improved profitability
Benchmark: ~1,000 acres in hay, fallow or lower-value SCs
Target: 75 acres (7.5% of benchmark) will be in new SCs
Result: 610 acres in new plantings of cherries (40 acres), walnuts (280 acres) and mixed row crop operation, expansion and in new management (290 acres).

3. Enhance natural resource stewardship by adopting new sustainable ag practices (e.g. crop rotations, water conservation, bio-controls) and establishing habitat enhancement (incl. hedgerows)

Goal: Enhance environmental performance, valley-wide ecosystem services/habitat
Performance Measure: % of SC growers; sq. ft. of habitat enhancement
Benchmark: ~44 growers; limited adoption of sustainable agriculture practices
Target: 25% of growers will have adopted new sustainable practices; 200,000 sq. ft. of new habitat enhancement
Result: ~ 10,000 sq. ft. of new habitat hedgerow established, and another 3,000 sq. ft. planned; new water conservation system for greenhouse production adopted; water conservation in row crop operations refined; otherwise limited adoption of new practices

4. Increase agritourism

Goal: Improve financial performance, community engagement with CV, access to SCs
Performance Measure: # of agritourism visitors to SC farms, agritourism operations
Benchmark: Limited visitors at two seasonal farm stands
Target: 30% increase in agritourism visitors; two new operations
Result: Over 5,000 new visitors, which is likely 100% increase in agritourism (however, baseline data was not available); one new farm-stand and one upgraded farm-stand

5. Increase sales of SCs to local market outlets (incl. on-farm sales)

Goal: Improve financial performance, access to SCs
Performance Measure: % increase in sales of SCs to local markets
Benchmark: Limited; to be measured in baseline study
Target: 20% increase in sales to local markets
Result: Direct connections established between the major SCs sold in the CV and new retail outlets in San Jose. Surveys of 20 restaurants, 15 retail stores, 11 corner-stores, and nine distributors in San Jose, showed that most of these businesses have far more demand than supply of locally-grown SCs. CV is the closest

growing area to San Jose. Establishment of over 600 acres of new SCs, and creation of a new and an upgraded farm stand will clearly result in a significant increase local sales. Baseline research showed no tracking of CV-grown SCs sold to local markets, beyond through farm stand sales.

The major successful outcome of the project was the increase in SC acreage. Six hundred ten acres in new plantings of cherries (40 acres), walnuts (280 acres) and mixed row crop operation, expansion and in new management (290 acres). A related qualitative outcome is that CV SC agriculture is the most major resurgence in the past 40 years, since pears and prunes for canning were leading crops in the area.

## Beneficiaries

The groups and other operations that benefited from the completion of this project's accomplishments are as follows:

- 44 SC growers in the CV and 100 in the Santa Clara Valley in general
- More than 10,000 consumers and market outlets who enjoy and/or who might enjoy in the future CV-grown SC

## Lessons Learned

The primary lessons learned were: (1) the importance of relationships with farmers and partners in trying to bring about change: (2) it takes time to build relationships and trust; (3) cultivating relationships with existing farmers needs to take precedence over bringing in new farmers, even when the existing farmers may question long-term agriculture viability and new farmers are very eager to get engaged; (4) the value of prime farmland near a dense urban area was re-enforced; and (5) it is very challenging to bring about re-investment in agriculture (e.g. investment in natural resources stewardship and in upgraded irrigation infrastructure) on farmland owned by developers, where future land use is uncertain.

A very positive unexpected outcome was the number of acres converted to SCs (410) and new management of SCs (200) exceeded the project goals by eight times.

## Additional Information

Attachment 1

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 25 | **Project Title:** Farmer Education and Enterprise Development | |
|---|---|---|
| **Grant Recipient:** Agriculture and Land-Based Training Association | **Grant Agreement No.:** SCB13025 | **Date Submitted:** December 2015 |
| **Recipient Contact:** Chris Brown | **Telephone:** (831) 758-1469 | **Email:** chris@albafarmers.org |

## Project Summary

Despite the prosperity of Monterey County and the strength of the local agriculture sector, many hard-working families employed in agriculture remain near or below the poverty line. Though the poverty rate in Monterey County of 13.9% is comparable to California's rate of 13.7%, there is a significant variance within the county. A closer look at communities with higher concentrations of Latino immigrant families is more reflective of the dire economic conditions Agriculture and Land-Based Training Association (ALBA) is trying to confront. For instance, Salinas' poverty rate is 18.1% and families residing in Salinas' East Alisal neighborhood suffer a rate of 21.5%, which is more than 50% higher than the California state and county levels. Many of these families depend on low-paid, seasonal work in the fields. To reduce poverty and increase economic self-sufficiency, it is crucial for local families to have opportunities to invest themselves in their communities with economic and educational advancement.

The opportunity to establish a family farm showed great promise as the demand for organic, locally grown foods was increasing at a rapid pace. Furthermore, California agriculture suffered a huge demographic gap with the average farm owner approaching 60 years of age, and no younger generation poised to take their place. Many Latino farmers have the work ethic, entrepreneurial drive, and agricultural skills to fill the gap. What was lacking in transforming these skills into enterprise creation, job creation, and local investment was educational opportunities and access to land and finance. This project provided access to education, technical assistance, land and equipment for aspiring family farms, as well as developed ALBA's food hub, which aggregates and markets organic produce from small family farms. Furthermore, this project expanded regional market channels which value local, organic produce; and provided long-term education and hands-on skills training through land-based farm incubator program.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Project staff educated sixty aspiring farmers through a ten-month, 300 hour, Farmer Education Course designed to launch an organic farm growing specialty crops. Two classes of thirty participants were set to run from January to October of 2014 and 2015, meeting twice a week. Modules included organic production, marketing, business management, compliance and record-keeping. The final module applied organic farming, during which students farmed a 1.3 acre piece. They grew several products, such as zucchini, kale, tomatoes, peppers, and carrots. Produce was sold through ALBA Organics and other direct market channels. The student farmers grew and sold nearly $20,000 in produce, gaining valuable experience in cultivation, packing, handling, and marketing. Students also gained exposure to successful practices and organic farms through site visits and guest speakers. Also contributing to the course were ALBA staff with Master Degrees in crop science, environmental policy, and business.

Important changes were made to the curriculum to better serve the students:
The term started in November in order to take full advantage of the off season when participants are often unemployed or underemployed. Project staff would fast track one to three capable students, allowing them to lease their land while finishing up the Programa Educativo para Agricultores (PEPA) course. This was an attempt to allow individuals to advance toward farm ownership at their own pace. For those needing more farming experience prior to entering the incubator, project staff would introduce another 'cooperative farming' module allowing them to group farm for another crop cycle prior to signing a lease.

In the organic farm incubator, fifty-five farm businesses received access to affordable land, equipment and markets. ALBA leased 150 acres of land annually to beginning specialty crop farmers. These farmers received an average of fifty hours of individual technical assistance on production, business management, and marketing each year of the program.

The Farm Incubator Manager provided daily technical assistance in the field, assisting farmers on soil preparation, input procurement, pest management, and irrigation. The Enterprise Development Specialist assisted farmers on financial management, facilitating loans, and organic and food safety compliance. The Executive Director advised farmers on business strategy and expansion plans, while the Finance Director advised them on accounting and financial management.

In addition to technical assistance, ALBA held monthly workshops on a variety of production and business-related topics. These allowed farmers to continue their education while employing the knowledge to run their businesses. Thirty workshops were held at ALBA during the project period, with a cumulative attendance of 385.

The ALBA organics staff worked with farmers on a daily basis to provide market access for produce, selling 450,000 cartons of specialty crop produce in two years valued at $8 million. ALBA Organics staff worked daily with farmers on forecasting production, advising on quality, harvest, pack and order fulfillment. This aggregation and marketing service not only allowed farmers to reach clients that would otherwise be unattainable to them, it provided essential lessons on how to meet the demanding requirements of California's competitive produce markets.

ALBA worked solely with helping new farm businesses grow and market organic strawberries and vegetables such as kale, cilantro, celery, cucumber, tomatoes, peppers, squash, beets, broccoli, and beans among others. The few activities that project staff undertook that did not relate to enhancing the competitiveness of specialty crops were funded and managed under specific grants which had adequate designated funds outside of this project's budget. One such unrelated activity was funded entirely by the Packard Foundation which supported visits from local elementary schools in order to teach fourth and fifth grade students about organic farming.

Partners were not sub-contracted on this project but several partners still made significant contributions:
California FarmLink is the most significant ongoing partner for the Farmer Education and Enterprise Development Project (FEED) program. FarmLink makes operating loans to ALBA's participating farmers. Over the project period, they provided loans for over twenty-five beginning specialty crop farmers. FarmLink also helps in finding land for graduates as they transition to new land. During the project period, they helped four farmers find land outside of ALBA and assisted other farmers in networking with prospective land owners.

El Pajaro Community Development Corporation provided marketing education through workshops and technical assistance to farmers on developing financial statements.

Community Alliance for Family Farmers provides workshops on marketing for the Farmer Education Course and incubator farmers.

## Goals and Outcomes Achieved

Project staff educated over fifty farmers, and conducted two classes over two years in organic farm production and business management in preparation for launching an organic farm. Each annual course lasted for ten months with 300 hours of class and field study. Project staff provided intensive, hands-on business development services for fifty beginning specialty crop farm businesses. Each farm business received an average of fifty hours of technical assistance per year in addition to workshops and access to land and equipment at a subsidized rate. Project staff also provided marketing services to fifty-five current and former ALBA farm businesses, allowing beginning farm businesses to reach lucrative markets statewide.

Longer term outcomes of FEED work include: Increase in the number of viable specialty crop businesses (expecting twenty to graduate and transition to independent farming in the next four years). Increase in the acreage grown by ALBA alumni due to newly graduated farmers and those expanding acreage farmed. Increase in jobs created and retained by newly launched and expanding farms. Increase in cumulative production and sales volume of specialty crop growers launching and/or expanding their business at ALBA.

The FEED program achieved its goal of educating and advancing the business goals of the farmers involved. However, the goals stated in the project proposal focused exclusively on sales growth of farmers and the food hub – ALBA Organics. The project fell slightly short of meeting these goals but project staff are achieving the mission of supporting beginning specialty crop farmers. Participation in the program was strong and is growing, as is the pipeline of developing farmers who will transition to independent farming in the coming three to four years. In addition, these courses advanced the competitiveness of the specialty crop industry by providing a rare opportunity for low-income farmers to develop their skills and obtain better employment while strengthening the industry as a whole.

There are two main reasons as to why project goals were impacted: The loss of key personnel (General Manager in the first year of the project) caused temporary disruption in marketing operation until late in the project period. Project staff anticipated a continued growth path in sales; this growth trend showed $500,000 in annual sales to over $5 million at their peak in 2013. The project staff expected this growth to continue at a slowing but healthy pace, which did not materialize. The project staff assumed that the growth would be driven by a pipeline of rapidly growing incubator and alumni farmers, instead, their expansion levelled off and many encountered disappointing strawberry production and lower average box prices due to the staff transition.

Project staff set a goal of $15 million in sales during the project period, but only achieved $8 million. The expected sales of $6 million in 2014 and $7 million in 2015 turned out to be $4.5 and $3.5 million, respectively. Instead of a 35% increase projected, it declined by 16% from the base period of $9.5 million (2012/2013).

Although farmers found alternative market channels, their growth did not meet the expectations. Rather than thirty farms increasing sales by at least 40%, only ten of the farms did. Most farmers experienced fairly flat sales growth or a minor decline over this period.

Ultimately, falling short of ambitious growth targets does not connote failure. Particularly in view of the challenges faced by beginning farmers in establishing viable businesses. Rather, the project staff consider the sales pattern experienced over the project period to be an understandable disruption arising from the loss of a dynamic individual who held valuable relationships with farmers and clients. The project staff have since managed to stabilize the food hub's financial performance and look to resume a growth path.

The baseline for overall sales of organic produce was $9.5 million in 2012 and 2013 ($4.5m/$5m). Though project staff projected a $5 million increase in sales over two years, sales actually declined by $1.5 million.

Individual farmer baseline data is regularly collected through the annual survey. The project staff projected that thirty farmers would increase sales by 40% or more. It was expected that this would be achievable through their rising capacity and increasing land base while in the program. As it turned out, most of the ongoing farmers did not increase their acreage as fast (due to short labor supply), while strawberry production declined due to weather. In other words, assumptions were too optimistic and other factors intervened. More importantly, most of the farmers are sticking with it and have managed to not only weather the difficult period but to establish new client relationships as a result.

Outcomes achieved during the project period include: Production and business skills development of one-hundred and five aspiring and existing specialty crop farmers; launched twenty-five specialty crop farm businesses on small acreage; provided intensive business development and marketing assistance to strengthen an additional thirty farm businesses; facilitate access to loans and credit line services to over thirty specialty crop farmers; assisted forty farmers annually obtain or renew organic and food safety certification; sold $8 million in produce on behalf of beginning specialty crop farmers; ten farmers increased sales by at least 40% (target thirty farmers); transitioned eight farmers to their own land to continue farming independently; and created or retained one-hundred twenty jobs through businesses supported in ALBA's program.

## Beneficiaries

One-hundred and five aspiring and existing farmers were assisted by the project to start their own farms growing specialty crops such as lettuce, strawberries, wine grapes, and spinach. Participants farmed one-hundred and fifty acres over two years. Assuming an average of $25,000 of revenue generated per acre, this comprised roughly $5.5 million in revenue flowing back to the farmers. In turn, this revenue creates a multiplier effect in the local economy as these revenues are passed on to workers and input suppliers, who then spend it on other goods and services. The final impact depends on the multiplier assumed.

This project worked primarily with low-income, aspiring farmers. These are people who have extensive agricultural experience but don't have access to the education and resources to be able to establish an independent farm. Many of these farmers are immigrants who have the work ethic, agriculture experience and entrepreneurial spirit to be farmers. ALBA offered access to resources and assistance to develop the business management and production skills to supplement their experience and establish a viable organic farming businesses.

The small farm businesses that benefitted from ALBA also benefit participants' families and their employees. In addition, these small farms generated revenue for business service providers. Skills developed at ALBA benefit employers and the industry as a whole.

Project staff believe the longer term impact by a farm business and/or careers advanced is much greater. Businesses launched and expanded at ALBA during the project period will grow and multiply their impact. Young professionals trained will gain practical experience, hone their focus and advance their careers which stretch well into the future. Investment in ALBA is in investment in people who will contribute to the growth and competitiveness of the industry. The investment will produce dividends in the form of new specialty crop businesses and professionals.

## Lessons Learned

Project staff learned that farming (and running a food hub) is not a steady upward march of progress. During the project period, setbacks have included: Departure of the long-time General Manager, a steep drop in sales during the 2014 and first quarter of 2015, and farmers looking for other market channels.

Project staff managed to achieve the goal of advancing the specialty crop industry by strengthening the skills and capacity of farm owners and employees in the industry. It didn't show up in the numbers as expected because the project targets set anticipated a continued expansion, when in fact project staff went through a period of reorganization. Still, the food hub sold over $8 million in specialty crops grown by beginning farmers during this period, an achievement in itself.

The project staff learned how dependent ALBA was on the knowledge and relationships that were acquired during the General Manager's tenure at ALBA. This is not atypical in the produce industry at large, particularly at a relatively small operation.

The project staff learned that minimizing fixed costs is essential. One of the strong sales growths leading up to this project resulted in moving to a second cooler. Although this added operational complexity as well as extra personnel, rent and utilities costs which made breaking even difficult even in periods of high sales; as a result, costs were cut by moving out of a second warehouse, moving back to the smaller site. This brought back sales and management to the main site which provided for better field oversight and helped in re-establishing relationships with farmers.

The project staff made a number of facility upgrades to make the smaller cooler more functional. Investment in a new inventory software system enabled better business management. These changes will help more effectively market the goods of the emerging specialty crop farmers.

The project staff also realized that outcomes are not encapsulated in financial performance (e.g. growth in sales and profitability) over a fixed period of time. Progress in farming is less predictable and often involves a fair amount of failure. This drives learning, forges resilience, and sets the stage for future success. Future proposals will set more modest financial targets and diversify the array of targets to reflect broader measures of success.

A survey was completed in 2015 which reached about one-third of ALBA's alumni. The survey results revealed that 38% of respondents are still farming independently. Over 70% are still working in California

agriculture and nearly two-thirds state they are better off financially for having participated in the program. ALBA remains an engine of economic growth and a rare opportunity for advancement among low-income specialty crop farmers. Through skills building, enterprise creation and job creation, ALBA contributes to developing the California's specialty crop industry.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 26 | **Project Title:** A Business of Details for California Specialty Crops | |
|---|---|---|
| **Grant Recipient:** Center for International Trade Development, State Center Community College District | **Grant Agreement No.:** SCB13026 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Alicia Rios | **Telephone:** (559) 324-6401 | **Email:** alicia.rios@scccd.edu |

## Project Summary

A key component in expanding California's advantage in marketing specialty crops internationally has been the development of a highly-skilled, well-trained workforce. Maintaining this competitive edge is a continuous process, particularly with rapid developments in such areas as information technology, transportation, cold-chain, and ongoing changes in regulations. Although the Center for International Trade Development (CITD) at State Center Community College District (SCCCD) has conducted regular training activities to develop regional exporters, effectiveness and training impact are both restricted by outdated training materials and program limitations in reaching specialty crop industry members in all corners of the State.

The “Business of Details” project was developed to help remedy these factors by funding an up-to-date training video and collateral materials for California specialty crop exporters. The combination of video topics with more in-depth, hands-on training treatment will help to reach a broader audience while providing intensive education in focused lessons. Primary distribution for the video and supplemental materials will be through online training/viewing.

This project was particularly relevant and timely at the time of funding, as the President's 2010 National Export Initiative called for a doubling of U.S. exports through 2015. This initiative inspired many specialty crop producers to look towards exporting as a means of diversification and expanding markets. One of the key means of accomplishing such a goal has been to increase the overall number of California specialty crop exporters, while upgrading the skills of both current and future exporters.

The CITD previously utilized a prior version of the training video, "A Business of Details." Produced in 1997, the video followed a shipment of California Fuji Apples from harvest to the foreign market, pointing out each export detail along the way. Because of the clarity of the materials content no other training video for specialty crop exporters had been so easily understood and widely used. However, while the video had been high impact in its success, with nearly all trainees recalling the key points as demonstrated in evaluative testing, it had also become quite outdated. Due to changing aspects of specialty crop exporting, instructors found they had to spend time explaining changes that had occurred since it was recorded over 19 years ago. Furthermore, evaluations by trainees often stated that the video was very informative, but out-of-date compared to the rest of the training. This trainee viewpoint was corroborated during statewide focus groups.

In an attempt to locate a more current version of similar training support materials, the United States Department of Agriculture, Agricultural Marketing Services had informed the CITD that no updated video was available.

This project builds upon 2009 Specialty Crop Block Grant Program (SCBGP) Project 23: *Export Training for Specialty Crops* which provided export training classes for new-to-export specialty crop producers and marketers throughout California.

One of the training tools used in this prior export training grant was the previously-described, "A Business of Details" video and accompanying workbook. The video had been a key visual element for trainees, easily demonstrating many of the common issues and roadblocks encountered by specialty crop exporters, and how to overcome them. The video was found to be a strong training tool by both instructors and trainees. Since the concept of the training format was proven to be strong in the 2009 SCBGP Project 23, the need to create an updated version highlighting current policy and practice for specialty crop exporters appeared as a clear priority for the CITD. This would allow a proven educational model to continue to provide strong outcomes while reducing the level of clarification and revision needed during the training sessions themselves.

## Project Approach

- Advisory Council (AC): The AC was made of five industry experts who provided guidance and feedback throughout the course of the project. This group assisted in development of updated video curriculum, storyboarding of the video, technical accuracy confirmation, identification of expert speakers, and securing partners for training materials dissemination purposes.
- Request for Proposal (RFP) - Video Contractor: The CITD developed and distributed the RFP to more than 15 regional video production companies. Seven companies responded with proposals/bids to complete production work. After the AC scored each proposal, a contract was awarded to produce the project video.
- Focus Groups: Focus groups included industry stakeholders, specialty crop cooperators and industry experts. Meeting were conducted over conference calls with materials for review distributed to the groups via email. The groups completed review and feedback on the original “Business of Details” training video. They also provided review and feedback to new video production.
- Develop Curriculum: Curriculum development has been an ongoing process which has been continuous throughout the project. This has allowed the CITD to incorporate up-to-the-minute changing rules, regulations and trends in its updated materials. The curriculum has focused more on the California specialty crop exporter’s point of view, and has included elements missing from the original video including Agricultural Commissioner inspections, issuance of Phytosanitary Certificates, discussions on Maximum Residue Levels, and banker explanations of how best to get paid. In addition to video updates, curriculum development provided for updates to the video companion workbook to bring it up to date; this included adding resources available for today’s specialty crop exporters which had not been readily available in 1997 (see ‘Develop Workbook’ below, for additional details).
- Video Production: The video production contractor worked directly with CITD staff, the AC, speakers featured in the new footage, the professional narrator, regional trade partners, and the featured expert contractor. This collaborative approach allowed the contractor to storyboard the project, develop a script, capture ancillary footage, interview speakers, and produce final edit of project based on strong and current market and technical input.
- Expert Contractor: The expert contractor provided technical expertise regarding the entire export process of a specialty crop. This individual also assisted in development of curriculum, secured the foreign video contractor in Taiwan (who supervised video production there), and contracted narration services for the video portion of this project.

- Develop Workbook: The CITD reviewed the original companion workbook and removed extraneous material and resources that no longer applied to exporting California specialty crops. After these edits, the project added in new materials, samples and resources that correspond with and expand on the newly developed training video's content. The workbook was developed in a format that can be easily updated to adopt changes to laws and adjust broken links. A downloadable version is available to trainees in a PDF format.
- Web Portal Development: On the www.fresnocitd.org website, a web portal was created to house the newly developed export training video. This web page also includes a downloadable version of the Companion Workbook and resource links for new specialty crop exporters who participate in training. Includes online survey to measure knowledge
- Dissemination: The CITD has 100 specialty partners to cross-link and share this video with the specialty crop community (California specialty crop commodity boards, farm bureaus, chambers of commerce, ports, economic development corporations, industry associations, etc.).

This project did not enhance the competitiveness of non-specialty crops.

The project video and collateral materials were designed to specifically benefit the export of specialty crops. This was accomplished in two ways: First, the updated video specifically demonstrates an export shipment of a California specialty crop (Romaine Lettuce). In this setting, the updated video demonstrates the export processes typically encountered by specialty crops, many of which are unique to these products. Secondly, a training discussion of the unique combination of issues faced by exporters of specialty crops included: phytosanitary issues, Maximum Residue Levels (MRLs), and maintenance of the cold-chain during transportation. No other non-specialty crop products face the same problems; thus, the entire training video will be useful only to specialty crop exporters.

Project partners played a significant role in this project's success which included participation in strategizing activities, providing input based on individual expertise, access to filming at facilities and locations (e.g. processing, packing and port facilities), and review of draft video and print materials in the focus groups. Finally, project partners helped ensure program success by disseminating the project's training materials through their respective websites, sharing them with organizational staff and/or professional members, and incorporating the video and workbooks into their export training programs for California specialty crop producers. This was a unique opportunity to synergize a broad array of groups all focused on a particular goal; expanded and improved specialty crop export opportunities.

## Goals and Outcomes Achieved

Objective 1: Increase distribution of training video through the Internet.
Once the video was complete and uploaded to the web, it was crucial to make it widely available to the California specialty crop industry. The project goal was to have the video cross-linked on 100 partner websites by June 30, 2016 and up to 150 websites by December 31, 2016 (long-term). Due to editing of the video taking longer than anticipated, the video wasn't completed until late May 2016. Cross-link goals were not achieved but CITD continues to work with partners and expects cross-links to be available soon.
Activities associated with this outcome: Completed video with companion workbook and resources, dissemination with partners, and web portal host.

Objective 2: To increase the number of California specialty crop personnel who view the training video. Starting from a baseline of zero in 2013, CITD projected the following schedule of viewers over the next 3 years. For 2014 the initial focus groups and industry feedback exceeded the 50 views projected by reaching 75 partner views and 10 test export class views. For the second year the CITD was to have 750 more views by June 30, 2016; however, due to editing delays the CITD has not reached that goal yet. CITD will continue to monitor views using its Google Analytics account to capture the 750 views as well as the 2,500 additional views projected to be completed by December 31, 2016.
Activities associated with this outcome: Completed video with companion workbook and resources, dissemination with partners, and web portal host.

Objective 3: To increase the level of export knowledge of the California specialty crop industry.
The target was an overall comprehension value of 80%. Based on AC and Focus Group feedback, it was determined that breaking up the video into modules would disrupt the flow of the video content. The CITD included a survey at the end of the video on the Web Portal for participants to take and record their responses to measure comprehension. The number of survey respondents compared to viewers is significantly less, but all have scored above 80% comprehension.
Activities associated with this outcome: Completed video, web portal host, and evaluation survey to capture and document knowledge increase.

Long-term measures for cross-links of video on partner web pages and views will be measured using Google Analytics. Google Analytics can summarize where the views were originally linked from as well as the number of views of the video.

For the reporting period, CITD met the goals as indicated in the last Progress Report for period of Oct 2015 through Mar 2016 and accomplishments included:

- Completion of the export training video, “A Business of Details”
- Completion of the export training video Companion Workbook.
- Completion of the web portal housing export training video, downloads and resources.
- Survey on web portal to measure and document participant’s level of export knowledge.
- Google Analytics is in place to measure where viewer of video originated from and how many views are made.
- Dissemination of video link to partners to cross-link on their respective websites to direct their members/followers to watch video on our site.

| Objective 1: Website Cross link | Baseline | Prior to Apr 30, 2016 | Jun 30, 2016 | Dec 31, 2016 |
|---|---|---|---|---|
| **Target** | 0 | 0 | 100 | 150 |
| **Actual** | 0 | 0 | 0 | 0 |

Due to video editing not being completed until late May 2016, cross-links goals were not achieved due to partners not having enough time to get the request approved and then posted. Cross-links to video are expected to increase, and Google Analytics is in place to identify and document where (which website) viewer came from to view video.

| Objective 2: Specialty Crop Views | Baseline | Prior to Apr 30, 2016 | Jun 30, 2016 | Dec 31, 2016 |
|---|---|---|---|---|
| **Target** | 0 | 50 | 750 | 2,500 |
| **Actual** | 0 | 85 | 23 | 47 |

Due to video editing not being completed until late May 2016, view have been limited to focus and test groups as well as industry partners. Viewers of video are expected to increase, and Google Analytics is in place to document the number of viewers.

| Objective 3: Increase Level of Knowledge | Baseline | Prior to Apr 30, 2016 | Jun 30, 2016 | Dec 31, 2016 |
|---|---|---|---|---|
| **Target** | 0 | | 80%+ | 80%+ |
| **Actual** | 0 | | 6 | 16 |

The number of survey respondents compared to viewers is significantly less, but all have scored above 80% comprehension. The goal was to score at or above 80% in comprehension.

The major successful outcome of this project was the comprehension level of individuals that had no previous export experience and participated in test groups. All these test subject scored at 100%. Once there is a larger pool of individuals completing the assessment, CITD expects these results will easily meet or exceed the 80% comprehension goal set for this project.

## Beneficiaries

Project beneficiaries include all specialty crop producers, processors and marketers in California whose product is exported. Through open distribution on the internet, the video and companion materials are available to all of these as a free resource. The video is used by the following: new-to-export companies (both producers and marketers) exploring export markets; California specialty crop producers wanting to learn more about the considerations of export markets, thus making their product more exportable; experienced specialty crop exporters wanting either to keep up-to-date on current export issues, or have new staff that require training. Specialty crop cooperators can also utilize this video to educate their respective professional members on the intricacies of exporting. In addition, the video has been added to the course curriculum for the CalAgX specialty crop export training series, which reaches an audience of 100 specialty crop exporters annually.

Untold millions of dollars are lost annually in both product value and the time of both private industry and Government officials when a shipment is held in customs due to an avoidable problem. These include lack of proper documentation or certificates, violation of phytosanitary controls, or exceeding maximum chemical residues. This project has helped to eliminate many of these common problems by educating potential exporters on the proper methods of shipping their product to foreign markets, thus saving the California specialty crop industry millions of dollars.

Following the call-to-action to double exports by the National Export Initiative and the weak US dollar, more and more specialty crop producers have continued to seek opportunities to diversify their sales utilizing foreign markets. Global exports of specialty crops have maintained an upward trend through the recession and

recovery recently experienced in US markets. This project will support the jobs of over 140,000 Californian's involved with specialty crop trade growth as a result of these expanding export developments. Presenting training through a visual tool will supplement the work of established export training programs and allow participants to readily see all the pieces put together; simplifying the process will make exporting a more inviting alternative, thus establishing more new exporters and export revenue for California specialty crops.

## Lessons Learned

One of the positives takeaways from this project is that in working together with professionals from all across the supply chain, the CITD was able to discover the most common challenges that each respective group encountered when it came to exporting. The CITD was then able to proactively address these uncovered issues and incorporate responses and training resolutions into the updated video. The downside of working with so many individuals was the resulting delays in feedback and eventual compilation of the numerous opinions offered; this sometimes complicated the process of deciding what should and should not be in the new video.

Using Romaine Lettuce as the focus specialty crop worked out very well with this project because the processes used in exporting this product cover almost all of the common aspects associated with the exportation of all specialty crops. Additional resources will be added for other specialty crops. The challenge was in coordinating filming based on harvest schedules, orders from Taiwan, shipping schedules and being able to meet with and interview the featured Exporter during one of their busiest times of the year. The CITD was able to minimize interruptions to the Exporter's schedule by coordinating directly with other key individuals involved to scheduling filming appointments, and by compiling pre-interview outlines that provided the speaker with a "cheat sheet" of all the key areas and topics that each presenter needed to address in their response to interview questions.

In terms of dissemination, multiple organizations have been eager to partner and stated their willingness to post the updated video and materials on their websites. This willingness has been complicated by the issues that arise in approving the video upload or links through the processes of each respective organizations. Linked videos must be able to be monitored via the use of Google Analytics, when posted on the host website. While these issues are quickly resolved, the video will be hosted on a CITD paid server whereby video views and downloads can be documents and recorded by incorporating the CITD Google Analytics accounts.

Implementing the project did not produce any unexpected outcomes or results. The video has received great feedback and staff expects the number of views to multiply exponentially as the word continues to spread of the availability of this export training video.

The initial views that the video has had does not yet reach the expected levels, and this is due to not having the video available for public viewing until late May 2016 (planned release was April 2016). Editing and putting together the final version of the video took nearly twice as long as originally projected. CITD expects numbers to increase as it continues to promote.

## Additional Information

The web portal hosting the newly produced "A Business of Details" export training video can be found at: www.fresnocitd.org

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 27 | **Project Title:** Growing Community Food Systems in Underserved Neighborhoods | |
|---|---|---|
| **Grant Recipient:** International Rescue Committee | **Grant Agreement No.:** SCB13027 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Anchi Mei | **Telephone:** (619) 641-7510 ext. 234 | **Email:** anchi.mei@rescue.org |

## Project Summary

This project was developed to address two insidious nutrition issues that plague low-income communities: obesity and malnutrition. The root problem underlying both these issues is ultimately poverty. Improving nutrition through education alone is insufficient. Rather, Internal Rescue Committee (IRC) has pioneered the Community Food System (CFS) approach, which weaves nutrition education into economic empowerment and community-building food projects focused solely on increasing California specialty crop consumption (such as gardens, markets and farming microenterprise). These projects are cost-effective, durable solutions leading to increased awareness in low-income communities about the importance of consuming fresh fruits and vegetables, while also bolstering the growth of future California farmers and strengthening both local food economies and individual household financial stability.

IRC replicated its CFS model created in an urban San Diego neighborhood in eastern San Diego County in the City of El Cajon. Both communities have deep pockets of poverty and food insecurity; however, El Cajon lacks the political organizing and food justice consciousness of the City Heights community and thus, made it a prime learning laboratory for best practices in terms of CFS implementation techniques. This project developed two very different CFS communities to draw upon in supporting the development of more CFS throughout the region and state.

This project was and still is important and timely for three reasons. First, California needs new farmers and specifically, San Diego County, which is home to the largest number of small-scale farms in the nation, is losing farmers to retirement each year; the average San Diego farmer is 61 years of age. Secondly, rising healthcare costs, due to obesity, impact both family household purchasing power as well as public healthcare costs shared by all Californians. Thirdly, IRC's economic empowerment approach addresses the root problems of poverty through the creation of self-reliant livelihoods.

This project did not build on a previously funded Specialty Crop Block Grant Program (SCBGP) project.

## Project Approach

Over the course of this project, IRC improved the nutritional status of over 2,000 low-income beneficiaries. Additionally, approximately 185 community gardeners increased their specialty crop production and consumption. Over $762,517 was generated in revenue for the California specialty crop industry for 20 specialty crop farmers. $165,115 was generated in CalFresh revenue and over $37,051 in microenterprise revenue by urban, small-scale farmers in San Diego County.

This project's greatest success in both the El Cajon and City Heights CFS was in the area of "market gardening". Throughout the project term, IRC saw sustained interest, results and impact with community gardeners who engaged in farmers' market sales. Over 40 low-income individuals either started or expanded

their market garden business during the course of this project. These market gardeners not only generated income to support their households but sold fruits and vegetables to many others in their low-income communities at the El Cajon Farmers' Market (ECFM) and City Heights Farmers' Markets (CHFM). This double win-win of increased economic well-being and health outcomes for both the participants and community has become one of the central tenets of a CFS.

Project staff undertook many activities and tasks during the course of this project to achieve these successes. Community garden programming activities included: working with gardeners to develop and implement a garden self-governance program, administering annual garden agreements and year-round enforcement of the garden agreement, site maintenance of community gardens, organizing volunteer work days, addressing and trouble-solving participant conflicts and issues, external relationships with land owners, neighbors and local government for community garden sites, conducting participant evaluations

Farmers' market programming activities included: Operating the ECFM, administering Fresh Fund at both ECFM and the CHFM, on-time financial reconciliation and payment of farmers and vendors, and conducting participant evaluations.

Leadership development activities included: community garden leadership conferences for gardeners to increase leadership skills, the CFS convening to support new CFS development throughout California, and encouraging local farmers' market managers to establish farmers' market nutrition incentive programs.

IRC created and utilized clear accounting and recording practices to ensure that SCBGP funding was only used to enhance the competitiveness of specialty crops. During the course of this project, IRC had other funding for personnel and materials for any activities unrelated to specialty crops.

The following project partners were instrumental in their support of this project: Kaiser Permanente is the land owner of the new El Cajon Community Garden that was expanded upon as a result of SCBGP funding. Kaiser Permanente has not only been generous in their continued leasing of the land to IRC but also in supporting with overall site maintenance, volunteers, press/media and creating special events to celebrate the garden; San Diego County Farm Bureau has been a wonderful partner of the City Heights Fresh Fund program; Ecology Center has been a strong organizational partner in overall Fresh Fund/Market Match programming and funding through their technical assistance to new farmers' market operators; and, Leah's Pantry was also a terrific partner in the development of a healthy cookbook using ingredients from the El Cajon community garden plots as well as the farmers' market. See the cookbook available for free download at http://leahspantrysf.org/cookbooks/

## Goals and Outcomes Achieved

To achieve the performance goals and measurable outcomes, IRC completed activities in three areas: community garden management, farmers' market programming, and leadership development.

In the area of community garden management, IRC staff supported over 185 households with individual community garden plots averaging about 600 square feet each. IRC staff facilitated over 60 community garden leadership meetings across both gardens, and met with each of the community gardeners approximately twice a year to review the garden agreement, collect payment and conduct participant surveys.

Market gardeners received a wide range of additional educational services as well as technical assistance. IRC farming staff offered an intensive three-month market gardening training program to 20 new farming participants and also facilitated 13 production-focused workshops taught by local urban agriculture experts. IRC staff provided additional technical assistance for market gardeners by assisting them with Certified Producer's Certificate applications and renewals, as well as fieldtrips to local markets and farms.

IRC's farmers' market program staff worked diligently each week at two farmers' markets to ensure quality service and operations of both the ECFM as well as Fresh Fund operations. Weekly in-office financial reconciliations and coordination of market outreach events were vital to helping the ECFM grow during this project period.

Over the course of this project, IRC improved the nutritional status of over 1,390 individual Fresh Fund recipients. The actual number of Fresh Fund beneficiaries is much higher given that the average number of people in each Fresh Fund household is over two. A conservative Fresh Fund impact estimate is at least 2,000 individuals. Additionally, IRC assisted at least 185 households in the community gardens to increase their specialty crop production and consumption. The average household size of community garden participants is closer to three, and therefore, a conservative community gardens impact estimate is at least 500 individuals. Altogether, IRC's CFS benefited at least 2,500 people in San Diego County compared to the stated goal of 2,000 individuals.

IRC exceeded its original target of 5-10 new specialty crop micro-farmers by assisting in the creation of 12 new micro-farmers during the course of this grant. IRC originally estimated $10,000 in microenterprise sales whereas over participants actually generated over $37,000 in farmers' market sales. IRC also exceeded its original target of growing 50,000 pounds of fresh fruits and vegetables as a result of this project. In fact, CFS participants grew over 150,000 pounds of fresh fruits and vegetables according to the annual Pounds and Dollars survey.

IRC had less success meeting the farmers' market sales target. Over $762,517 was generated in revenue for the California specialty crop industry whereas the original target was $1 million. Additionally, IRC was only able to generate $165,115 of $225,000 in CalFresh revenue spent solely on eligible specialty crops.

One additional program benefit has been the building of IRC's food and farming data/evaluation system over the past three year of this grant. This has been a notable accomplishment for a new program that was in the process of pioneering new projects while also creating standard reporting and operating protocol. IRC has robust financial tracking for all farmers' market and Fresh Fund sales that is reconciled with the Finance Department on a weekly basis. There is documentation of all farmer sales, CalFresh, and Fresh Fund activity. Additionally, IRC has developed an electronic data platform for recording all interactions and assessments with participants called Efforts to Outcomes.

IRC surveys revealed the following progress in participant health through participation in CFS activities:

- 97% said their physical health has improved. 3% said it has stayed the same. 0% said their physical health has decreased or were not sure.
- 92% said their access to healthy foods has improved. 5% said it stayed the same. 3% said not sure.

- 83% said their outlook on life and the future has improved. 12% said it has stayed the same. 2.5% said it has decreased. 2.5% said not sure.
- 91% said their connection to neighbors and the community has improved. 3% said it stayed the same. 1% said it decreased. 5% said not sure.
- 83% said their overall well-being of their neighborhood/community has improved. 10% said it has stayed the same. 7% said not sure.
- 13% said their savings on groceries have improved. 26% said it stayed the same. 47% said it decreased. 4% said not sure.
- 73% said that their household eating habits have improved as a result of this program. 23% said it stayed the same. 1% said it decreased. 3% said not sure.
- 36% said their household income has improved. 59% said it stayed the same. 1% said it decreased. 4% were not sure.

Overall, the major successful outcomes of the project can be quantified by the sales of market gardeners as well as the production of healthy fruits and vegetables by community gardeners. Market gardeners generated over $37,000 in farmers' market sales while community gardeners grew and consumed over 150,000 pounds of fresh fruits and vegetables during the course of this project.

## Beneficiaries

During the course of this project, several groups and operations benefited from IRC's accomplishments in building CFS in San Diego County: Success of IRC's CFS model supported community advocacy for new City of San Diego urban agriculture ordinance and AB551: urban agriculture incentives zone; IRC's experience and expertise with the CFS model was critical in assisting the County of San Diego to support community agriculture planning projects across seven cities in San Diego County; Shoppers at local farmers markets, particularly in underserved communities, gained more access to fresh, locally grown produce due to IRC-supported market gardeners

Over 2,000 beneficiaries benefited directly from IRC's CFS projects either through community garden-grown produce or farmers' market programs at El Cajon and City Heights. However, the potential economic impact exceeds just the additional food dollars provided to CFS participants (through production, market incentives and farmers market sales). Studies have shown that low-income households spend additional discretionary income at a higher proportion than higher income households. Therefore, the potential economic impact of the CFS to the local economy would be at least: $37,000 in additional local spending by market gardeners with their increased income, and approximately $50,000 in the local economy through food dollar savings provided by Fresh Fund.

Additionally, many community gardeners have reported secondary health benefits gained from community gardening. These medical benefits include a reduction of diabetes and depression/sleep medication. The improved health of community gardeners can also have a potential economic impact of health savings in the future.

## Lessons Learned

SCBGP funding has been an important opportunity for IRC to refine the CFS model based on the experience in replicating a CFS in the community of El Cajon. Two important insights were noted: The "community

gardener self-governance" was not an effective sustainability strategy for garden maintenance and management. The pilot allowed to distill the key activities to garden management down to site management towards the goal of "safety and cleanliness". Project staff saw that low-income individuals had a myriad of different issues and that the work of collecting and managing water payments, coordinating repairs in a timely manner, and managing conflict cannot rest of the shoulders of people with multiple jobs, health issues and/or language barriers. However, the pilot was a good experience for several gardeners to see the value of IRC staff to continue coordinating the garden and for IRC to distill staff time and activities for continuing garden operations for participants. During this project term, IRC also saw the limitations of full-time farming for low-income individuals and refugees due to the lack of land access, high cost of water as well as the high-risk, time-intensive nature of full-time farming. Additionally, IRC also saw the relatively high cost of entry for beginning farmers as well as the long road (and/or high level of marketing) required to earn a living wage as a farmer. At the same time, IRC saw that part-time, urban farming was a very viable and beneficial activity for low-income individuals to earn additional income, improve their communication skills, build on their work skills and develop confidence.

IRC met 50% of its CalFresh target. The original target was based on CHFM redemption and over the past three years, project staff has seen CHFM CalFresh sales grow incredibly high whereas ECFM CalFresh use has been quite moderate. Project staff have learned that the economy has improved in the past year and CalFresh redemption has gone down. However, project staff also realized the need for continuous development of new community outreach partners. Finding the right partners and developing partnerships takes time.

As is not unusual in a non-profit, there is staff turnover each year as staff relocate for family reasons and/or return to school for an advanced degree. IRC has learned over the project term to create more staff cross-coverage as well as project protocol and training documentation to ensure continuous service delivery and minimize disruption and losses in productive work time.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 28 | **Project Title:** Harvest Program | |
|---|---|---|
| **Grant Recipient:** Ag Against Hunger | **Grant Agreement No.:** SCB13028 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Lynn Figone | **Telephone:** (831) 755-1480 | **Email:** Lynn@agagainsthunger.org |

## Project Summary

In the growing counties of Monterey, Santa Cruz and San Benito, there are tens of millions of pounds of surplus specialty crops that would go to waste if it were not for the collection and distribution efforts of Ag Against Hunger (AAH). The Harvest Program collects surplus produce that would normally be wasted, and distributes the fresh specialty crops to food banks throughout California. The biggest issue is that the waste of fresh specialty crops is detrimental to the health and wellbeing of citizens, with 3.8 million low-income Californians who cannot afford food and are classified as food insecure. The project was designed to bring specialty crops to those who needed it most, children, school programs and senior citizens. The availability for cooler overflow for additional specialty crops would help bring specialty crops to those who needed it most, thereby reducing as much waste as possible of fresh specialty crops.

This project was important and timely because there is a direct correlation between food insecurity and health issues such as hypertension, obesity and diabetes. Utilizing additional cooler space for the Harvest Program would expand access to healthy, safe California specialty crops to those who are in need. All the while aiding the growers, shippers and processors to combat specialty crop waste.

The objectives achieved were increased overall consumption of California specialty crops and improved distribution systems from farm to table of surplus specialty crops. AAH is a distribution clearing house of surplus produce. The more space available for coolers, the more efficient AAH will be.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

After approaching several commercial cooler companies, a company was selected and hired as needed throughout the growing seasons. The selected commercial cooler company provided the best price, and was one of the several companies that donated specialty crops to AAH. During the first growing season the overflow space was specifically helpful in the summer months when local in season fruit was in overabundance and the project team was able to get the surplus to schools for their food programs. However; AAH harvest program did not receive enough surplus specialty crops during subsequent seasons to justify the cooling facility expenses.

AAH expected there to be more surplus specialty crops available because more growers and shippers were participating with the program. The effects of the drought continued to decrease the supply of specialty crops grown elsewhere resulting in most of the growers giving less during each year of the grant.

The Program Director (PD) contacted 10 new growers of which four growers provided specialty crops to the harvest program. The specialty crops the four growers provided was prepackaged salad, celery, spring mix,

spinach, green onions, carrots, and romaine. The new growers were contacted by AAH board members, and thereafter an arrangement for one-on-one meetings with either the CEO, head of cooling operations, and/or harvesting managers of each of the new companies contacted. The project Executive Director (ED) attended the meetings with board members to describe AAH program and distribution systems. For the grower participants, the project team wrote annual letters regarding how the specialty crops were distributed, and the ED arranged for one-on-one meetings throughout the year to update the growers about the program. AAH cooler manager reached out to other cooler mangers to donate specialty crops as well.

The two trucks originally secured to transport specialty crops from growers donating surplus could no longer be used for the project because the trucks did not comply with California Air Resources Board (CARB) regulations. Therefore, the PD worked to find two used tractor trucks to be donated to the program. AAH had a promising lead with two used trucks, but the trucks were never needed as was anticipated.

The overall scope of the project did not benefit commodities other than specialty crops, and funds were used to solely enhance the competitiveness of specialty crops.

The contributions and role of project partners in the project were the stakeholders of AAH, representing all of the largest growers in Monterey, Santa Cruz and San Benito counties. These stakeholders/growers, shippers and processors directed the ED regarding the collection of surplus specialty crops and were to distribute them.

## Goals and Outcomes Achieved

The overall goal of the project was to utilize additional cooler space for the Harvest Program which would expand access to healthy, safe California specialty crops by increasing overall consumption and improving distribution systems from farm to table of surplus produce.

This project would decrease the waste of surplus specialty crops from growers, shippers and processors in Monterey, Santa Cruz and San Benito counties by increasing the amount of cooler space to store surplus specialty crops from the Harvest Program before distribution to food banks in California.

Unfortunately the goals were not met for this project due to unforeseen issues. During the first growing season of the project the effects of the historic drought continued to decrease the supply of specialty crops grown elsewhere, which resulted in the growers giving less fresh specialty crops than anticipated during the peak time (April thru October), preventing the project team in utilizing the grant funds for cooler overflow. Besides the low water amounts, lack of labor in the produce markets had been extremely active which had an effect on the amount of overall specialty crops that normally would come into the cooler. During the second growing season the effects of the drought continued and with the demand in the marketplace for specialty crops, the surplus was much smaller than normal than in previous years.
AAH expected there to be more surplus specialty crops available because more growers and shippers were participating in the program. But the effects of the historic drought continued to decrease the supply of specialty crops grown elsewhere, therefore the need for additional cooler space was not required.

There were not any long term outcome measures in this project.

Project staff were unable to increase and hit the target of increased poundage of specialty crop surplus and make available to food bank partners, due to the slow recovery from this historic drought.

One of the most successful outcomes of the project is that there wasn't any surplus specialty crops that went to waste. All the fresh specialty crops received by AAH were distributed to food banks throughout California and school children in the Salinas Valley.

## Beneficiaries

Groups and other operations that benefited from this project were specialty crop growers, shippers and processors in Monterey, Santa Cruz and San Benito counties, local food banks in the tri county area and school children in the Salinas Valley were the prime recipients of the surplus produce.

Over 20,000 people in the tri county area benefitted from this project.

## Lessons Learned

Unfortunately, with not understanding how volatile and unpredictable agriculture can be, the potential pit falls of a drought were underestimated. A closer look at future patterns would be of benefit along with a broader use of funds.

One of the results that were an effect of implementing this project, staff have changed data collection and retention protocol. Also, analyzing trends of the agriculture industry and talking to specialty crop produce partners for in-depth information on potential issues that may arise will take place.

Lessons learned with this project would be the importance to consult others in the industry about the pros and cons of a potential project and the viability of such a project. Also, making sure complete data is collected along with a better detail request of funding.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 29 | **Project Title:** Cooking Matters in Community | |
|---|---|---|
| **Grant Recipient:** 18 Reasons | **Grant Agreement No.:** SCB13029 | **Date Submitted:** December 2014 |
| **Recipient Contact:** Sarah Nelson | **Telephone:** (415) 994-2164 | **Email:** sarah@18reasons.org |

## Project Summary

California's poverty rate is 23.25% (the highest in the nation), and nearly 10% of Californians have been diagnosed with Type 2 diabetes, typically caused by an unhealthy diet. Only 50% of eligible Californians receive CalFresh benefits (formerly known as food stamps). 18 Reasons and project partners recognize the clear and proven link between low economic status and high rates of diet-related disease, particularly in low-income diverse communities, and the need to reverse the linked trends of food insecurity and diet-related diseases. This project helped over 1,000 low-income families increase their consumption of healthy specialty crops.

The cooking-based nutrition education program, Cooking Matters, offers tools that empower residents to make healthy changes in their diet. Many participants begin their first class by reporting they "never" eat vegetables or "never" cook at home; by the end of the first class, these same participants are enthusiastically eating vegetables they have prepared, and vowing to make the same dish at home. Demand for this program has grown rapidly over the past two years, from 56 courses in 2011 to 120 in 2012. The total courses increased to 200 over the past year.

## Project Approach

The project team completed 96 six-week-long Cooking Matters series as part of this project, graduating 1,062 adults and children from the program. This exceeded the goal of 90 series and 1,000 graduates.

Cooking Matters classes meet once a week for six weeks; each class is two hours long, and focuses on a different nutrition topic and cooking technique. Professional chefs and nutritionists volunteer to teach the classes, which are hosted by a variety of partner organizations including clinics, low-income housing sites, schools, food pantries, and community centers. Community health promoters are also trained to deliver Cooking Matters classes in their communities. This program offers community member's valuable training in cooking, nutrition, and facilitation skills, while enabling the program to reach communities more effectively.

18 Reasons worked with over 60 partner organizations to deliver Cooking Matters classes. Host site partners typically hear about this program through word of mouth, and reach out through an application on 18 Reasons website https://18reasons.org/cooking-matters/host. Hosts include any agency or nonprofit offering services to low-income clients. Once a day and time is established for the classes, host site staff members (who already have existing relationships with their clients) recruit participants for the series. Host site partners are required to sign up at least 20 participants, to ensure that each series has 8-15 people graduating from the 6-week series.

An 18 Reasons staff member coordinates each series, bringing all food, equipment, and materials to every class. Instructors (either volunteers or health promoters) use facilitated dialogue and hands-on teaching

techniques (for example, using open-ended questions to guide discussion) to deliver the Cooking Matters classes. The first hour of class is dedicated to a nutrition and food budgeting topic; the second hour consists of hands-on cooking instruction and practice that relates to the lesson topics. At the end of each lesson, the class enjoys a healthy meal together and participants go home with a bag of fresh fruits and vegetables and copies of the recipes to practice making healthy meals at home. As the program is designed to build self-sufficiency, graduates can only complete the series once.

The learner-centered courses aim to identify the challenges each participant faces to eating and accessing healthy food, and each series is tailored to the specific needs and questions of the participants. For example, a class of parents of young children might focus on recipes that encourage children to enjoy trying new vegetables, while a class of teenagers might focus on acquiring basic cooking skills they can use to prepare quick snacks and breakfast items. The chef instructor or 18 Reasons staff member chooses each week's recipes based on what participants want to learn, as well as which fruits and vegetables are in season.

Seven Cooking Matters series were held in partnership with urban farm partners; of the 73 graduates of classes held on urban farms, 32 went on to subscribe to weekly farm boxes (a box of fresh fruits and vegetables grown on the farm – similar to a more traditional Community Supported Agriculture program). One of the urban farm partners also began offering weekly farm stands at social service offices, where project staff partnered with them to offer cooking demonstrations promoting California fruits and vegetables.

Fifteen adults and 20 teen community health workers were trained to conduct Cooking Matters classes in their community; the teens went on to teach two Cooking Matters series to their parents, and two Cooking Matters for Kids classes to younger children in the community. The adults taught a total of 16 Cooking Matters series. The project team plans to expand this program to other areas in 2015, training more teenagers as peer educators and engaging them as Cooking Matters instructors for both their parents and younger children.

The evaluation shows that graduates eat more fruits and vegetables and enjoy cooking more than they did before the class.

When staff members shop for Cooking Matters classes, they are careful to track specialty crop purchases separately from other ingredients they may need for that day's recipes. They enter each receipt into an excel spreadsheet with a column for specialty crops and a column for anything else. They are also careful to ensure all recipes focus on specialty crops as the main ingredient, and contain more than 50% specialty crops by weight.

Partnerships with urban farms have been successful in increasing enrollment in their farm boxes by 7% as well as increasing sales at farm stands.

Specialty crop produce for classes were sourced through partner Veritable Vegetable.

Project staff partnered with 30 different host sites who hosted Cooking Matters classes over the past six months. Host site partners included schools, clinics, shelters, free dining rooms, and community centers.

## Goals and Outcomes Achieved

The project team partnered with 30 community-based organizations and two urban farms to plan and conduct 96 six-week-long cooking and nutrition classes. Thirty five community health workers were trained and deployed as instructors for these classes, as well as 220 volunteer chefs, nutritionists, and assistants. Class attendance, produce purchases, and enrollment in urban farm weekly farm box programs were carefully tracked. Each graduate completed a pre- and post-test measuring the behavior changes they made as a result of the program.

The overall goal was to complete 90 series with 1,000 graduates. 96 series were completed, with 1,062 graduates. Thirty five peer educators were also trained, which is 20 more than the goal of 15. Project staff worked with two urban farms to offer Cooking Matters classes, as planned, and was able to engage with one of the farms by offering cooking demonstrations at their farm stands in addition to offering classes in the community.

After a course, adults report that 82% are eating more vegetables; 76% are eating more fruits; 91% improved their cooking skills. They are eating at least two cups of fruit per day, 45% more often, and eating at least 2.5 cups of vegetables per day, 46% more often. Eighty one percent made a Cooking Matters recipe at home, and 98% would share the recipes they learned with others.

After a course, 40% of child graduates are more confident that they can make themselves a snack with fruits or vegetables, and 35% are more confident that they can talk to their parents about healthy eating. Eighty percent say they improved their cooking skills.

Urban farms experienced a 7% increase in sales directly due to Cooking Matters graduates signing up for farm box programs operated by the farms.

The overall goal of helping low-income families eat more fruits and vegetables and feel more confident about cooking fresh produce at home was achieved.

## Beneficiaries

Fifty one percent of the graduates attending the Cooking Matter classes participate in some form of federal food assistance (CalFresh, WIC, or free school lunch). Sixty one percent of graduates are Latino, and nearly all of them attend classes taught in Spanish by peer educators.

Thirty California specialty crop farmers also benefited from the 14,000 pounds of specialty crops purchased and distributed through the program. Urban farms experienced a 7% increase in sales of farm boxes as a result of Cooking Matters classes and demonstrations conducted at the farms or farm stands operated by the farms.

One thousand sixty two low-income adults and kids graduated from the program; if each participant increased spending on fruits and vegetables by an average of $5 per week as a result of the program, the potential economic impact would be $276,000 per year in increased spending on specialty crops.

## Lessons Learned

Project staff learned that teaching people to cook with fresh fruits and vegetables in a hands-on class is a powerful educational tool that can bring about significant behavior changes. Working with community health

workers who come from the low-income communities served helps the classes to be even more effective. Partnering with urban farms helps increase community participation in weekly farm box delivery programs, while boosting fruit and vegetable consumption among participants.

Project staff did not expect to work with teen community health workers, but they turned out to be excellent teachers, engaging both children and adults in their lessons.

## Additional Information

Attachment 1: Cooking Matters Participant Survey

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 30 | **Project Title:** If They Grow it, They'll Eat it | |
|---|---|---|
| **Grant Recipient:** Western Growers Foundation | **Grant Agreement No.:** SCB13030 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Ryan Zilker | **Telephone:** (949) 885-2229 | **Email:** rzilker@wga.com |

## Project Summary

Western Growers Foundation (WGF) worked with the California Department of Education (CDE) to award 100 K-12 schools $1,500 each to grow and sustain a fruit and vegetable school garden. Schools applied for these competitive grants via an online application. Before awarding any funding to the schools, the applicants signed a form committing to only using the funds for fruit and veggetable seeds/plants, garden equipment and professional development. According to the CDE, nutrition is an essential building block for student success. Healthy, active, and well-nourished children are more likely to attend school and be more prepared and motivated to learn. Studies showed children who were taught nutrition while growing vegetables outdoors in their own gardens increased their preference for vegetables. Improving the desire to taste vegetables is a first step in developing healthier eating patterns.

Seventy-five percent of Americans eat less than two servings of fruits and vegetables per day. Today's children may be the first generation of Americans whose life expectancy will be shorter than that of their parents. A recent study by the Center for Disease Control (CDC) and Duke University stated that by 2030, 44% of Americans will be obese. Connecting people to their food source and educating them about the importance of 5 - 13 servings of fruits and vegetables per day is paramount to arresting this trend. By creating 100 edible school gardens, children were taught good nutrition and increased specialty crop consumption. In addition, those adults (both parents and teachers) who were involved in gardening and promoting this message to their children and students were more likely to consume more produce.

WGF and CDE partnered on two previous grants, each offering $1,000 to one hundred preschool centers for edible school gardens; 2010 Specialty Crop Block Grant Program (SCBGP) Project 16: *Garden-Enhanced Nutrition Education Grants for Pre-school* and 2012 SCBGP Project 27: *Child care/Pre-school Fruit and Vegetable Gardens*. This project focused on K-12 and provided $1,500 each. Useful information had been obtained from past grants; like ways to improve accountability, measurability and communication with grantees. Prior to awarding funds, the grantees signed a letter of commitment to participate in follow-up surveys, provide receipts (when possible) and be open to visits. The Association Management System database was incorporated into the grant process. This provided financial reconciliation, contact tracking, mobile capabilities and website integration. This database management allowed for better tracking of the needs and successes of the grantees and helped facilitate efficient communication with them.

## Project Approach

WGF worked with a contractor to create an improved online application for schools to apply for the grants. This system allowed applicants to save and come back to their application, upload documents such as a garden budget, W-9 and photos as well as confirm application submission. Project staff worked with CDE to promote the grant opportunity to California K-12 schools via email communications. In total, 179 applications were received and reviewed with the help of the Child Nutrition Assistant at the CDE. Both parties used a

scoring checklist to ensure consistency with review. The top 100 highest scoring schools were selected to receive the grants and winners were announced via email and online at http://www.csgn.org/news/california-school-garden-grant-winners-announced. Grant recipient schools were then sent checks for $1,500, a copy of California Gardens for Learning book, Producepedia bookmarks, seed packets, and recipe cards. Upon receipt of the grant packages, the school garden coordinator at each school completed and returned a commitment form to confirm receipt of the grant package and acknowledge agreement to the grant guidelines.

During the project period 10 recipient schools were visited and media was earned in San Diego, Orange County, Shasta and Oakland. WGF visited an additional seven schools for filming and created a video to promote the school garden program and support the specialty crop industry. The video can be viewed at https://www.youtube.com/watch?v=Ip0bNlTpLIY or http://www.csgn.org/california. The video currently has 319 views.

The project did not benefit any other commodities other than specialty crops.

CDE was instrumental in promoting the grant application and also reviewing the applications. A project partner created the online application tool, addressed bugs and trained project staff on use of the tool.

## Goals and Outcomes Achieved

The three goals of the project were 1) create new fruit and vegetable school gardens; 2) awareness of how food is grown and awareness of California specialty crop farmers through Producepedia web presence engagement; and 3) increase the number of California students exposed to fresh produce and how it is grown.

WGF received and reviewed 179 grant applications and chose 100 mini-grant recipients. WGF was able to meet the goal of creating 100 new fruit and vegetable gardens with the distribution of 100 mini-grants for $1,500 each. Each grant recipient school had on average 50 students participating in the gardens (~5,000 total) which exceeds the goal of 2,500 students involved in planting/harvesting fruits and vegetables.

WGF was unable to meet the goal of increasing traffic to Producepedia.com because it was impossible to determine where the traffic was coming from and if it could be attributed to this grant project or not; however, project staff are confident that progress was still made on increasing awareness of how food is grown and awareness of California specialty crop farmers through Producepedia.com, though this cannot be quantified.

Prior to the grant project, WGF had funded 600 California K-12 schools with money for fruit and vegetable gardens. At the end of this project WGF can confirm that 100 more gardens were created bringing the total funded to 700 gardens.

Over 5,000 students participated in the school gardens according to data provided by each school. That number exceeds the project goal and improves the impact of this project that much more.

## Beneficiaries

Each grant recipient school and their students (approximately 5,000) benefitted from the creation of fruit and vegetable gardens through WGF's grants. WGF estimates that approximately 5,000 students benefitted from the grant and likely the same amount of parents were impacted garnering increased consumption of fruits and

vegetables. This project increased the amount of California edible school gardens by 100. Students and their families learned about nutrition and the joys growing and of eating more produce.

The California produce industry represents more than $20 billion dollars. As children learn to enjoy fruits and vegetables through participation in school gardens, they are not only improving their own personal health, but also supporting one of the state's most important industries. Additionally, a child's increased taste for fruit and vegetables often leads to increased consumption of such foods by their parents.

## Lessons Learned

Based on the amount of grant applications submitted, it proved to WGF that the interest in school gardens is growing and so is the demand for funding. WGF learned that monitoring web traffic is not a viable option for future grant projects because of the inability to determine source of said traffic. The goal of increasing web traffic to Producepedia was not met because it was impossible to gauge the source of web traffic and attribute it to this particular project.

## Additional Information

Media coverage:
Times of San Diego (October 2014): http://timesofsandiego.com/education/2014/10/31/western-growers-foundation-announces-150000-california-garden-grant-recipients-4/
San Diego 6 (October 2014): http://www.sandiego6.com/news/local/12-SD-County-schools-get-edible-garden-grants-281138422.html
Capital Press (November 2014): http://www.capitalpress.com/California/20141105/grants-help-calif-schools-plant-expand-gardens
Orange County Register & Current – December 2014
UT San Diego (February 2015): http://www.utsandiego.com/news/2015/feb/05/vista-high-farm-community-service-honor/
Oakland Post (April 2015): http://postnewsgroup.com/blog/2015/04/15/malcolm-x-wins-grant-support-school-garden/
The Fresno Bee - http://www.fresnobee.com/news/local/education/article20936754.html
Topanga Messenger - http://www.topangamessenger.com/story_detail.php?ArticleID=7554

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 31 | **Project Title:** Fresh Food for Native Folks | |
|---|---|---|
| **Grant Recipient:** Hoopa Valley Tribe | **Grant Agreement No.:** SCB13031 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Kimberly Davis | **Telephone:** (530) 625-4284 ext. 110 | **Email:** KimmerzDawn@live.com |

## Project Summary

The Hoopa Valley Reservation is located in a small rural town that had little access to fresh healthy produce and a high obesity and diabetic population. The high poverty rate in Hoopa and the surrounding communities and the fact that there was only one grocery store with a small fresh produce section made it a necessity to come up with a way to make available fresh healthy foods. The aim of this project was to create healthier produce and a farmers market to provide Hoopa and surrounding communities access to these products. With the availability of the crops, the community was able to start making healthier food choices, income was made by the farmers, farms were created by the project (this was not a main goal by it does help the poverty stricken community), and those who suffer with diabetes and struggle with obesity were provided healthier food choice options. With the use of a matching fund vouchers awarded to those who qualified as low-income, families were able to purchase even more healthy food than they originally would have been able to.

In the Hoopa Valley and nearby areas there has been a large rise in obesity and diabetes affecting the community members. The ability for people to access healthy, affordable foods is the foremost reason for this problem. There is one grocery store in the town of Hoopa, which has a small selection of overpriced produce. The majority of the people are low-income families who cannot afford to purchase these foods on a regular basis. Not being able to buy healthy foods, the community is left buying the cheaper foods that are full of sugar. The longer the community is denied access to healthier foods, like specialty crops, the worse the problem will get. The local diabetes program already has reached its limit on the amount of clients it can help. Also there is a large rise in many people attempting to use diet shakes in place of being able to just eat healthier and lose the weight that is causing high risk to their health and well-being.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Six farmer recruitment meetings were held on 1/22/14, 2/27/14, 12/22/15, 12/29/15, 03/09/16 and 03/16/16. The meetings had an average attendance of 15 people per meeting but did well with getting the word out into the community. Informational and recruitment meetings were organized in order for the project director to meet and talk with the local public about the project purpose and the potential farmers responsibilities. Farmer applications, which included project information and rules, were handed out during the meetings for the attendants to complete as well as pass along to others who were interested in the project. The potential farmers and returning farmers had the opportunity to ask questions and meet the agricultural crew that would be working with them on the gardens. Every year of the project showed an increase of farmer applicants and an increase of farmers who participated. In the end, the project had up to 35 farmer applications and 20 farmers currently participating as of the project end date.

The majority of supplies were purchased at the beginning of the grant project. Flyers, posters, and handouts were made to advertise the recruitment meetings, the farmers markets, and matching fund voucher program. These advertisements were distributed out by the agricultural technicians. All supply purchases were conducted by the director. The project director approved all matching fund vouchers awarded. These purchases were made for items that were needed for the grant project in order to enhance the knowledge and use of California specialty crops by the Hoopa community and surrounding community members.

Planting and land preparation took place starting generally every February for the majority of the crops planted and in October for winter crops. Planting consisted of sowing the seeds directly into garden sites or into seedling pots, then older seedlings and saplings (trees and berries) were transplanted during proper season timing and when the seedlings were ready. Normal planting usually started in March and could go all the way into late July or August for some plant species; winter plants were usually planted around November at the latest. Land preparation consisted of ground tilling, plowing, row and mound building with soil media, trench digging, trellis setup, raised box building, raised bed box setup, weed and rock removal, and digging of holes. Inventory of tools, supplies, and seeds were carried out regularly as needed. During growing season, after plants have been sown, the seedlings were watered, weeded, and fed the necessary fertilizer by the agricultural technicians and the director.

Prior to having farmers markets, farmer meetings took place to prepare for the markets. Seven farmer meetings took place on 5/22/14, 7/18/14, 4/23/15, 7/13/15, 8/03/15, 5/18/16 and 5/27/16. The last two farmers meetings took place in order to prepare the farmers for self-sufficiently continuing the farmers markets after the end of the project funding. Farmers markets started late July after the first crops became mature enough to harvest and continued up into the end of October. After the first project year farmer market booths were held as well as full farmer market days. These market booths consisted of the agricultural technician crew and a few farmers who wished to participate, but were not required to. The booths took place during the week and was a way to increase the sale and consumption of specialty crops by those who could not attend the full farmers markets that took place on weekends. Throughout the project 15 full farmers markets that consisted of all the farmers having a table and specialty crops to sell took place and nearly 20 market booths were set up. The director developed surveys that were given out to the public during each farmer's market day. These surveys were collected and later analyzed to show a 5% increase in knowledge and use of California specialty crops by the Hoopa community and surrounding communities.

Only specialty crop commodities benefitted from the project. All grant work, activities, and funds only benefitted California specialty crops.

Project partners include the temporary seasonal employees at Tsemeta Nursery. The seasonal employees, under the directives of the project director, carried out the following activities during the project: Growing of fruit and vegetable seedlings for planting in farmers gardens which consisted of filling pots with soil media mixture, sowing seeds in the pots or directly in the gardens, watering, weeding, and applying fertilizer to the growing seedlings; land and garden site preparation which consisted of ground plowing, tilling, row and mound building with soil media, trench digging, trellis setup, raised box building, raised bed box setup, weed and rock removal, and digging of holes; and transplanting of seedlings, fruit trees and fruit bushes into the raised beds and garden sites that were prepped.

## Goals and Outcomes Achieved

This project was meant as a startup project. The aim was to get a farmers market started that would continue long after the grant funding was done. The Fresh Food for Native Folks project is a success. Several farms have been successfully created and the farmers are continuing on with farmers markets. There had been a lot of work during the last six months of the project to help get these farms and farmers well established to be self-sufficient and able to continue to supply the community with fresh and healthy California specialty crops. At least five of the 20 farmers that the project ended with have been a part of the project since the very start and have been holding their own markets since the end of the grant funding in June of 2016. The five farmers have been keeping in contact with all the farmers and have done very well in overseeing the continuation of the farmers markets.

Compared to the initial plan, the project's actual accomplishments were on schedule for all activities except a few. One project activity that was consistently off target was the meetings. The meetings took place like planned but they did not take place during the months originally set. This change was made to help ensure that more people would be able to attend the meetings. Although the majority of the supplies purchased were made during the proposed months, it became clear that supplies and other grant project expenditures were necessary throughout the entirety of the grant project.

The data gathered from the farmers markets during the first year of surveys showed there was little to absolutely no knowledge and consumption of California specialty crops by the Hoopa community and surrounding communities. This was not surprising considering such a market and product did not exist in the area. At the end of the project it was shown that at least 5% of the Hoopa community consumes California specialty crops and know what California specialty crops are. The benchmark goal was to get 190 to 200 people to attend and make purchases at the farmers markets, which would have showed that at least 15% of the Hoopa population was now regularly consuming California specialty crops. That did not happen and the attendance stayed at an average of 61 people attending the markets. Considering the average attendance of 61 people at each farmers market and assuming that the average local Hoopa community household consists of 4 people, it is safe to say that 5% of the local Hoopa community population of 5,100 were purchasing and consuming California Specialty Crops. This is not the outcome that was initially proposed, but it does show that there is now a successful California specialty crop market where there was once none.

There is now a seasonal farmers market in the town of Hoopa where there was once no farmers market. When the project started there was little to no knowledge or consistent consumption of California specialty crops among the Hoopa and surrounding communities. Now at least 5% of the Hoopa community population know of California Specialty crops and now purchase and consume them on a regular basis. The project made 20 successful farms that grow and produce California specialty crops of which five have been with the project from the start and are now continuing to oversee the farmers markets that the 20 farms participate in.

## Beneficiaries

The main beneficiaries of this project are the local farmers and specialty crop consumers of the Hoopa community. Other beneficiaries include the obesity patients within the community that now have access to fresh, local specialty crops.

If 5% of the Hoopa community of 5,100 is purchasing and consuming specialty crops, then approximately 250 consumers benefited from this project. The 20+ farmers who participated in the project are also benefiting from specialty crop sales in the community.

## Lessons Learned

Positive lessons learned include learning all the hard work that goes into growing California specialty crops. When the project started the director, agricultural crew and farmers had little to no knowledge on how the majority of the crops grew or how they needed to be cared for. Now after working with them for the length of the project, knowledge on how to properly care for them and how to get large harvest from the crops was acquired. These horticulture skills have come to help with knowing what can be planted in the area and what cannot, the proper amount of fertilizer and water needed, and how much space each plant needs to grow. Also the farmers learned their consumer market, helping them know what types of crops to grow more of and what type of crops did not sell well. Farmers market location was another positive lessoned learned. After holding the farmers markets at a few different locals within the town of Hoopa it became apparent that holding the market as close to the center of town where the more people pass through was the best location for higher sales. There were several losses of seedlings, tools and supplies due to theft. The result of these thefts helped the staff learn to keep better inventory of all the supplies and plants for the remainder of the project and to store them more securely. California has been in drought conditions during the entirety of the project which posed a real problem. The lack of water availability had caused complete loss of more than one garden and some crop loss to a lesser extent for others. These conditions helped the staff and farmers to learn water conservation methods, which helped to save water while also still providing enough for crop survival.

A very unexpected but positive result from the implementation of this project was the rise in the number of people growing their own home gardens in the area. A large majority of the customers who attended the farmers markets have stated that since they started purchasing the produce from the farmers market it inspired them to try growing a few of their own vegetables. These crops were usually the more utilized crops such as tomatoes and zucchini. This was not intended but with the need of the obese and diabetic population in the Hoopa community it is a positive result.

The only goal that was not achieved was the benchmark goal of getting 15% of the Hoopa population to purchase and consume California specialty crops. Staff did not account for the fact that this was a new market for the Hoopa area. A more realistic goal should have been considered. Although, eventually the amount of specialty crop consumers in the Hoopa area may reach 15% it did not happen during the short grant project time frame. This could have been avoided if a little more research into the ability and willingness of the targeted consumer had been done.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

## SPECIALTY CROP BLOCK GRANT PROGRAM

### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 32 | **Project Title:** NCO FoodPREP (Produce + Rural Enterprise for Prosperity) Project | |
|---|---|---|
| **Grant Recipient:** North Coast Opportunities | **Grant Agreement No.:** SCB13032 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Patty Bruder | **Telephone:** (707) 462-1956 | **Email:** pbruder@ncoinc.org |

## Project Summary

Through the Produce + Rural Enterprise for Prosperity (FoodPREP) Project, North Coast Opportunities (NCO) proposed to partner with the Ford Street Project and local specialty crop producers to purchase and process Mendocino and Lake County fruits and vegetables and market them to institutional and retail buyers. The FoodPREP Project was designed to add an essential link to the value chain between growers and institutional buyers by creating the community's first food processing facility, building on existing resources to link specialty crop growers with mainstream markets.

NCO anticipated that FoodPREP would increase farm income for specialty crop producers, because they would have increased access to institutional markets. Farmers who lacked the capacity to clean, process, and package their specialty crops for institutional use would gain market access, while schools and other institutions that lacked the resources to process excess specialty crops for use during winter months would increase their utilization of local crops. Further, clients of Ford Street, which provides transitional housing and substance abuse treatment programs, would gain nutritional knowledge and job skills, learning to clean, cube, freeze, can, or otherwise process specialty crops while fulfilling their commitment to work 20 hours per week in exchange for transitional housing.

Project goals were to: 1) improve nutritional awareness of children and adults and increase consumption of California specialty crops; 2) enhance utilization of specialty crops by improving the efficiency of the processing and distribution systems; and 3) encourage and expand the availability of affordable and locally grown specialty crops through farm-to-fork programs that would make it easier for specialty crop producers to sell to local institutions. These goals were to be addressed through the FoodPREP Project objectives:

- Purchase specialty crops from local producers to process and package foods for purchase by schools and other institutions
- Provide nutrition education, food preparation and processing training, and work experience to 40 homeless people living in on-site transitional housing.
- Develop and distribute at least one branded food product, such as a soup or soup mix, for marketing in retail outlets in the community.

At the end of Year 1, NCO revised the proposed activities because Ford Street was not able to continue its participation in the project. Although this revision resulted in extensive programmatic changes, the project's overall goals remained the same. NCO partnered with a range of community partners to purchase bulk quantities of specialty crops from local producers and use them in presenting food processing workshops in low-income communities. Details are reported in the Project Approach Section below.

NCO has been working to strengthen the local food system for more than 15 years. The FoodPREP Project addressed two important components of the food system by providing a new market for local specialty crop producers while increasing nutritional knowledge, specialty crop processing skills, and specialty crop consumption in low-income communities.

The project benefited from work accomplished through two previous Specialty Crop Block Grant Program (SCBGP) projects, as described below.

The 2011 SCBGP Project 46: *North Coast Opportunities Farm2Fork Project* provided training, equipment, and technical assistance (TA) to specialty crop producers and to schools and other buyers to increase institutional purchasing of locally grown specialty crops. This effort trained 65 school food service staff, and four school districts began buying fresh specialty crops from 12 local specialty crops growers, representing a sustainable 100-250% increase in local farm to school purchasing. An additional nine school districts, three hospitals, seven grocers, and 15 restaurants also began developing their local purchasing capacity through Farm2Fork and regional producers began to benefit from the increased institutional demand for local specialty crops. Farm2Fork increased school demand for local produce and prepared specialty crop producers to sell to this market, allowing them to experience the economic potential of selling to institutional markets. The Farm2Fork Trainer transitioned to become the FoodPREP Project Coordinator, and structures, processes, and lessons learned through Farm2Fork created a solid foundation for implementation of the FoodPREP Project.

The 2013 SCBGP Project 5: *NCO Food Hub Project* was developed to maintain and expand the Lake County Grown online ordering system and to facilitate partnerships that would increase market access for Lake and Mendocino County farmers and buyers. During the course of the FoodPREP Project, this effort became a fully developed online ordering system as part of the 2013 SCBGP Project 5. The online ordering system has played a key role in developing the link between institutional buyers and specialty crop producers. The two projects complemented each other, with the Food Hub Project establishing and operating the online system and the FoodPREP Project ordering local produce through the system for use in project activities.

## Project Approach

Year 1: During the first year of the grant, NCO strengthened both individual- and community-level food self-reliance while addressing the needs of Ford Street's highly vulnerable clients by completing the following tasks:

- Working in partnership with the Food Hub Project, NCO recruited 22 specialty crop producers, buyers, and community members to participate in an Advisory Group that met regularly throughout the project.
- NCO entered into an agreement with the Ford Street Project, completed an assessment of the Ford Street kitchen facility, and purchased storage and small ware upgrades.
- NCO's Gardens Project worked with Ford Street to revitalize two Ford Street Project gardens and create a new production garden, growing more than 25 specialty crop varieties.
- During the year, NCO conducted three rounds of trainings (24 trainings in all) covering 12 training topics. A total of 54 people participated in the trainings—49 clients and 5 Ford Street staff. The food-related trainings began with three core classes that were prerequisites for subsequent trainings. These were Knife Skills, Food Safety, and Kitchen Operations. These topics were expanded through separate, more detailed training sessions that covered the use, care, handling, storage, processing, and preparation of specialty crops for healthy family and/or congregate meals. Training was delivered in both a classroom setting and through hands-on demonstration and practice in the kitchen. During the course of the year, half of the participants completed at least three of the training sessions. Although the Ford Street Project did not continue with the project, the organization has continued to deliver an in-house version of the training curriculum.

- The project integrated the processing of local specialty crops and from the on-site gardens into clients' daily work schedule so that meals were prepared using these ingredients, improving the nutritional value of the meals. Ford Street has continued to serve its clients the improved menus that were developed through FoodPREP.
- NCO developed a comprehensive training curricula and training materials covering nutrition education as well as personal and institutional specialty crop processing and cooking skills.
- In fulfillment of the objective of developing and marketing a value-added specialty crop product, NCO partnered with Ford Street to purchase 720 pounds of local apples and sell 182 jars of "apple crisp in a jar" mix using dehydrated apples to local businesses and individuals.
- NCO also developed a demonstration catering program as a social enterprise to further develop skills and generate income to sustain the program. By the end of Year 1, NCO had developed 15 catering-ready recipes and training participants had planned, prepared, and served meals at eight events that ranged from 12 to 40 diners.

Years 2 and 3: During the second and third years of the project, NCO worked with five community organizations to bring specialty crop processing skills to low income communities:

- To identify appropriate partners, NCO prepared a Request for Proposals and interviewed a variety of agencies in Lake and Mendocino County to assess their needs, interest, and capacity to partner with NCO in planning and delivering food processing workshops. Contracts and Memorandum of Understandings (MOUs) were developed with five selected organizations, detailing their responsibilities in conducting workshops using their commercial kitchens and facilities.
- NCO developed a comprehensive training curriculum with a wide range of recipes and meal plans utilizing local seasonal specialty crops. Rather than being organized as a series of workshops, each workshop was a stand-alone food processing lesson.
- NCO conducted assessments of each partner's commercial kitchen and purchased a variety of kitchen supplies to facilitate implementation of the food processing workshops. Providing project partners with appropriate supplies had a significant impact on their capacity to plan, prepare, and process specialty crops for use in their programs (as detailed in Table 3).
- NCO piloted the workshops at Willits Grange in October 2014 and at Ukiah Senior Center in December 2014. In the pilot workshops, participants canned applesauce and pears in honey, made butternut squash soup, and learned tips for storing, preparing, and preserving specialty crops. All local specialty crops used in the pilot workshops were purchased and/or harvested from two local farms and a community garden.
- Full workshop schedules began in April 2015. In all, there were 369 participants in the 89 trainings and workshops offered by the project during the grant period.

Table 1. Workshop summary

| Year | Number of trainings or workshops | Number of participants |
|---|---|---|
| Year 1 | 24 trainings | 54 (49 Ford Street clients/5 Ford Street staff) |
| Year 2 | 41 workshops | 198 participants |
| Year 3 | 24 workshops | 117 participants |
| **Total** | **89 trainings and workshops** | **369 participants (290 unduplicated)** |

- NCO purchased 3,476 pounds of fresh local specialty crops through the Food Hub to prepare the focused foods for each workshop. These specialty crops, which cost a total of $4,906 (averaging

$1.41/pound), included bulk purchases made through the Food Hub for workshop participants' use in their own kitchens as well as the food purchased for the workshops. During each workshop, produce was weighed, measured in volume, and amounts documented so that recipes could be replicated easily in the future. Each recipe included the amounts of produce needed in order to prepare batches of various sizes, serving up to 50 people. The finished products were measured and accurate yields were documented on the recipes for future use.

- NCO efforts to modify the existing online ordering system enabled the MendoLake Food Hub to become operational during Year 2. The Food Hub ordering system was used throughout the remainder of the project to purchase specialty crops for use in FoodPREP workshops.

The project was designed for the sole benefit of specialty crops, and all project activities related to the grant were focused on promoting sales, consumption, and utilization of local specialty crops. The Food Hub lists and sells only specialty crops, thus ensuring recipes and food preservation activities are using these ingredients. Recipes used in training and workshops featured specialty crops grown in season and used in a multitude of ways. Ingredients used in the recipes were primarily seasonal specialty crops.

The Food Hub Advisory Committee has been instrumental in providing advice and feedback for the benefits and challenges of the online ordering system. The group consists of farmers, local businesses, financial professionals, and representative from the Environmental Health Department.

The Mendocino County Farmers Market Association (MCFARM) has been a major supporter for advertising the workshops and encouraging farmers to sell their specialty crops through the Food Hub.

During Year 1, NCO partnered primarily with the Ford Street Project. Ford Street's contributions to the project included the kitchen facility and access to the target population. Ford Street benefited from the project in numerous ways. Even though they participated as a partner in the project only during the first year, they have continued to use the training curriculum that was developed through the project as well as the recipes that were developed to incorporate specialty crops in client meals. Ford Street is continuing to harvest produce for client meals from gardens developed with the assistance of the NCO Gardens Project. However, Ford Street did not continue to purchase from local specialty crop farmers or create any additional specialty crop products to sell outside their program.

During Years 2 and 3, NCO partnered with five organizations to deliver food processing workshops: Caspar Community Center, Willits Little Lake Grange, Ukiah Senior Center, Lakeport Big Valley Grange, and Clearlake Highland Senior Center. Although similar, each site differed in its needs and structure. Each site provided access to their commercial kitchen, classroom space for the workshops, and, through their membership, assistance with recruiting workshop participants. In two sites (Caspar Community Center and Lakeport Big Valley Grange), NCO contracted with a local trainer to conduct the workshops, while project staff organized and delivered the workshops in the other three locations.

## Goals and Outcomes Achieved

The overall aim of the FoodPREP Project was to enhance the competitiveness of specialty crops by completing the value chain between specialty crop producers and mainstream markets through infrastructure and food processing. Activities carried out in pursuit of each goal and outcome are described below.

GOAL 1. Improve nutritional awareness of children and adults and increase consumption of California specialty crops. The project addressed this goal through the food processing workshops described in the previous section, each of which was a stand-alone food processing lesson. By the end of the project, NCO had conducted 89 workshops, with 369 participants. Attendance averaged 8 and ranged from one to 29 people.

Many people attended multiple workshops, resulting in an unduplicated number of 290 participants. Of these, 195 (67%) attended just one workshop, while 48 (17%) attended two workshops; 20 (7%) attended three workshops; 13 (4%) attended four workshops; and 14 (5%) attended five workshops or more. One individual participated in 14 workshops!

The three-four hour workshops were based on specialty crops that were available locally at the time of the workshop, and the lesson plans and recipes were developed to feature those crops. During each workshop, participants were given an overview of the project, information about the crops being used and the farmers that grew them, and instruction on following the featured recipes. With the introduction complete, instructors guided participants through the hands-on kitchen preparation as they learned to work in a commercial kitchen. Food preservation was a key component of the curriculum, so participants were given training on food safety and proper canning techniques, using USDA Canning Guidelines. Various food preservation methods were taught, including canning and freezing, and recipes included jams, pickles, canned fruits, salads, vegetable spreads, sauces, pestos, salsas, and soups. In addition, NCO conducted three workshops that were specifically focused on the use of specialty crops in meeting the nutritional needs of people with diabetes.

GOAL 2. Enhance utilization of California grown specialty crops by improving the efficiency of the processing and distribution systems. Working in partnership with the MendoLake Food Hub, NCO addressed distribution efficiency through the modification, development, and operation of the online ordering system. The ordering system makes it possible for business and institutional buyers to see available local specialty crops in real time, order the produce they need, and have it delivered to their location. NCO addressed processing efficiency through the food processing workshops, which increased the number of people with skills and knowledge related to processing local specialty crops.

GOAL 3. Encourage and expand the availability of affordable and locally grown specialty crops through farm-to-fork programs that make it easier for producers to sell to local institutions. As with Goal 2, NCO's online ordering system made it easier for producers to sell to local institutions, while facilitating purchase of local specialty crops by business and institutional buyers. FoodPREP staff contributed to the success of the online ordering system by helping to train food service staff from schools and other organizations to use the new system.

OUTCOME 1. Sales of locally-produced specialty crops will be increased through the participation of 44 of the 110 local specialty crop producers, and by increasing the number of institutional/retail buyers from eight to 15. FoodPREP purchased specialty crops for workshops through the online ordering system, which makes it possible to identify the producer associated with each purchase. Workshop fees paid by participants enabled the project to purchase specialty crops from a total of 41 specialty crop producers during the course of the project, and four of the five Year 2 and 3 project partners have continued to purchase specialty crops through the Food Hub for operation of their own programs. (The fifth partner, Lakeport Big Valley Grange, buys from the farmers market located a half mile from their location.) Among Year 3 workshop participants, 71% reported that they would "definitely" or "probably" purchase local produce through the Food Hub in the future, and several have already done so.

As a result of the workshop introductions to individual local farmers and to a variety of local food outlets, community members who attended the workshops gained a stronger awareness and appreciation of the local specialty products available and commented on the new skills and resources they had gained. On Year 3 post-surveys, 96% of surveyed workshop participants stated they "probably will" (15%) or "definitely will" (81%) increase their purchasing of local specialty crops. They gave high praise for the workshop content, organization, recipes, quality of produce, and collaborative group learning.

OUTCOME 2. The competitiveness of local specialty crops will be enhanced as producers experience increased market access, including 10% reduction in marketing time, expansion of marketing season by at least three months, and a 15% increase in marketing of surplus and seconds. During the last year of the project, staff conducted surveys of 23 specialty crop producers that sold their produce through the Food Hub for use in FoodPREP workshops. Asked how many times they had sold through the Food Hub, 14 producers (61%) reported that they had sold through the produce two to five times, while nine producers (39%) sold more than five times during the grant period. Producers were asked to report farm business costs (e.g., transporting produce to markets, marketing, and post-production costs) that were impacted by their participation in the Food Hub. Of the 21 producers that responded to this question, all but two reported decreased costs in at least one of the expense areas. The extent of the change in costs varied widely, ranging from 1% to 100%. (Note that, while 21 producers reported cost decreases, not all provided an estimated amount of decrease.) Producers were also asked to report any net gains in farm income that resulted from their participation, as well as the type of farm business activity that resulted in the increased income (e.g., increased sales, higher sales prices, more sales of surplus and seconds). Of the 23 producers that responded to this question, all but four reported small increases in their net income that ranged from 0.1% to 60%. Producers were next asked to report any changes in the amount of time they spent on their farm business as a result of their participation, as well as the types of activities (e.g., marketing, transportation, direct sales) for which the time spent changed. In all, 16 of the 23 producers (70%) reported reduced time spent in at least one activity.

OUTCOME 3. Community awareness of the availability and value of local specialty crops and value-added products made from local specialty crops will be increased. Working in coordination with NCO's other food system programs, the FoodPREP Project carried out a number of community education and marketing activities to increase community awareness of the availability and value of purchasing and consuming local specialty crops. In addition to 16 presentations to community groups reaching 482 people (summarized in Table 2 below), these activities included: articles in local newspapers; print and radio public service announcements (PSAs), and six issues of an e-newsletter, The FoodPREP News. Recruitment for workshops was conducted at food stamp tables at four farmers markets; at local clinics, Public Health and CalWorks; and through PSAs on two radio stations, four newspaper articles, and posting of flyers, social media, and 12 blog posts on the NCO website, NCO Facebook page, Grown Local website and Facebook page, and the NCO Gardens Project Facebook page.

Table 2. Community presentations

| Location | Number | Content |
|---|---|---|
| Big Valley Grange Board of Directors | 3 | Overview of project, potential for partnering |
| Caspar Community Center | 12 | Overview of project, potential for partnering |
| Clearlake Highlands Senior Center | 9 | Overview of project, potential for partnering |
| Ford Street Project Board | 8 | Overview of project and progress |
| Grange Farm School | 8 | Overview of project, potential for partnering |
| Hopland Pomo Specialty Foods Show | 100 | Demonstration, samples of specialty crops |
| Lake County Farmers Market Board | 8 | Potential for selling specialty crops |
| Lake County Hunger Taskforce | 10 | Overview of project, community needs |
| Leaders for a Healthy Community (Ukiah) | 25 | Overview of progress, samples of specialty crop foods |
| Leaders for a Healthy Community (Ukiah) | 15 | |
| Mendocino County Farmers Guild | 55 | Potential for selling specialty crops |
| Mendocino County Farmers Market Association | 43 | Potential for selling specialty crops |

| | | |
|---|---|---|
| NCO Board | 17 | Overview of project and progress |
| Willits Hometown Festival | 100 | Overview of progress, specialty crop samples |
| Willits Little Lake Grange Board | 30 | Overview of project, potential for partnering |
| Willits Senior Center | 40 | Overview of project, potential for partnering |

While the original outcome measures were intended to be achieved during the project period, NCO is confident that these measures will continue to increase into the future (e.g., increased number of participating producers and buyers, and increased community awareness of the availability and value of local specialty crops).

Baseline data collected at the beginning of the project was primarily qualitative in nature; most local specialty crop producers were either unable or unwilling to share specific details related to their income and expenditures. Rather, baseline data collected by the project focused on compiling data on the local specialty crop producers (e.g., where they are located, types of crops they produce, where their produce is sold, marketing strategies) and local specialty crop buyers. Intensive interviews with 16 producers revealed that: 13 sell locally (within 100 miles); seven would like to sell wholesale; seven would scale up and grow more if they were sure they could sell it; and their most successful crops were cucumbers, tomatoes, greens, squash, potatoes, and orchard fruit. NCO also collected post-workshop assessments from participants to assess self-reported knowledge gains, provided previously in this report.

Some of the major successful outcomes of the FoodPREP project was NCO conducted a total of 89 workshops and trainings reaching 369 people with information on specialty crop nutrition and processing and purchased 3,476 pounds of local specialty crops through the Food Hub, from 41 producers. NCO also developed a wealth of training materials and resources that will be an integral part of the continuing program and will also be used independently by project partners, including those listed below:

- A comprehensive training curricula and lesson plans for the specialty crop workshops.
- A binder of 105 tested bulk recipes that is indexed alphabetically as well as by food type, primary ingredients, and season, with each recipe designed for ease in adapting to prepare any number of servings. A binder has been shared with each partner site and NCO is working to create a searchable digital version of the recipes that can be posted online.
- A comprehensive listing of 39 locally available seasonal specialty crops, categorized by months of peak season and months of shoulder season.
- An assessment of 20 potential partners throughout the two-county area for continuation of the project.

## Beneficiaries

Specialty crop producers: As described previously, the project purchased 3,476 pounds of specialty crops from 41 local specialty crop producers during the grant period. Responding to surveys conducted at the end of the project, producers reported that they had benefited from the project in terms of decreased operational costs, increased farm income, and reduced time spent on marketing, and transportation, and sales activities.

Ford Street clients: At the end of the project, 20 (69%) Ford Street clients reported that they knew more about cooking healthy food than they did at the beginning of the project, and nearly three-quarters (73%) said they would use what they had learned “quite a bit” or “a lot” to improve their health. In addition, three clients gained employment in the food service sector, two earned Food Manager Certificates, and three earned Food Handler certificates.

Workshop participants: Survey responses from a high proportion of workshop participants show that participants benefited from learning "quite a bit" or "a lot" from the workshops in terms of food preservation techniques (92% in Year 1 and 92% in Year 2), new recipes using local specialty crops (98% in Year 1 and 92% in Year 2), and using local specialty crops to prepare healthy meals (97% in Year 1 and 93% in Year 2).

As previously noted, beneficiaries included the 41 specialty crops producers whose produce was purchased for use in project activities, as well as the 290 participants in trainings and food processing workshops.

## Lessons Learned

Although the Ford Street Project initially seemed an ideal partner for implementing the project, it became clear during the first year that the turnover of both staff and clients, and the transitional situation of many clients, made it difficult to conduct trainings with consistency. NCO addressed this challenge by learning to value every opportunity to interact and offer learning opportunities to participants, whether or not the individual followed through by completing an entire training series. Although this approach limited the project's capacity to standardize the learning experience and collect comparable pre/post data for assessing learning and behavior changes, letting people participate at-will enabled NCO to reach the highest possible number of individuals. To further facilitate participation, NCO condensed the length of the trainings to a three-week package (rather than the planned six-week package) and invited people who had missed a training to participate in make-up sessions that were offered during the last quarter of the year.

Programmatic, budget, and staff changes made it impossible for Ford Street to purchase from local specialty crop farmers. Since most of the canned and frozen commodities used in the Ford Street food program are donated, they did not have the funds to begin purchasing from local specialty crop producers. Ford Street was not able to overcome this barrier. Because one of the primary project goals was to increase the use of local specialty crops, NCO found it necessary to identify additional partners. This transition was facilitated by NCO's strong community relationships, and the lesson learned was that it can be possible to achieve positive outcomes even when involuntarily forced to change the direction of a project.

In early 2015, as part of the overall process of planning project revisions, NCO conducted a focus group with people who had participated in the pilot workshops. Suggestions from the groups that were incorporated into the full implementation of the project included the following:

- Length: workshops should be three hours, and should be opened with a 30-minute introduction to food safety, a tour of the kitchen, an overview of the recipes, and nutritional information.
- Outreach: To ensure participation of the target population of low-income families, conduct outreach and recruiting through such groups as local clinics, family resource centers, and church groups.
- Workshop topics: Suggestions for the types of foods to be covered during the workshops included roasted vegetables, fruit preserves, pickled vegetables, butternut squash lasagna, fruit pepper jelly, frozen berry medley, herb pesto, salsa, kale chips, herb cubes, dried tomatoes, tomato jam, fig jam, dried fruit, and more.

Throughout the project, NCO learned a great deal about the permitting requirements for processing specialty crops, and successfully navigated this process.

In part because of the mid-project changes in project activities, NCO experienced a number of unanticipated positive outcomes, as described below.

- Because the recipes and types of specialty crops used in the workshops were flexible, coordination with producers enabled them to use this as an opportunity to sell some of their smaller, imperfect, or blemished crops (e.g., apples, peppers, and tomatoes). This type of produce is not accepted by grocery

stores and is rejected at farmers markets, so without FoodPREP it would end being composted or fed to animals. This option greatly increased producers' sales of imperfects and, with the convenience of the Food Hub, the marketing costs were minimal.

- Participation in FoodPREP workshops required participants to pay a fee of $20 for purchase of the specialty crops and other ingredients used in the classes. NCO initially planned to allow low-income people to make this purchase using an EBT card, but this did not prove to be possible. As an alternative way of encouraging the participation of low-income people, NCO developed a scholarship program. This had the dual benefit of enabling people to participate for only $5 per class while raising awareness of the program through outreach that was done to explain the scholarship program.
- The Clearlake Highland Senior Center, which joined the project in Year 3, reported an increase of 37% (from 1,513 pounds to 2,413 pounds) in the quantity of fresh specialty crop produce used in senior meals, and a corresponding decrease (from 707 pounds to 54 pounds) in the quantity of frozen and canned produce purchased for senior meals. (Comparison is between July 2015 and May 2016). Furthermore, the number of meals served during the course of the project (from November 2015 to April 2016) rose from 682 meals per month to 1,050 meals per month, an increase of 54%. In a survey of 47 senior center diners, conducted after serving the new specialty crop recipes, almost half pointed to the fruits and vegetables as their favorite part of the meals.
- The Willits Little Lake Grange's commercial kitchen was upgraded in 2010, but had been underutilized until the FoodPREP workshops raised community awareness of the availability of the kitchen and provided training in using the upgraded equipment. Several small businesses are now using the kitchen to process specialty crops for value-added products.
- NCO has begun working to adapt some of the 150 specialty crop recipes developed through the project for the use of schools, ensuring that they meet nutritional and portion size requirements.
- The Expected Measurable Outcome of increasing participation of local farmers to 44 was challenging, but NCO's efforts resulted in achieving 93% of the objective.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 33 | **Project Title:** Connecting Agriculture to Schools and Homes (CASH) | |
|---|---|---|
| **Grant Recipient:** California State University, Chico Research Foundation | **Grant Agreement No.:** SCB13033 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Kristin Gruneisen | **Telephone:** (530) 898-6476 | **Email:** kgruneisen@csuchico.edu |

## Project Summary

The Center for Healthy Communities' (CHC) Harvest of the Month (HOTM) and Farmer of the Month (FOTM) programs introduce children to specialty crops and the farmers who produce them. These programs successfully increase students' specialty crop selection and consumption patterns as documented by CHC (formerly CNAP) research (Waite et al, 2012). Although CHC's programs generated a 2-3 fold increase in produce consumed, CHC's funding ended in 2013 and therefore eliminating an effective way to increase consumption of California grown specialty crops in schools and communities. In addition, the Healthy Hunger Free Kids Act requires schools to ensure that students select at least one fruit or vegetable daily. The proposed Connecting Agriculture with Schools and Homes (CASH) project was written in part to assist food service directors to meet this rule with California grown specialty crops.

Regional school districts purchase 0-6% of specialty crops directly from farmers. The CASH project focused on providing support to school districts to increase local purchasing by connecting them with area farmers who were ready to sell to schools. In addition, the CASH project was focused to increase awareness in the rural northern California communities about what products are grown locally and the season in which they are available.

Research shows an inverse relationship between fruit/vegetable consumption and obesity. Increasing fruit/vegetable consumption is critical in project counties where rates of childhood overweight range from 35-41%. In addition, over 2 billion dollars a year is spent promoting food to kids in the United States (U.S.), but less than 1% of that promotes healthy foods. The CASH project promoted local farms to schools and families.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

The HOTM program was revamped from the prior look and feel to match CASH's specifications with new materials featuring an increased focus on local farmer promotion. CHC's HOTM tasting program is one of the largest in the state, and the rural districts that receive the HOTM program are vocal about their enthusiasm for the program. CHC delivered approximately 15,000 tastings per month to 42 elementary sites for 26 months over the course of the grant period. This equates to 390,000 tastings of locally grown California specialty crops purchased directly from local farmers. The new materials including a HOTM educator newsletter, HOTM family newsletter, FOTM newsletter/video, and stickers were created and delivered each month to the participating teachers and their students. More than 600 teachers and food service staff in 17 school districts also received this information electronically. The monthly email contained additional information and resources selected to enhance the tastings via nutrition education activities, local farmer information and food safety information.

Communication with Food Service (FS) Directors improved over the course of the grant period. CHC staff met initially with FS directors to identify obstacles to local procurement, and then continued to meet with them throughout the project. CHC's other farm to school projects complemented the CASH activities with several regional gatherings that were designed to provide training for food service staff for scratch cooking and local procurement. After these events there was increased awareness of the HOTM program as a method to connect the cafeteria to the classroom. Several districts made an effort to repeat the HOTM products on their menu and in their salad bars. CHC has created a HOTM 2016/2017 schedule for districts to provide a version of the HOTM program as well. For example, Chico Unified School District has a goal of providing HOTM tastings in their cafeterias at 17 sites in the upcoming year, an unprecedented effort in the district. The HOTM program was a terrific anchor for many outreach events and served as a valuable tool for increasing awareness of what is grown in the area during the school year. For example, in Colusa Unified School District, CHC was able to facilitate a Farm Stand Pilot Project via Farmers' Market Promotion Program (FMPP) funding, that sold low cost produce to families and provided tastings of simple recipes using the HOTM featured product. These stands also market the local farmers and the projects complimented each other well.

Teacher and parent surveys were developed, distributed and analyzed during the grant period. While teacher surveys had a significant response, reaching the homes and getting parents to complete either paper or electronic surveys was extremely difficult and unfortunately had very low participation.
CHC worked with area farmers to purchase the HOTM produce. These farmers were promoted via the newsletters. Several districts also highlighted featured farmers on their websites and in their cafeteria. CHC promoted the farmers via social media. CHC met with local growers throughout the grant to improve the HOTM cycle, to set up forward contract purchases and connect growers with school districts. The relationships built during this grant period will continue beyond the funded project. CHC created three "virtual field trip" farmer videos during the project period. The videos were extremely popular with teachers and students and the farmers. Teachers commented often about how much they loved the videos. CHC has made the videos available on the CHC website and also shared DVDs of the videos at the California Farm to School Network Conference in 2015, and National Farm to Cafeteria Conference in 2016. As a result of the videos, one of the featured farmers created a Facebook page to post a video on it and create a social media presence for the farm.

The project solely benefitted California grown specialty crops.

The farmers that partnered with the project were generous with their time for the creation CASH materials. In particular, Dhillon Farms, Lee Family Farm and Citrus Norte Farm featured in the CASH videos during the project, donated a significant amount of time for filming these videos.

Teachers receiving the CASH program tastings and materials provided lessons and valuable feedback and played a key role in connecting kids to in season produce and local farmers.

FS Directors in several districts met regularly with CHC staff. The three districts that allowed CASH staff to collect and analyze procurement records and answer many questions around local procurement, contributed a significant amount of time to the project. There were also several distributors who contributed valuable information during the effort to analyze purchasing records, in particular General Produce and Pro Pacific Fresh.

## Goals and Outcomes Achieved

Goal #1: Throughout the project period, on-going interviews were conducted with food service directors, distributors and farmers to identify barriers to and strategies for buying local.

Goal #2: School production records and invoices were obtained as a strategy to measure changes in specialty crop purchases by school districts. However, while production records and invoices measured types of produce purchased, these records did not capture whether or not these were California specialty crops. Furthermore, distributors were unable to provide additional information about these purchases due to the amount of time that would be required. Therefore, CHC was unable to measure changes in purchases of California specialty crops.

Goal #3: Twenty-seven HOTM deliveries were made to schools. Each delivery included a FOTM sheet to highlight to farmer that grew the item. Three FOTM videos were produced to highlight California specialty crop farmers.

Measureable Outcome (MO) #1: Identification of obstacles, strategies, procedures and tools for school district specialty crop purchases: see activities for goal #1.

MO #2: FS directors were provided with strategies (identified by goal #1) and connected with farmers who were able to supply the volume and type of crops food service directors identified to include in their menu cycles.

MO #3: HOTM lessons were provided to approximately 15,000 students per year to encourage the selection and consumption of California specialty crops. FS directors included the featured HOTM item on the menu cycle to encourage consumption of California specialty crops.

MO #4: Teacher surveys were conducted at the end of years 1 and 3.

MO #5: Parent surveys were conducted at the end of years 1 and 3. Nine parents returned completed surveys in year 3.

All outcome measures were to be completed within the grant period. However, outcome measures #2 and #3 could not be measured during the project period as California specialty crops could not be identified using only invoices and production records. Project staff did work with foodservice directors and farmers to enable certain specialty crop purchases (kiwi, mandarins, apples) from California growers.

Goal #1: Increase economic opportunities and local specialty crop sales in Butte, Glenn and Tehama counties by assisting food service directors and farmers in identifying marketing and procurement obstacles and developing strategies, tools and procedures.

Throughout the project period, obstacles, strategies, procedures and tools for school districts to increase specialty crop purchases were identified. A summary of their obstacles to purchase specialty crops has been created and shared with the school districts. The sales increases directly related to this goal were not tracked separately from overall school food service purchases. However, economic opportunities were increased based on connections that were made between farmers and FS directors via FOTM promotion activities and

meetings between the CHC Farm to Fork Coordinator and FS directors. In total, $34,883.37 of produce was purchased from local specialty crop farmers throughout the grant on HOTM.

Goal #2: Increase school district purchases of specialty crops by 100%, doubling the specialty crops available to students in response to greater student cafeteria selections as an outcome of participation in the Harvest of the Month (HOTM) program.

Creating relationships between growers and foodservice directors allowed individual purchases to be identified as California specialty crops. However, overall purchases made by school districts could not be categorized as California specialty crop or not based on the data collected (production records and invoices). Conversations with distributors and school food service directors made clear that in order to measure changes in specialty crop purchases, distributors must have tracking systems in place.

Since school districts and distributors couldn't track overall California specialty crop purchases, school district HOTM figures can be substituted. For the 2013 - 2014 school year, there was $10,200.71 spent on specialty crops through HOTM tastings. For the 2015 - 2016 school year, there was $14,457.16 spent on specialty crops through HOTM tastings. This shows an increase of 42%.

Goal #3: Increase sales by marketing at least 20 California specialty crops and farmers to consumers by highlighting farms, growing locations and production practices via Farmer of the Month (FOTM) activities.

During the project period, HOTM was delivered each month to 15,000 students during the school year. Twenty-seven California specialty crop deliveries were made highlighting 14 different farmers and 14 different crops. Some crops and farmers were repeated specifically to strengthen the relationship between the growers and the schools. Three FOTM videos were created and shared with teachers.

Expected Measureable Outcome (EMO) #1: Interviews with foodservice directors on obstacles, strategies, procedures and tools for school districts to increase specialty crop purchases were conducted and responses were documented throughout the project period.

EMO #2 & #3: Six-week periods of food service production records and invoices were collected at baseline and throughout the project period: October 2013 (baseline), February 2014, May 2014, October 2014, February 2015, May 2015, October 2015 and February 2016.

EMO #4: Ninety teacher surveys were completed in year 1 (baseline), 36 in year 2 and 108 in year 3.

EMO #5: Forty six parent surveys were completed in year 1 (baseline) and only nine parents returned completed surveys in year 3.

- Twenty-seven HOTM tastings of California specialty crops were purchased directly from local farmers and distributed to partnering schools.
- Three FOTM videos were created, allowing for ongoing promotion of California specialty crops.
- At the end of the project period, almost all teachers (n=108) surveyed (99.1%) participated in HOTM tastings each month. Over 90% of teachers surveyed either "agreed" or "strongly agreed" that HOTM/FOTM made students more receptive to eating fruits and vegetables, show more interest in

food/farms/nutrition and more knowledgeable about food/farms/nutrition. See attachments for summary tables with complete teacher survey results.

## Beneficiaries

The primary beneficiaries of the CASH program included farmers, teachers, students, CHC student interns and food service staff.

Farmers benefited directly by making bulk sales to the program. Many of these growers are primarily direct sale focused and the HOTM program gave them the opportunity to sell to an institutional buyer. Technical support was provided to farmers to assist in preparing invoices to CHC. Two farms began selling directly to schools that received their product via the HOTM program. Several growers received media exposure and three farms now have videos featuring their farm and products. All the farmers that partnered with CHC on the program reported that it was a positive experience, great for sales, and that farmers would participate again.

The school communities benefited in many ways from this program. Children that received the tastings and nutrition materials benefited from this project by being exposed to healthy food and learning how it grows.

Teachers loved the program tastings and educational materials, especially the videos. Many of the districts' food service staff liked the connection with the classroom and also the support to find local farmers who would sell to them.

CHC's student staff and interns gained knowledge about school food service, local foods, and working with farms. Many of these students will enter into food service or teaching in the future, and they gained valuable experience to support local food economies in their future careers.

Thirteen farmers received $34,883 for HOTM crops used in the tasting program, along with promotion to schools and the community.

As school food service starts to spend a significant amount of their food dollars on local California Specialty Crops, new opportunities for farmers will develop, so potential impact could be significant beyond the grant. In addition, providing tastings to elementary school students is educating consumers of tomorrow. If consumers are given the opportunity to educate the palate, thus young growers will seek out local healthy foods when as they grow up and start purchasing and developing healthier eating habits.

## Lessons Learned

- CHC's ability to deliver a low-cost HOTM tasting program is unique because of intern staff who receive, process and deliver the HOTM tastings. Most partner school districts are struggling to process produce due to lack of facilities, lack of staff time and motivation, and lack of funding. Having CHC prepare and deliver tastings to 42 sites per month was a very efficient method of providing HOTM to schools.
- Collecting procurement records to extract a % of local purchases is a labor intensive, complicated, impossible task. Working with distributors to provide this information to schools would be a more viable method.
- Short videos are an extremely effective and cost efficient outreach tool for teachers and students. A resource library of FOTM videos would be a great way to promote seasonal California specialty crops.

- The "Ask me about my Farmer stickers" lost appeal with teachers after the first year of the project. Teachers reported that the stickers ended up "everywhere." Feedback from the farmer received was not many kids made it to the market to find the featured farmer. The stickers were the one component of the HOTM program that would not be recommended in the future.
- Reaching parents via schools is a difficult task. Sending paper surveys and newsletters to homes is not an effective use of funds as there wwere very few responses received.
- Everyone loves the HOTM tasting program – it's a win for farmers, teachers and kids. While it was low cost at an average of just nine cents per tasting, the repeated tastings have a strong influence on the students and the teachers. Farmers feel connected to the schools and enjoy selling to the program. This program has been a bridge to connecting farmers to school districts. The HOTM program is also a great way for school districts to start their own Farm to School program. CHC will continue to offer technical assistance to districts who attempt to implement HOTM on their own in the upcoming year.

One unexpected outcome of the project was CHC supplying technical support to farmers to market themselves via social media. This resulted from schools and families trying to contact the Farmer of the Month. Once growers realized that having a page on Facebook is like a free website, a few were motivated to set up a page. An additional outcome of the program is that the farmers like the connection with the schools, and after a few years of partnering with the program, they now initiate the conversation about HOTM, and are more inclined to work with schools via CHC's Farm to Fork Coordinator's referrals.

Another unexpected outcome of the project was with retail stores. CHC interns called stores in the four counties to find out where families could purchase locally grown HOTM featured produce near them. Several retail stores reported an increase in sales of that item being featured and a few began highlighting local growers whom they were already purchasing from but hadn't advertised as "local" before.

Collecting procurement records to extract a % of local purchases is labor intensive, complicated, and a nearly impossible task. Working with distributors to provide this information to schools would be a more viable method. Schools using geographical preference in their RFA's, and requiring vendors to track local purchases and calculate a percentage for them is a more efficient and realistic way to obtain this information.

## Additional Information

The FOTM video on Lee's Family Produce/sugar snap peas can be viewed here: https://youtu.be/lTXFiQRzuKs.

In addition, please see the attachments which include materials accompanying this report.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 34 | **Project Title:** California Hotel Community Crops Project | |
|---|---|---|
| **Grant Recipient:** People's Grocery | **Grant Agreement No.:** SCB13034 | **Date Submitted:** December 2014 |
| **Recipient Contact:** Patricia St.Onge | **Telephone:** (510) 652-7607 | **Email:** patricia@peoplesgrocery.org |

## Project Summary

The California Hotel Community Crops Project (CHCCP) is a project designed to bring healthy and fresh, fruits, vegetables and herbs to residents of an affordable housing development and the surrounding West Oakland community. This is a low income community that is food insecure, meaning residents do not have an accessible source of fresh, healthy fruits and vegetables within walking distance or reasonable price range. The residents targeted are an especially vulnerable population as they were formerly homeless, are living below the poverty level, and many already have mental and physical health challenges related to inadequate nutrition. The People's Grocery program was designed to produce specialty crops from seedlings, to cultivate, harvest and distribute the crops to the aforementioned community members, with their participation and assistance in educational workshops. These workshops share information on cooking, nutrition, and the historical context of how oppression has affected the health and well-being of the primarily African American population. The health disparities are well documented. The California Hotel Community Crops Project is unique in that it is designed to address the root causes of food insecurity, and to engage the community in the production, cultivation, and distribution of healthy foods, thereby enhancing the viability of the idea of bringing a fresh food grocer to the neighborhood and enhancing the competitiveness of locally grown specialty crops.

The California Hotel Community Crops Project provides an example of a local food system in which the local community has access to affordable fruits, vegetables, herbs, and information, and in which residents have agency in their health and well-being.

This project built upon 2011 Specialty Crop Block Grant Program (SCBGP) Project 49. This project produced more varieties of specialty crops and reached more residents of the California Hotel as the occupancy in the building reached capacity in time for the May 15, 2014 grand reopening ceremony. Building on the previous year's 30 hotel residents served through weekly educational workshops, one hundred and fourteen unduplicated Cal Hotel residents and surrounding community members attended Flavas of the Garden workshops over the 26 week series in 2014.

## Project Approach

Daily garden activities performed during this project included propagating plants from seed in the greenhouse, transplanting, cultivating, pruning, weeding, managing pests and disease, managing compost operations, and harvesting. Specialty crops produced included lettuce, three varieties of kale, collard greens, arugula, mizuna, mustard greens, turnips, beets, carrots, radishes, green onions, three varieties of chard, spinach, artichoke, parsley, thyme, sage, basil, mint, rosemary, chamomile, cilantro, yarrow, borage, hyssop, snap peas, scarlet runner beans, tomatoes, cherry tomatoes, sweet peppers, hot peppers, potatoes, cucumbers, melons, summer squash, winter squash, chayote, fennel, oregano, plums, figs, raspberries, and honey. Over 50 varieties of specialty crops were produced on ¼ acre of land at the California Hotel in West Oakland.

According to the CHCCP records 72 different residents participated in educational workshops, special events, or volunteered in the garden. All of the workshops and special events featured specialty crops in season and were used as an opportunity to increase knowledge, consumption of, and exposure to specialty crops.

Plant starts were propagated in the greenhouse for sale to the surrounding community for the purpose of encouraging community to grow and consume more specialty crops. In April 2014 approximately 172 plant starts were sold to 43 different people yielding $750. A weekly workshop series called Flavas of the Garden was held on Thursdays from 3pm- 5pm at the garden of the California Hotel. The series ran weekly from April 17, 2014 through October 30, 2014, and culminated with a garden workshop. Topics were centered around California-grown specialty crops, nutrition, health, and how to use medicinal and culinary herbs. Most workshops included a cooking demostration made from specialty crops in the garden. Participants were encouraged to practice preparing foods in healthy ways. 114 unduplicated Cal Hotel residents and surrounding community members attended Flavas of the Garden workshops over the 26 week series.

Three major special events were held during the period which benefitted specialty crops. In October 2013, the annual Harvest Festival was held with local partner City Slicker Farms. Approximately 150 community members were in attendance. 10 educational workshops on specialty crops were offered. In February 2014, the Black History Month celebration honored black and brown farmers by planting 12 fruit trees. Fruit trees planted included apple, fig, lemon, lime, persimmon, and pear. All are expected to produce specialty crop fruits that will feed the community. Participants learned about care of fruit trees, and the nutritional value of the fruits produced. Residents from the California Hotel and the surrounding community participated and food from the garden was served. Over 75 community members were in attendance. In June 2014, the Juneteenth celebration conducted educational workshops including how to make smoothies, how to use medicinal herbs, and a children's activity on recognizing different plants in the garden. 112 community members were in attendance.

Additionally, 12 tour groups visited the garden during the project. 314 people were exposed to the garden and all of the specialty crops produced there. Tour groups included a sixth grade class, a group of sociology professors, alternative spring break college students, and a faith-based group.

It is certain that SCBGP funds were used solely for specialty crop production when staff salaries were dedicated to specialty crop production. Time dedicated to other work was paid for through other funding sources.

All program income comes from and gets reinvested in the greenhouse, which is the widest reaching garden program. Program income was used to enhance the competitiveness of California specialty crops so hundreds of individuals and families will continue to receive access to and information about California specialty crops. The specialty crop plant starts were distributed to West Oakland residents with limited income.

The following partners assisted with this project: East Bay Asian Local Development Corporation (EBALDC), from whom the land is leased and with whom a memorandum of understanding for the services provided in the garden is in place; Lifelong Medical Services, who oversees health care and social services for residents in the Cal Hotel; City Slicker Farms, with whom People's Grocery partnered for the Harvest festival; Bay Localize who helped promote People's Grocery events; Growing Together, who supplied the fruit trees and an educational workshop at the tree planting for the Black History month event; and the many individual volunteers and supporters who have helped in the garden and facilitated workshops.

## Goals and Outcomes Achieved

The activities completed for achieving the performance goals and expected measurable outcomes are identified below:

1. Increase consumption of fruits and vegetables for a sample size of 750 participants in the West Oakland community by at least 20% measured by survey responses indicating the level of increase.

   The activities performed in working toward the above performance goal included the propagation, cultivation, and distribution of over 50 varieties of specialty crops on the grounds of an affordable housing development. Participants are an especially vulnerable population, primarily people of color and some who have mental or physical challenges. Residents of the housing development and surrounding neighbors were encouraged to participate in garden activities in order to gain a deeper connection to where food comes from. A weekly workshop series called Flavas of the Garden was planned and implemented. Several special events were held including a Black History Month Celebration, Juneteenth Celebration, Smoothie Day, and Chestnut Street Community Day. Each event was an opportunity to build community, promote specialty crops, and get a pulse on the progress toward outcomes by asking participants to complete surveys. Events were promoted via flyers and community outreach in the building and the surrounding community. In addition to growing specialty crops, great emphasis was placed on individuals sharing knowledge and information, and transforming attitudes and behaviors pertaining to consumption of specialty crops grown locally. Participants in the program received opportunities for practice in growing, harvesting, cooking, consuming, and preserving specialty crops. Additionally, several tour groups who visited the garden had an opportunity to interact with specialty crops. In partnership with EBALDC and Lifelong Medical Services fresh specialty crops were provided for cooking classes and special events as a part of the California Hotel Community Crops Project.

   The activities completed as outlined in the work plan were:
   - Daily garden activities
   - Specialty crop distribution
   - Plant start sales and marketing
   - Planned and implemented special events
   - Planned and implemented weekly garden workshops
   - Scheduled and facilitated garden tours
   - Performed ongoing outreach to residents
   - Developed, administered, and interpreted healthy food surveys

2. Increase knowledge of specialty crops for a sample size of 750 participants from the greater Oakland area. Participants will demonstrate three new points learned about specialty crops measured by survey responses indicating types of facts learned.

   The activities completed toward this outcome were:
   - Planned and implemented special events
   - Planned and implemented weekly garden workshops
   - Scheduled and facilitated garden tours

- Developed, administered, and interpreted healthy food surveys

Twenty six Flavas of the Garden workshops held during this reporting period were the primary means of disseminating information and exposing people to specialty crops for the California Hotel Community Crops Project. Each provided an opportunity to increase knowledge and practical experience preparing and consuming specialty crop vegetables and herbs. Of thirty six people who completed a survey by the end of July 2014, thirty five reported learning at least one new thing. Two reported learning three or more things. Twenty two additional surveys were completed in September 2014. In these surveys, people were able to identify new things that they learned. Nineteen of the twenty-two reported learning at least three new things.

Special events were held including the Harvest Festival, Black History Month tree planting and Juneteenth celebration. People who attended these events had opportunities to participate in educational workshops including caring for fruit trees, making smoothies solely from specialty crops, and learning about the culinary and medicinal uses of a variety of common herbs found in the garden.

3. Further develop the garden and greenhouse space as a healthy, attractive, and accessible hub for promotion of specialty crops through regular planning and maintenance and increased attendance by the public through nutrition demonstration and community health outreach and events. Regularly identifying resident health challenges and promoting use of specialty crops in the kitchen are essential to this goal.

   The activities completed as outlined in the work plan were:
   - Daily garden activities
   - Planned and implemented special events
   - Planned and implemented weekly garden workshops
   - Facilitated garden tours
   - Performed ongoing outreach to residents

   People's Grocery garden staff remains in regular consultation with Lifelong Medical service providers regarding resident health issues and behaviors. The garden is intended to be a safe space for residents to disclose information regarding health and lifestyles. The California Hotel Garden community is built around trust and compassion for shared struggles, and around production, preparation, discussion, and consumption of specialty crops.

   Due to the vulnerable and transient nature of the population targeted for this project, there were barriers encountered in terms of consistency in participation in the programs and in attending events.
   For that reason the 750 residents reached as projected in outcome measure #1 was not documented, nor were before and after surveys completed by the same group to determine increased consumption. Recognizing that a mindset transformation is required, and that it takes time to foster relationships and trust, the work toward this endeavor continues. Through ongoing programming and innovative initiatives the California Hotel Community Crops Project will continue to positively impact the lives of hundreds of consumers through the promotion, consumption and increased awareness and accessibility of California grown specialty crops.

The actual accomplishments and progress toward achieving set targets is outlined below:

Goal: (1) Increase consumption of fruits and vegetables for a sample size of 750 participants in the West Oakland community by at least 20% measured by survey responses indicating the level of increase.

Actual: 40 Health and Wellness surveys were completed: 19 before the end of July 2014, and 21 after.
"Before" surveys indicated average servings of fruits and vegetables consumed per day to be 2.7;
"After" surveys indicated average servings of fruits and vegetables consumed per day to be 3.4.
This is a 26% increase.

Goal: (2) Increase knowledge of specialty crops for a sample size of 750 participants from the greater Oakland area. Participants will demonstrate three new points learned about specialty crops measured by survey responses indicating types of facts learned.

Actual: 53 Garden workshop surveys were completed: 36 before the end of July 2014, and 17 after.
"Before" surveys indicated average new things learned to be 1 (.9);
"After" surveys indicated average #of new things learned to be 5 (4.6).

Goal: (3) Further develop the garden and greenhouse space as a healthy, attractive, and accessible hub for promotion of specialty crops through regular planning and maintenance and increased attendance by the public through nutrition demonstration and community health outreach and events. Regularly identifying resident health challenges and promoting use of specialty crops in the kitchen are essential to this goal.

Actual: The process of further developing the garden for fruit, herb, and vegetable production, as well as increasing outreach efforts in order to reach more members of the community is ongoing. People's Grocery and the California Hotel garden staff continue to assess and re-evaluate the urban agriculture programs for efficacy, and to create new and innovative programs to promote California specialty crops according to the needs of the community. Ongoing communications with colleagues in the medical profession will help enhance the competitiveness of specialty crops by integrating specialty crop products into a medical discussion endorsed by doctors and nurses.

The major successful outcomes of the project are identified below:

- 114 unduplicated residents attended the Flavas of the Garden events.
- 12 tour groups were hosted at the garden totaling 314 attendees.
- 362 people attended special events.
- 40 Health and Wellness surveys were completed: 19 before the end of July 2014, and 21 after.
    - "Before" surveys indicated average servings of fruits and vegetables consumed per day to be 2.7.
    - "After" surveys indicated average servings of fruits and vegetables consumed per day to be 3.4, which is a 26% increase.
- 53 Garden workshop surveys were completed: 36 before the end of July 2014, and 17 after.
    - "Before" surveys indicated average new things learned to be 1 (.9).
    - "After" surveys indicated average # of new things learned to be 5 (4.6).
- Over 50 varieties of specialty crops were produced on the ¼ acre of land.

- Over 250 units of vegetables were distributed.
- Over 250 specialty crop plant starts were sold to community members.

## Beneficiaries

The specialty crop industry and residents of the California Hotel were all beneficiaries of the California Hotel Community Crops Project. The competitiveness of California specialty crops grows as people are exposed to specialty crops and begin to understand the health, economic, and environmental implications of integrating more specialty crops into their diets. EBALDC and Lifelong Medical groups are the organizational partners who benefit from the project.

At least 790 individuals interacted with the specialty crops in the garden and directly benefitted from the project. The potential health improvements can potentially be vast as residents have limited access to healthy fruits and vegetables and suffer from high rates of diet-related diseases and other health challenges. By providing specialty crop information the project will potentially have long term positive economic effects for consumers and specialty crop producers.

## Lessons Learned

Project staff learned a great deal as a result of implementing the California Hotel Community Crops Project. Positive lessons include learning patience, compassion, and effective communication skills when working with vulnerable populations. Adequate nutrition is related to more than just access. Programs which delve deeper into understanding and addressing the root causes of food insecurity are more effective and can promote positive change. People participate when given incentive and that high frequency outreach is needed to maximize participation.

Having concise surveys which measure attitudes and behaviors, and having a process in place for getting them completed would have yielded more detailed results.

When establishing goals they should be clear, concise, measurable, and realistic. A tool must be in place which accurately measures the goals, and the tools must be utilized in a consistent and controlled way. All of this needs to be in place prior to starting the project. Also having the same staff to develop the goals for the program should be the ones to implement it, which would allow for optimal success.
Unexpectedly, a great interest in using herbs for their healing properties was expressed by residents. Future CHCC projects will further integrate this concept into programming.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 35 | **Project Title:** California Farm to School Network | |
|---|---|---|
| **Grant Recipient:** Community Alliance with Family Farmers | **Grant Agreement No.:** SCB13035 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Diana Abellera | **Telephone:** (510) 832-4625 | **Email:** Abellera@caff.org |

## Project Summary

With over 1,000 school districts in California, new Farm to School programs are beginning in every region, and existing programs want a streamlined way of finding resources, sharing successes, and networking with other organizations. To support programs that improve connections between specialty crop growers and schools at various stages statewide, the Community Alliance with Family Farmers (CAFF) proposed to develop a California Farm to School Network (CFSN). The goal was to support California specialty crop growers through creating a unified, organized Farm to School movement that allows a better understanding of the California Farm to School landscape, minimize duplication of efforts, and increase economic viability of local growers.

The objectives were to:

1) Launch and build the CFSN.
2) Foster efficient regional distribution efforts through facilitating at least 30 meetings among growers, distributors, and school districts.
3) Provide training and resources through deploying 12 FoodCorps service members to increase awareness of California specialty crops among K-12 students.

California is a national leader in promoting specialty crops through Farm to School efforts. However, there are hundreds of parallel programs that are creating duplicative resources and working in individual counties rather than regionally. At the 2012 National Farm to Cafeteria Conference in Vermont, dozens of representatives from all over California asked CAFF for more networking and resource sharing opportunities at the state level. CAFF received requests for support from new programs on a weekly basis. Partner organizations also regularly requested help in connecting to growers and technical expertise to solve regional distribution. As a statewide organization with a membership comprised of family farmers, CAFF has worked for over a decade at the state and regional levels to implement Farm to School programs and develop best practices. California needed stronger communications tools and infrastructure to respond to the increasing need for support statewide and in regions where CAFF does not run programs. In addition, the 2014 United States Department of Agriculture (USDA) Farm to School Census found that 350 California school districts have Farm to School programs that already purchase $52 million of local food, and 59% of those districts wanted to purchase more local food. Because schools are required to serve multiple servings of fruits and vegetables in school cafeterias each day, the data shows a great opportunity to direct specialty crop purchases towards California family farmers.

This project builds off of the 2012 Specialty Crop Block Grant Program Project 12: *Linking Nutrition Education with California Grown Specialty Crops Statewide*. CAFF's Harvest of the Month (HOTM) Tasting Kit project on the Central Coast educated over 25,000 students each month on specialty crops and generated nearly $30,000 per year for specialty crop growers. CAFF received the funding in 2012 to expand the program through developing a local procurement toolkit for school (HOTM) programs, launching a HOTM tasting kit

program in Sonoma County, and working with 5 partners statewide to link them with local specialty crop sources. The demand for partnership was extremely high, and CAFF had to choose from over 20 interested programs around the state. The project allowed CAFF to support specialty crop producers in regions where CAFF doesn't operate programs; however, demand for technical assistance was much higher than what could be provided at the time. As a result, CAFF decided to launch the California Farm to School Network to share resources developed from the previously funded project, as well as other resources and technical assistance, with Farm to School efforts statewide. The California Farm to School Network complimented and built off of the funded project by creating the communication channels and infrastructure to support all Farm to School programs statewide by connecting them to a variety of resources, including the local procurement toolkit and case studies developed from the previously funded project.

## Project Approach

CAFF organized work plan activities under three objectives explained below.
Objective 1) Launch and build the California Farm to School Network (CFSN).
To build the CFSN, CAFF worked with a variety of partners to develop network structure, collaborate on communications channels, coordinate regional efforts, and host a conference. The CFSN was developed in partnership with several organizations that worked together to coordinate efforts around the state. There were multiple committees that formed to accomplish the tasks under this objective.

- The communications working group developed and executed a plan for unifying communications tools and audiences from multiple organizations. As a result the CFSN housed many communications mechanisms: an event calendar, a listserv, a refreshed website featuring bi-weekly blogs, a monthly newsletter, and a series of webinars. Any specialty crop grower, school food service employee, educator, administrator, parent, or advocate in California who had content to contribute about procuring and educating students about California specialty crops in schools was able to utilize these tools to share their resources and information. These communication tools reached 2,772 people with bi-weekly blogs, monthly newsletters, quarterly webinars, and regular listserv activity.
- 10 regional leads (partner organizations that focused on procurement of California specialty crops from farms to schools throughout the state) were the backbone of the CFSN. The regional leads developed and ran programs in their communities to promote specialty crops. The regional leads met quarterly on the phone and annually in person to share approaches to promoting specialty crops, develop evaluation systems and reporting tools, and coordinate opportunities to support California specialty crop growers statewide. In addition, the regional leads conducted outreach to recruit local Farm to School programs to the CFSN, sharing information about the statewide network at their regional events and through local communications.
- The California Farm to School Conference Planning Committee worked to develop and host the 2015 California Farm to School Conference. The committee hired a conference planner, chose the location, created goals, conducted outreach, supported logistics, cultivated conference content, issued the call for workshop proposals, reviewed workshop applications, and hosted the event in May 2015.

All of these activities served to launch and build the CFSN, a now robust communications network and resource center for Farm to School programs throughout California. CAFF staff coordinated all of these efforts among partners working on the CFSN and followed up with conference participants to link them into the CFSN.

Objective 2) Foster efficient regional distribution efforts by facilitating at least 30 meetings among growers, distributors, and school districts.
The CFSN held 38 meetings across 10 regions to improve efforts to distribute California specialty crops from farms to schools. Regional gatherings, as these meetings were called, were hosted by regional leads and supported by CAFF staff. The gatherings brought together local specialty crop growers, distributors, and school food service staff to work together on overcoming regional distribution challenges. CAFF staff visited each of the regions to learn about the unique distribution and Farm to School landscape as well as opportunities the community faced and to share lessons learned from other regions. CAFF worked with each regional lead to identify regional distribution needs and share state level resources and assistance in how to address issues. The format of the gathering varied, depending on the community's needs. For example, in the greater San Diego region, regional gatherings were held quarterly. The stakeholders developed a State of Farm to School Report, created a San Diego County Crop Availability Chart to assist schools in identifying local crops available during each season, and hosted annual Wholesale Produce Showcases for vendors to share their products with the institutional buyers. Finally, CAFF followed up with each regional lead to provide one on one technical assistance as needed in implementing regional buying and selling. In the Central Coast, CAFF worked with the regional lead to help 15 school districts create joint bid language for their fruit and vegetable procurement. One regional lead stated "My involvement in the California Farm to School Network prepared me to approach more school districts with confidence and best practices for sourcing local produce in the cafeteria. I have already seen an increase in local produce purchases and more inspired food service!"

Objective 3) To provide training and resources by deploying 12 FoodCorps service members to increase awareness of California specialty crops among K-12 students.
CAFF and the CFSN developed a partnership with the National FoodCorps program to train and deploy FoodCorps service members that worked at select K-12 school sites in the state to increase awareness of California specialty crops. CAFF made many of the training opportunities available not only to FoodCorps service members but also to the broader CFSN. CAFF collected information from FoodCorps and CFSN members about the topics they were interested in learning about related to Farm to School. An initial survey of CFSN members showed that 70% of people were interested in procurement, 20% were interested in school gardens, 15% in nutrition education and 5% in farm to preschool. CAFF staff responded by identifying speakers with successes in each of the high interest topic areas, developing written case studies in the form of blogs, and delivering webinars. CAFF conducted outreach through the CFSN communications for 8 webinars that focused on enhancing awareness of or access to California specialty crops. Topics and dates are listed below.

| **Date** | **Topic** | **# Attendees** |
|---|---|---|
| April 1, 2014 | Oakland Unified School District's Farm to School Program | 79 |
| January 29, 2015 | California Food for California Kids, Part I | 45 |
| March 19, 2015 | California Food for California Kids, Part II | 37 |
| June 25, 2015 | Harvest of the Month: Innovative Models | 127 |
| November 16, 2015 | Evaluating Farm to School | 53 |
| March 9, 2016 | From Board Policy to LCAP: District Policy and Funding Opportunities for Farm to School | 30 |
| May 12, 2016 | Going to Bid for Local Produce: Lessons from California Schools | 52 |

| | | |
|---|---|---|
| June 14, 2016 | Straight from the Farm: Making the Most of Direct Purchasing in Schools | 43 |

These webinars were delivered for FoodCorps members as well as broader CFSN members. CAFF worked each year to recruit new service members and place them with service sites in various regions around the state. In 2013, 12 FoodCorps service members were deployed around the state. In 2014, the number increased to 15, and in 2015, 18 service members were sent to support Farm to School efforts around California. In total, staff trained and deployed 45 service members to work in Farm to School programs across the state, increasing awareness of the benefits of California specialty crops and helping to increase consumption and sales of California specialty crops in the school cafeterias. For each term, CAFF provided 3 trainings for FoodCorps service members, for a total of 9 during the grant period.

Several mechanisms were used to ensure that funds were used to solely enhance the competitiveness of specialty crops:

- Memoranda of Understanding (MOUs) were signed by regional leads to indicate that their work with the CFSN is solely focused on specialty crops. All regional leads report out to Project Director and Manager when planning and coordinating a regional gathering. These check-ins allow Project Director and Manager to ensure that all regional gatherings solely enhance specialty crops.
- Each FoodCorps service site signed a MOU agreeing that FoodCorps service members are solely working on increasing specialty crop nutrition education and specialty crop procurement in school cafeterias. Project Manager and subcontractor visited each service site to ensure that each of the FoodCorps service members worked solely on specialty crop nutrition education and specialty crop procurement.
- Final budget numbers for the California Farm to School conference indicated that 40.35% of the conference content was dedicated to solely enhancing the competitiveness of California specialty crops, as calculated by minutes of the sessions that are solely focused on California specialty crops. Specialty Crop Block Grant Program funds allocated for the event was only 25%, a smaller percentage than what is allowed at 40.35%. The rest of the conference was covered by registration fees and sponsorships. These numbers do not cover pre-conference activities, as those activities were covered by other sources.

Numerous partners contributed to the success of this project. The hired subcontractor played a major role in helping to coordinate the California FoodCorps service members, coordinate the California Farm to School Conference, and serving on the communications working group. 10 regional leads were critical partners in conducting outreach for the CFSN and hosting all activities under objective 2.
Regional leads were:

- North Coast Opportunities (North Coast)
- Chico State University – Center for Nutrition and Activity Promotion (North Valley)
- Gardens to Grow In / University of California Cooperative Extension Central Sierra (Motherlode)
- Yolo County Department of Agriculture / Valley Vision (Sacramento Valley)
- Center for Agroecology and Sustainable Food Systems (Central Coast)
- UC Cooperative Extension Stanislaus (Central Valley)
- Urban and Environmental Policy Institute (Greater LA)
- Conejo Valley Unified School District (South Central Coast)

- Community Health Improvement Partners (Greater San Diego).
- The 10th region was the Bay Area, which was covered by CAFF staff that served as the official regional lead.

Other important partners volunteered their time to support the California Farm to School Conference, such as the Edible Schoolyard, California Ag in the Classroom, and Center for Ecoliteracy. Western Growers worked with the CFSN to share content on a community calendar, and FoodCorps trained FoodCorps service members at the national level and supported their wages and benefits.

## Goals and Outcomes Achieved

Objective 1- Goal: At least 300 Farm to School programs statewide will direct at least $1 million dollars towards local, in-season specialty crops. Baseline: Unknown. Outcome: Final was that at least 46 school districts directed $4,523,624 towards local, in-season specialty crops, exceeding project goals.

In order to achieve this outcome, CAFF had to determine the number of Farm to School programs statewide, access contacts that track data about school district procurement of specialty crops and then collect data about the results. First, staff collected all of the contacts from the California Farm to School Taskforce, California School Garden Network, and FoodCorps. This totaled to about 1,500 contacts, but not a clear number of distinct Farm to School programs in California. Regional leads were also asked to submit lists of their programs, but they were hesitant to share data to protect their contacts.

CAFF tracked this outcome with external data from the USDA Farm to School Census as well as data staff collected during the project period. The USDA Farm to School Census was conducted in 2014 and 2016, and data can be filtered by state and at the school district level. The census collected information about the number of active Farm to School programs, as well as how much food (in dollars) the participating school districts procured from local farms. Only one representative from school food service / child nutrition programs filled out the census on behalf of the school district.

To focus data collection on California specialty crops, CAFF also worked with regional leads to develop a simple and easy to use system for reporting procurement data online from school districts conducting the California Golden Seed Awards. The California Golden Seed Awards was an incentive program that CAFF created and distributed to members of the CFSN to award school districts that were purchasing California grown specialty crops by collecting their data and publicizing the results.

The USDA Farm to School Census found that in 2013, 350 school districts reported that they participate in Farm to School efforts and have directed $52 million towards local food. In 2016, 373 school districts participate in Farm to School activities. These 373 school districts spent $167.6 million in local food. 80% of the districts said they purchase local fruits, and 76% said they purchase local vegetables. However, these numbers do not focus on specialty crops; survey responders use various definitions for local; and the dollar amount self-reported by school districts is uncertain due to reliability of distributor data. CAFF launched the Golden Seed Awards to collect more specific information about the dollars spent on California grown specialty crops. Forty-six school districts contributed data, which showed that in just the 2014-15 year $4.5 million was spent on California grown specialty crops.

In addition, several of the Regional Gatherings resulted in sales of local, in-season specialty crops. $13,000 of snap peas, strawberries, and radishes were purchased collectively among five school districts for Earth Day events. In addition to this, through regional gatherings four school districts continued purchasing relationships, which has already resulted in $40,000 worth of specialty crop purchases in three months.

Objective 2- Goal: 70% of regional leads identify that regional meetings created increased collaboration and efficiencies among local programs. Baseline: 0 regional meetings were held prior to the project. Outcome: 100% of regional leads identified that regional meetings created increased collaboration and efficiencies among local programs.

CAFF conducted an online survey of regional leads in February 2014 to determine needs in meetings across regional programs. Instead of distributing more surveys at annual meetings, CAFF conducted in-person interviews during annual site visits and asked for feedback on how the CFSN has impacted regional leads' efforts to work with schools in procuring California specialty crops and how local programs have benefited from regional gatherings. Data was collected and analyzed for this report.

Baseline was that 0 regional gatherings were held. In the February 2014 survey, regional leads noted that they wish to report out on accomplishments and specific needs related to enhance specialty crops in their respective regions on a rotating basis, which will allow staff to obtain a more in-depth understanding of the status of specialty crop procurement in each CFSN region over time. The survey showed that three regional leads had received more than five inquiries from local Farm to School practitioners about CFSN since the launch of the network, and an additional three had received between 1-4 inquiries. Additionally, regional leads overwhelmingly requested bimonthly conference calls and for the statewide meeting to incorporate a site visit to a regional Farm to School program.

In-person interviews have taken place with all 10 regional leads. All of the 10 interviewed have said that there have been increased collaboration and efficiencies among their local agencies and that local specialty crop purchasing has increased through connections made at regional meetings.

Objective 3- Goal: Over 50% of students participating in FoodCorps Farm to School programs will increase knowledge of California specialty crops. Baseline: 53% of children who were surveyed demonstrated an increase in knowledge about fruits and vegetables. Outcome: At the end of the project, 62% of children surveyed demonstrated an increase in knowledge about fruits and vegetables.

CAFF and partner FoodCorps collected quantitative data to support this outcome. Quantitative data collected in coordination with FoodCorps include a neophobia survey completed by a statistically significant sample of students at all FoodCorps California Service Sites at the beginning and end of the program year, and a Landscape Assessment to be completed at the end of each program year that tracks increasing knowledge of California specialty crops, specialty crop farmers, and nutrition knowledge over time. The information collected using the neophobia attitude assessment tool is used to evaluate the impact that participating in 10 hours of garden-enhanced nutrition education has on students' attitudes towards specialty crops, in particular their willingness to try new fruits and vegetables. In FoodCorps' preliminary review of surveys from the 2015 – 2016 school year, 62% of students in California showed improved preferences for vegetables and/or tried new vegetables. This is compared

to 58% across all of FoodCorps service sites nationwide and shows a growth of 9% since the beginning of the project. AmeriCorps requires that FoodCorps service members complete this survey as a part of CAFF required performance measures.

All goals were exceeded. Over 373 Farm to School Programs directed over a minimum of 4 million dollars to California specialty crop growers – exceeding the original goal by 73 programs and over 3 million dollars. 100% of Regional Leads reported more collaboration and efficiencies in programs. 62% of students participating in FoodCorps Farm to School programs measured an increase in knowledge of California specialty crops.

The major successful outcome of the project was that school districts directed at least $4.5 million of their budgets towards local, in-season specialty growers. The CFSN was successful in helping Farm to School programs statewide connect to each other, unify efforts, overcome regional distribution challenges, and enhance economic opportunities for specialty crop growers.

## Beneficiaries

The project's target beneficiaries were California specialty crop growers, which benefited economically through increased sales to school districts and through establishing stronger connections to their local communities.

Secondary beneficiaries were California K-12 students, particularly the students in regions where regional leads and FoodCorps members served. 551 school districts participate in Farm to School, reaching tens of thousands of students across the state through increased consumption and knowledge of California specialty crops. These K-12 students benefited from receiving specialty crop nutrition education and increased access to healthy, fresh specialty crops in school cafeterias.

Over 4 million dollars of California specialty crop sales were generated for growers. New purchasing relationships were establishing between dozens of school districts and farms, and these relationships of sales will continue after the grant period.
Over the course of this project, the following numbers of K-12 students were reached:

18,611 students in the 2015 – 2016 school year
21,633 students in the 2014 – 2015 school year
16,816 students in the 2013 – 2014 school year

## Lessons Learned

CAFF learned that collecting data about sales of California specialty crops from farms to schools is extremely difficult to track, as many schools prefer to purchase California specialty crops through their distributors. Broadline distributors do not have systems in place for tracking food by farm name and location, and much of the work with regional leads centered on how to develop sustainable systems for tracking this data and working with distributors. While staff made progress in helping distributors set up systems, they also determined that incentive programs for school districts was an easier and more effective way of collecting data statewide about their Farm to School procurement efforts of California specialty crops. The Golden Seed Award was established primarily as a means for collecting evaluation data and to assess the landscape of Farm to School efforts in California.

This project advanced California's efforts as a leader in Farm to School nationally. CAFF shared results of the California Farm to School Network, the California Farm to School Conference, and the Golden Seed Awards with the National Farm to School Network. Other agencies and non-profits have asked CAFF for more information about these programs in the hopes of replicating the efforts in their states.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 36 | **Project Title:** Food What—Food for Self, Food for Family, Food for Community | |
|---|---|---|
| **Grant Recipient:** Life Lab Science Program | **Grant Agreement No.:** SCB13036 | **Date Submitted:** December 2015 |
| **Recipient Contact:** Don Burgett | **Telephone:** (831) 459-3833 | **Email:** don@lifelab.org |

## Project Summary

While Santa Cruz County is rich in agricultural production, low-income Latino youth and adults are disproportionately suffering from obesity and poor nutrition. "Food, What?!" (FW) uses farming and cooking as the vehicle for enhanced nutrition and increased consumption of fresh fruits and vegetables, California Specialty Crops (CSCs) for 975 area low-income high school youth and 300 adults annually. FW does this by operating seasonal programs and large events on a unique youth-run production farm with outdoor kitchen. At FW, teens dive into a culturally relevant meal with CSCs that they have cultivated, harvested and cooked (Food for Self). Youth harvest and package Community Supported Agriculture (CSA) shares to take home for their family, and FW engages parents in a cooking series using the produce (Food for Family). Youth operated a weekly farm stand at a low-income elementary school and organized three major seasonal events on the farm (Food for Community).

Low-income, youth culture centers around fast food, sugary drinks and snack foods, which are contributing factors to obesity and poor health. The 2011 United Way Community Assessment Project (CAP) report shows that in Santa Cruz County: 1 in 3 Latinos' overall health is fair or poor; 1 in 4 low-income youth are obese; and 2 of 3 Latino adults are obese. FW programs counteract these health trends, and research shows students involved in garden-based nutrition education increased their fruit and vegetable consumption by 2.5 servings per day (2011 United Way CAP report).

FW is a youth empowerment and food justice program reaching 1,275 youth and community members using food, through sustainable agriculture and health, as the vehicle for growing strong, healthy and inspired teens. FW encourages healthy food choices and promotes increased CSC consumption through three program focus areas: Food for Self, Food for Family, and Food for Community. This model addresses the health and diet problems described above by: (1) Engaging youth in growing and cooking CSCs; (2) Providing specialty crop produce shares to youth and their families as well as a parent cooking series; (3) Increasing access to CSCs through a farm stand in one low-income school; (4) Implementing 3 seasonal events for youth to engage with CSCs and attend nutrition workshops; and (5) Executing peer-to-peer workshops in county high schools and local non-profits to increase awareness of the relationship between CSCs and health.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

The following activities were performed during the grant period:

Administrative set-up and initial coordination for the project: Life Lab Executive Director established administrative processes for monitoring grant progress and fiscal management.

Management oversight of personnel and budget for the project: Life Lab Executive Director met with FW staff to discuss progress on grant objectives and budget.

Spring, summer and fall program planning and goal setting for 2014: The FW team reviewed grant deliverables and set goals for 2014.

Youth outreach and selections for spring Internship: FW Director conducted outreach at schools across Santa Cruz County in the winter of 2014, which led to over 200 applications to FW. From this pool of applicants, the FW Director and Program Manager selected 52 low-income, struggling youth to participate in the Spring Internship.

Farm crop planning for upcoming season to achieve all goals of youth programming, family shares, big events, and community activities: FW Farm and Program Manager did extensive crop planning in the winter of 2014, selecting a wide variety of CSCs to be planted, tended and harvested for all FW events throughout the year. In 2014, more FW specialty crop grown produce was used for large events and community activities than used in previous years.

Implement Spring Internship: Fifty-two youth successfully completed the 2014 12-week spring internship, which ran from March 3-May 12, receiving an introduction to CSC production through weekly 3-hour visits to the FW farm. Spring youth participants were involved with every aspect of CSC production from March-May, including seeding transplants, preparing beds for planting, weeding crops and harvesting spring CSCs. In addition to this farm work, youth spent one hour each week cooking and eating meals full of CSCs—for many youth this was one of their first chances to cook with fruits and vegetables and one of their first effective exposures to hands-on nutrition education that emphasized the benefits of CSCs.

Planning and implementation of the Strawberry Blast event: The 2014 Strawberry Blast, held on May 20, drew over 200 students to the FW farm. Middle-school and high-school students learned about how CSCs are grown while touring a diversified specialty crop farm. Activities focused on nutrition, health, farming, and food justice topics. Students had the opportunity to make strawberry tarts and smoothies, rainbow veggie quesadillas (with chard, onions, cabbage, and broccoli) and strawberry salsa, as well as harvest strawberries from the field. The “Grow Your Own” activity let students plant vegetable seeds in a pot to take home to their families.

Interview and select youth for summer program: Of the 52 spring interns who completed the internship in May of 2014, 30 applied for summer job program positions. Each youth who applies is given an interview that includes coaching on interview tips. Twenty youth and 4 junior staff were selected to participate in the Summer Job Program.

Implement summer program including family CSA and parent workshops on cooking and nutrition: In the main field, the youth took the farm through every stage from winter dormancy into full production over the course of the intensive 7-week summer job program, held from June 16- August 8, 2014. By the time they harvested in the summer and fall, they talked about “our farm” and “our crops.” FW youth in 2014 developed a deep understanding of how CSCs are produced, going way beyond a simple introduction to fruits and vegetables and developing lasting connections to California’s specialty crop industry.

The youth in the summer program shared lessons and inspiration with their families through the weekly produce and through a family cooking night at FW farm and at a partner farm. Each week, the FW crew harvested a CSA share to take home to their families. The crop plan included the "greatest hits" of the produce world that integrated parent feedback on items most needed in their meals or budgets. This year, great feedback was received that parents used the produce, and this component also ensured that youth could take positive diet change into their home life.

Planning and implementation of Youth Day event consisting of educational workshops that teach youth how to grow, prepare, eat and advocate for CSCs in their community: This year FW partnered with a nearby farm, Pie Ranch, that also conducts youth programming to organize and host Youth Day. FW brought the entire summer crew of 24 youth and junior staff to the all-day event, where youth were given tours of the working farm, ate farm fresh food filled with CSCs and engaged in conversations about the regional specialty crop production economy. Over 100 youth from all around the region came to this year's Youth Day from a wide variety of organizations that serve youth.

Implement summer school low-income farm stand: Because the Santa Cruz City Schools summer school calendar did not align well with the dates of the summer program, hosting the low-income farm stand at Dominican Hospital in Santa Cruz was chosen. For 5 weeks youth sold and promoted CSCs to hospital staff, patients and families. Youth brought produce that they had grown to the stand and learned valuable marketing skills, increasing their potential readiness for jobs in agriculture.

Interview and select youth for fall program: Out of 24 summer program youth, 14 youth applied for 22 positions, some of which were held by multiple youth. The 2014 summer crew was dedicated and enthusiastic. FW follows a graduated model, so each successive element deepens youth knowledge of and connection with CSCs.

Implement fall program and weekly low-income farm stand and peer-to-peer education: In the 2014 Fall Business Management Program, which was conducted from September-November, 14 youth were hired to run various farm-related businesses. All of the fall jobs gave youth extensive training on marketing and handling CSCs. These jobs were organized into the following small crews: 1) a flower crew, which cultivated and sold cut flowers to local restaurants, 2) a harvest crew, which harvested CSCs for sale at the low-income farm stand, 3) a farm stand crew, which promoted and marketed CSCs for 9 weeks at a low-income, school-based farm stand, 4) a farm crew, which cultivated CSCs for FW's catering and produce sales businesses, 5) a school garden "Blast" crew, which helped 14 area schools prepare their gardens to be educational classrooms that highlight CSCs and 6) an event planning crew, which planned, coordinated and conducted outreach for the Harvest Festival event.

This year, 3 youth from the fall program became peer-to-peer "Community Educators," teaching a 3-week series of lessons conducted with 8 classes and youth programs at area schools. The lessons included nutrition education elements as well as tastings of prepared foods made with CSCs. These lessons reached an additional 170 teens in Santa Cruz County.

Planning and implementation of the Harvest Festival: FW hosted the Harvest Festival on October 23, 2014—with over 250 high school and middle school youth attending from across the Santa Cruz County. Youth were involved with every aspect of this event, from planning and promoting to coordinating logistics and

conducting workshops at the event. Students attending the event explored California-grown fresh specialty crops on the farm through apple varietal tasting, winter squash varietal tasting, apple pie making, and fresh cider making. In addition to these opportunities to taste CSCs, youth participated in 2 hands-on specialty crop nutrition workshops, which educated them about good diet choices.

Program evaluation, reporting and audit: FW conducted thorough program evaluations of each aspect of the work through evaluation surveys, personal reflections by the youth, and staff observations/notes. At the end of the 2014 programs, the results were tabulated and are currently being used for reporting and planning purposes.

Throughout the year, FW educated youth about CSC production, harvesting and preparation; core elements to the program. Whenever the work focused on other topics, such as job training, youth empowerment or food justice, FW was careful to draw on other funds. FW used other funding sources that supported program elements not related specifically to CSCs.

The University of California Santa Cruz, Center for Agroecology and Sustainable Food Systems hosts Life Lab's programs on its research and education farm. The Center provided partnership support daily in the form of farm land, greenhouse space, agricultural and food systems expertise and volunteers from its student and adult training programs. Live Earth Farm's nonprofit Discovery Program operates farm-based education programs throughout the year. They partnered with Life Lab to bring FW program activities to their site in the spring and summer. Staff including teachers, administrators and directors of the local school systems were valuable FW partners. FW also partnered closely with the United Way program, which advocates for fresh food access in Watsonville.

## Goals and Outcomes Achieved

Hands-on involvement in every aspect of produce production—growing, harvesting and meal preparation—throughout a full season; weekly cooking lessons/shared meals in the spring and daily lessons/meals in the summer; produce share for summer youth families; workshops on nutrition and diet; Harvest Festival and Strawberry Blast events which inspire consumption of CSCs.

1) At least 90% of parents completing cooking and nutrition programs will describe positive diet change from increased consumption of fresh fruits and vegetables in their end-of-program evaluations.

Two parent orientation and cooking nights were held at the beginning of the summer 2014 program.

2) One hundred percent of youth will co-lead meal preparation demonstrating comfort with, and understanding of, how to prepare CSCs.

All FW youth co-led meal preparation throughout the spring and summer programs, learning to read recipes and modify dishes to include more CSCs.

3) One hundred percent of families with youth in FW will increase their CSC usage in weekly meal preparation from receiving free youth-grown produce shares weekly.

Twenty four summer program youth took home 1,500 pounds of CSCs to their families in the weekly youth-grown produce boxes over seven weeks. Youth reported increased usage of CSCs at home.

4) One hundred percent of youth attendees to seasonal FW events will taste, cook, or prepare food using CSCs and will attend at least one nutrition workshop.

Harvest Festivals (2013 and 2104) and Strawberry Blast (2014) featured many activities where attendees could taste and prepare food that highlighted CSCs (in particular strawberries, squash, apples and corn). Each event had dynamic, engaging nutrition workshops, and attendees visited at least one of these.

5) Increased access to CFCs by low-income, Latino population through the FW farmstand.

FW farmstands held at Gault Elementary (fall) and Dominican Hospital (summer).

6) Participation in peer-to-peer workshops result in increased awareness of the relationship between CSCs and health.

Three FW youth lead a three-part Community Educator series with 8 classes at 4 sites for 162 students. At Watsonville Community School, Pajaro Valley High School, and Jovenes Sanos (all in south Santa Cruz County) students were predominantly Latino and eligible for free and reduced meals. At YES (Youth Experiencing Success) School in the city of Santa Cruz, the audience was ethnically and socioeconomically diverse teenage youth in recovery from substance abuse.

Though FW did not list this as a measurable outcome for the one-year project, it is known that FW has long-term impacts on FW alumni diets (and their relationship to CSCs). In a 2014 alumni survey, 94% of former FW youth reported that their diets changed because of FW and 88% say they continued to eat healthy long after the program had ended. Because of this, project staff are confident that the FW model supports youth to make real, lasting overhauls of their daily diets.

1) At least 90% of youth completing seasonal programs will describe positive diet change from increased consumption of fresh fruits and vegetables in their end-of-program evaluations.

Ninety percent of FW youth who have been through the spring and summer program reported that they like healthy food more as a result of the program, while 86% said they eat more fruits and vegetables. These numbers suggest major positive diet changes.

2) At least 90% of parents completing cooking and nutrition programs will describe positive diet change from increased consumption of fresh fruits and vegetables in their end-of-program evaluations.

Due to staffing, FW was unable to provide the parent cooking series. Project staff added the equivalent of a parent cooking night into two orientations to the summer program held in Santa Cruz and Watsonville, California, to ensure parents were well-prepared to incorporate the specialty crops they were about to receive into their diets. This event was not evaluated, but parents incorporated FW grown specialty crops into the meal, which was well-received.

3) One hundred percent of youth will co-lead meal preparation demonstrating comfort with, and understanding of, how to prepare CSCs.

All 52 youth in the spring and summer programs co-led meal preparation several times, which made use of many CSCs. Ninety-five percent of FW youth who participated in the spring and summer programs report feeling completely comfortable with a recipe and cooking.

4) One hundred percent of families with youth in FW will increase their CSC usage in weekly meal preparation from receiving free youth-grown produce shares weekly.

All 24 families of FW summer youth received bountiful produce shares with over 1,500 pounds of youth-grown produce throughout the summer. Spring youth would occasionally bring home small amounts of produce to share as well.

5) One hundred percent of youth attendees to seasonal FW events will taste, cook, or prepare food using CSCs and will attend at least one nutrition workshop.

Over 675 students attended the seasonal events in 2013 and 2014. Students prepared, cooked, and tasted a wide range of healthy CSC snacks. Students were given a worksheet for the event that required them to visit various kinds of activity stations, including multiple specialty crop nutrition workshops.

6) Increased access to CFCs by low-income, Latino population through the FW farmstand.

FW distributed approximately 2,700 pounds of affordable, fresh specialty crops through the farmstands in the summer and fall. The farmstands were strategically located in areas accessible to low-income and Latino residents. The summer farmstand was held at Dominican Hospital in Santa Cruz to serve patients and their families. This nonprofit hospital serves majority low-income patients- 64% are eligible for MediCal or MediCare. In the Fall FW held farmstands at Gault Elementary to serve students and their families. The student population is 52% English Language Learners, 66% Latino, and 70% qualify for free and reduced meals.

7) Participation in peer-to-peer workshops result in increased awareness of the relationship between CSCs and health.

The peer-to-peer workshops were successfully delivered to 162 students in December of 2014. This engaging workshop series, led by youth, raised awareness about diet and health among students.

For the outcomes listed above, the evaluations of youth diet change rely on youth reporting perceived comparative changes in their diets at the end of the programs, rather than gathering pre-program baseline data and post-program data and comparing those data ourselves. Nineteen of 21 (90%) of youth who participated in the spring and summer programs and completed evaluations reported that they like healthy food more as a result of the program, and 18 of 21 (86%) youth reported that they eat more fruits and vegetables as a result of the program. Twenty of 21 (95%) youth stated they feel comfortable using recipes and cooking with CSCs after the program. For other outcomes, quantities of CSCs harvested and distributed are based on written harvest and market data sheets that are completed by youth and staff and retained throughout the year.

Numbers of students impacted by peer-to-peer workshops are based on sight count and recorded through the year. Numbers of students impacted by farm events are projected through teachers who report how many of their students will attend, and confirmed by the number of farm maps distributed as each student receives one.

These youth, who have reported positive diet changes (86 – 90%) and feel at ease using recipes that are full of fresh specialty crops (95%) as a result of the project, are often seen as a hard-to-reach population uninterested in health/diet. FW youth were also able to provide their families and community members, many of whom do not have ready access to fresh specialty crops, with over 4,000 pounds of CSCs. With 24 youth taking home specialty crops, an estimated 125 family members were impacted based on the average 5-member family size. It is a challenge documenting the unduplicated customer base of FW farmstands given the volume of people passing through, so, using sight counts, the project conservatively estimates at least an 100 additional unique community members (and their families) accessed fresh specialty crops through the FW farmstands.

## Beneficiaries

The following groups benefitted from FW's Program in 2013-14:

- Specialty Crop Industry. FW connected a hard-to-reach youth demographic with fresh specialty crops. FW youth grew, cooked, ate and distributed CSCs. Though youth culture is notoriously not centered on fresh specialty crops, the project deepened their understanding of and connection to CSCs, and resulted in significant immediate increased consumption. The project inspired youth who were not previously committed CSC consumers to internalize preferences and values that will drive lasting behavioral change around fresh specialty crops for themselves and their families. The project will drive greater purchasing of CSCs and increase the CSC industry for the long term.
- FW Youth. 52 low-income, struggling youth from across Santa Cruz County participated in FW's core spring, summer and fall programs. These youth are a diverse group, ages 14-18, with 40% coming from the farming community of Watsonville.
- Youth from local high and middle schools. 845 students from 16 different schools engaged with FW, learning about CSC production, nutrition and the food system. These students attended one of FW's large on-farm events and/or were taught by FW youth in Community Educators workshop series.
- FW Youth Families. 52 families benefitted from their children's involvement with FW, whether it was through fresh CSCs brought home in the summer, the summer program parent orientation dinner, or through their child sharing FW cooking lessons at home.
- Community Members. FW served the broader Santa Cruz County community through the low-income farmstands, various community events, catering jobs and through FW youth leadership.

FW Youth: 52
Youth at Events: 845
Families: 52
Community Members: 100
Increased CSC Consumers: 1,870

## Lessons Learned

FW continues to hone the educational and empowerment model each year. The 2013-14 season, the eighth for FW, was an especially smooth and successful one—more youth were reached in the community through

seasonal events at the farm; the spring and summer FW crew were extremely successful in getting jobs (some of which were with local food businesses and a farm); the fall flower, produce sales, and catering businesses were busier than ever; and, the 2014 crew worked together beautifully and enthusiastically. Staff made recruitment choices that invited struggling youth into FW who demonstrated a motivation to succeed and a desire to complete the program. This refinement of selection criteria led to this year's reduction in numbers of youth whose program work was disrupted by personal or family struggles.

The farming portions of FW consistently make a strong impression on the youth, 91% of them stated that they learned how to farm at FW. Having the right support (in terms of staffing and funding), the small farm can be tremendously productive.

The only goal that wasn't met was conducting and evaluating a parent cooking series. Because of unexpected reduced staff capacity this summer, a cooking series was substituted with two parent orientation nights which involved cooking specialty crop quesadillas and roasted root vegetables followed by a final summer dinner for youth families that was similarly loaded with CSCs. If reduced staff capacity should happen again, hiring additional, short-term help would be considered with coordination of non-core program elements like the parent cooking series.

**Additional Information**

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 37 | **Project Title:** Produce Toolbox: Linking Produce Education and Specialty Crop Distributions at California Food Pantries | |
|---|---|---|
| **Grant Recipient:** California Association of Food Banks | **Grant Agreement No.:** SCB13037 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Stephanie Nishio | **Telephone:** (510) 350-9905 | **Email:** stephanie@cafoodbanks.org |

## Project Summary

California has an extremely high rate of food hardship (20%) and unemployment averaging 10%.[1] Additionally, California's low income population suffers high rates of diet-related illnesses such as heart disease and diabetes. To address these needs, California Association of Food Banks (CAFB) developed the Farm to Family program, which brings donated unmarketable and surplus specialty crops from California growers and packers directly to a network of 44 member food banks. Food banks in turn distribute the produce through partnership with 5,000 charities and pantries to over 2 million people. Many low income people cannot often afford fresh produce or are unfamiliar and uncomfortable preparing certain produce items at home, and so handing out bags of produce is not enough support for behavioral shifts. Educational interventions are needed to increase the probability that clients will purchase, cook, and consume produce. The emergency food setting provides an optimal point of contact to offer education to low income people.

CAFB is uniquely qualified to address these challenges. From 2003-2012 CAFB contracted with California Department of Public Health (CDPH) to lead 22 nonprofit organizations in educating over 224,000 people annually. In 2012, CAFB partnered with CDPH and several food banks to develop a model program that specifically addresses produce education in emergency food settings. After reviewing existing nutrition education practices and research, the team developed the Produce Toolbox curriculum, now called the Produce Education Program (PEP), which was then pilot tested at pantries and rigorously evaluated by an independent evaluation firm. Results indicated that the program successfully increased participants' consumption of and likelihood to purchase fresh produce. PEP is unique in that it can be applied on a statewide level with food banks and food pantries to employ researched-based produce education, while simultaneously reducing food waste and enhancing competitiveness of the specialty crop industry.

California's agricultural industry leads the nation, and yet 1 in 7 Californians, 13.5% of the state's population, experience food insecurity. Ensuring access to healthy food is vital to California's future- our people, our farms, and our economy. Many families are unable to access fresh produce regularly and so can be unfamiliar with preparing certain produce items. Educational interventions are one of the ways to support access to healthy eating. PEP is a successful and accessible educational tool that staff and volunteers at emergency food settings can use to support their clients health.

This project did not build on a previously funded Specialty Crop Block Grant Program (SCBGP) project.

[1] Since CAFB's application for this funding in 2013, the food hardship and unemployment rates have decreased to 15.1% and 5.4%, respectively.

## Project Approach

YEAR ONE

- Hire Produce Education Coordinator: Produce Education Coordinator was hired January 2014.

- Conduct outreach to food bank members and select five food bank partners for Produce Toolbox program: CAFB requested interested food banks to submit applications which were then evaluated by CAFB staff and a committee comprised of staff from three non-applicant food banks. The selected food banks were: Feeding America San Diego, Los Angeles Regional Food Bank, Second Harvest Food Bank of Orange County, Second Harvest Food Bank of Santa Clara and San Mateo Counties, and West Side Food Bank (Los Angeles County).

- Choose four pantry partner sites for each of the five food bank partners (20 sites total): Each of five food bank partners recruited four pantry partners for a total of 20.

- Provide training in Produce Toolbox curriculum for each group of four pantries (total of five trainings covering 20 pantries) plus ongoing technical support: Training curriculum and agenda were created and trainings were conducted with each group of four pantries.

- 20 pantries conduct 100 produce toolbox sessions on 10 specialty crops to 3200 clients. Pantries choose lessons based on produce availability: Produce Education Coordinator was hired in January 2014, which moved the project timeline back four months. The program curriculum and materials were developed and implemented by June 2014. In year one, 20 pantries conducted 60 produce toolbox sessions on 20 specialty crops with approximately 2100 clients. Twenty specialty crop lessons were developed as opposed to the goal of 10.

- Provide bilingual farmers market EBT materials to food bank partners to distribute to 200 pantries: 20,000 bilingual farmers market EBT flyers were provided to participating food bank partners. Additionally, flyers were distributed to member food banks to share with their networks but the number of pantries reached is unknown.

- Convene the CAFB Produce Education Advisory Committee to review specialty crop/Produce Toolbox lesson development and online resources: The committee reviewed and offered feedback on lessons and food bank applications.

- Develop five additional specialty crop/Produce Toolbox lessons: Twenty lessons were developed and translated from English to Spanish. This put CAFB ahead of schedule with developing 20 lessons before 2016.

- Pilot test five new lessons at five pantries: The new lessons were only slightly modified from the ones used in the pilot study. Rather than re-piloting, CAFB focus grouped new lesson components and materials at food pantries and food bank distributions.

- Hire evaluation consultant: An evaluation consultant was hired March 2014 after a request for proposal (RFP) process. Evaluation activities began April 2014.

- Conduct Year One evaluation activities including case and control studies: CAFB and the evaluation consultant conducted case and control study evaluations of participating agencies and control sites. See attached report for details.

- Create a website for sharing specialty crop curriculum, data, and results among project partners: CAFB released a RFP and hired a design consultant. Graphic design efforts were focused on getting lessons and materials finalized. The website was completed by June 2014.

YEAR TWO

- Select three additional food bank partners and four pantries per food bank: CAFB welcomed Second Harvest Food Bank of San Joaquin and Stanislaus, Community Action Partnership of Kern County, and Food Bank Coalition of San Luis Obispo County, and their food pantry partners to the program in October 2014.

- Provide training in Produce Toolbox curriculum for each group of 4 new pantries plus ongoing technical support and annual site visits to 20 existing pantry partners: Produce Education Coordinator trained 10 pantries (four food pantries at both Second Harvest Food Bank of San Joaquin and Stanislaus and Community Action Partnership of Kern, and two food pantries at Food Bank Coalition of San Luis Obispo County) to successfully conduct the program's walk-the-line lessons. The Produce Education Coordinator also provided ongoing technical support to the existing food pantry partners through in-person site visits, conference calls, and email communications.

- Twenty-five pantries conduct 384 Produce Toolbox lessons on 15 specialty crops to 11,980 clients: 25 pantries conducted 312 produce toolbox lessons on 20 specialty crops to 10,000 clients.

- Provide bilingual farmers market EBT materials to food bank partners to distribute to 500 pantries: 20,000 bilingual farmers market EBT flyers were provided to participating food bank partners. Additionally, flyers were distributed to member food banks to share with their networks but the number of pantries reached is unknown.

- Produce toolbox training and site monitoring to participating agencies: The Produce Education Coordinator provided Produce Toolbox training for the new food banks and their partner agencies. The Produce Education Coordinator conducted site monitoring visits to partner agencies.

- Develop and pilot test five new Produce Toolbox/specialty crop lessons: CAFB only slightly modified the lessons from the previously developed versions, so instead of re-pilot testing the lessons entirely, CAFB pilot tested new lesson components at food pantries. Food pantries requested recipe diversity and since CAFB was ahead of schedule with lesson development more focus was placed on recipe development. CAFB updated the sweet corn recipe card and lesson plan to clarify that they refer specifically to the specialty crop sweet corn, instead of the commodity.

- Update website for sharing specialty crop curriculum, data and results among project partners: CAFB added recipe cards and lesson plans for six new specialty crop items, bringing the total to 16, and putting the program ahead of schedule. The recipe cards and lesson plans can be found on the CAFB website: http://cafoodbanks.org/pep-materials

- Conduct Year Two evaluation activities, including case and control surveys: CAFB and the evaluation consultant streamlined the programs evaluation tools and coordinated data collection through client surveys. See attached report.

YEAR THREE

- Select four additional food bank partners and four pantries per food bank: CAFB welcomed the Redwood Empire Food Bank, Resource Connection Food Bank, Community Action Agency of Butte County, and Sacramento Food and Family Services and their food pantry partners to PEP.

- Provide training in Produce Toolbox curriculum for each group of four new pantries plus ongoing technical support and annual site visits to 26 existing pantry partners: The Produce Education Coordinator trained four new pantries to implement PEP in Kern, Los Angeles, and San Luis Obispo counties. PEP refresher trainings were provided to partners in Kern, Los Angeles, and Stanislaus counties. Site visits including onsite technical support were completed with partners in Los Angeles and Orange counties; additionally, ongoing technical support through in-person visits, phone calls, and email communications was provided to all pantry partners.

- Forty-two pantries conduct 432 Produce Toolbox lessons on 24 specialty crops to 26,880 clients. Pantries will choose lessons based on produce availability: Twenty-five food pantries conducted 200 Produce Toolbox lessons on 24 specialty crops to 13,000 clients.

- Provide bilingual farmers market EBT materials to food bank partners to distribute to 500 pantries: 49,000 bilingual farmers market EBT flyers were provided to participating food bank partners. Additionally, flyers were distributed to member food banks to share with their networks but the number of pantries reached is unknown.

- Produce Toolbox training, and a site monitoring visit: The Produce Education Coordinator provided Produce Toolbox training for the four new food banks and their partner agencies. The Produce Education Coordinator has also conducted site monitoring visits to partner agencies.

- Update website for sharing specialty crop curriculum, data and results among project partners: Lessons for eight new specialty crop items (apples, beets, bok choy, kale, pears, persimmons, potatoes, and turnips) and six new recipes were developed. The website was updated with new materials and the findings from the previous year's evaluations.

- Partner agencies expressed that PEP was not accessible to some of their clients because they speak languages other than English and Spanish. This feedback prompted translations of the PEP materials into Russian and Chinese. Russian was chosen because there are a high number of Russian speaking clients at

pantries presently implementing PEP. Chinese was chosen because it is the third most common language spoken as a first language in California, after English and Spanish, among people living below the poverty line.

- Review Spanish translations; translate PEP materials (lessons and recipes) into Russian and Chinese to expand PEP's reach and utility to food banks and food pantries: Spanish translations were reviewed; Chinese and Russian translations were completed and reviewed.

- Conduct Year Three evaluation activities and prepare final evaluation report: CAFB worked closely with the evaluation consultant to evaluate PEP and gather learnings from the field. See attached report.

Only specialty crop commodities benefitted from this project.

Project partners include:

- California's food banks are nonprofit organizations that procure, store, and distribute food to smaller organizations in their communities. They are primarily county-based and range from small food banks in rural communities with few agencies to large multi-county operations with hundreds of agencies, and all are working to alleviate hunger in California. CAFB partnered with the following food banks to implement PEP: Feeding America San Diego, Second Harvest Food Bank of Orange County, Los Angeles Regional Food Bank, Westside Food Bank, Food Bank Coalition of San Luis Obispo, Community Action Partnership of Kern County, Second Harvest Food Bank of San Joaquin & Stanislaus Counties, The Resource Connection, Redwood Empire Food Bank, Community Action Agency of Butte County, and Sacramento Food Bank and Family Services.

- Agencies, which may be known in their communities as food pantries, food closets, and soup kitchens, deliver food they receive from the food bank directly to people experiencing hunger. CAFB partnered with the following food pantries to implement PEP: Fallbrook Food Pantry, El Sol Academy, Newport Church, La Purisima Catholic Church, Native American United Methodist Church, First Unitarian Church, Immanuel Presbyterian Church, Grace Resource Center, All Peoples Community Center, Church on Pearl, St. Anne Catholic Church and Shrine, St. Joseph Center, Peoples Self Help Housing/Courtland Street Apartments, Oceano Family Resource Center, Bakersfield New Life Center, Under Grace/7th day Adventist, Catholic Charities, World of the Pentecost, Big Valley Grace Community Church, United Samaritans Foundation, Nineveh Outreach, St. Josephs St. Vincent De Paul Ministry Brownsville SDA Church, Youth for Change, NCALC, Oroville Gleaners Food Basket, Vineyard Christian Fellowship, and New Covenant.

- CAFB partnered with several organizations to provide healthy, inexpensive, and nutritious recipes to clients: EatFresh.org, Leah's Pantry, the CDPH/Nutrition Education and Obesity Prevention, Share Our Strength, SuperFood Drive, San Francisco Department of Public Health, and United States Department of Agriculture: Team Nutrition.

## Goals and Outcomes Achieved

- PEP consists of 1) a 3-5 minute interactive specialty crop education intervention offered to food pantry clients while they wait in line by food pantry staff and/or volunteers; 2) a recipe card featuring the specialty crop being distributed at the food pantry; and 3) a sample of the recipe on the recipe card.
- Year One and Year Two of the program were evaluated with case and control quantitative surveys, comparing clients at food pantries who had the PEP intervention with control groups who did not.
- Year Three of the program was evaluated using qualitative interviews to gather best practices and learnings from pantries participating in PEP.

GOAL: Increase produce consumption among low income food bank clients to improve health, alleviate hunger, and expand the market for California fruit and vegetable specialty crops.

The activities completed to achieve these performance goals and measurable outcomes were the development of PEP materials, overall program, and the training of partner food banks and pantries in how to use and implement the program.

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| OUTCOME 1: Increase nutritional awareness of specialty crops and their health benefits among low-income clients.<br><br>Measure: Percent of clients who indicate increased nutritional awareness in post-intervention survey responses.<br><br>Benchmark: In 2012, clients in the Produce Toolbox pilot indicated a 27% increase in nutritional awareness of specialty crops.<br><br>Target: By 6/30/16, 51% of participants surveyed will indicate an increase in Nutritional awareness of specialty crops and their health benefits. | Results: The intervention group was 25% more likely than the control group, who had no PEP at their sites, to remember the MyPlate food groups and 30.6% more likely to make half their plates fruits and vegetables. In effect, they recognized the nutritional value, and corresponding health benefits of utilizing the featured specialty crop as a significant portion of their meals. |

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| OUTCOME 2: Increase likelihood of low-income clients to prepare and consume specialty crops received from food bank distributions.<br><br>Measure: Percent of clients who indicate increased likelihood to prepare and consume specialty crops received from food bank distributions.<br><br>Benchmark: In 2012, clients in the Produce Toolbox pilot indicated a 45% increase in likelihood to prepare and consume specialty crops received from food bank distributions.<br><br>Target: By 6/30/16, 65% of participants surveyed will indicate an increased likelihood to prepare and consume specialty crops received from food bank distributions. | Results: The intervention group was 30% more likely than the control group to have used MyPlate knowledge to prepare more vegetables for their families and 24% more likely to prepare/offer fruits to their families. Among those clients who received recipe cards, 75% either made the exact recipe, modified or changed the recipe, or did both. Approximately 95% of both groups are likely to consume all or most of the specialty crops they received from the food distributions. |
| OUTCOME 3: Increase likelihood of low-income clients to purchase specialty crops at retail venues such as supermarkets and farmers markets.<br><br>Measure: Percent of clients who indicate increased likelihood to purchase specialty crops at retail venues such as supermarkets and farmers markets.<br><br>Benchmark: In 2012, clients in the Produce Toolbox pilot indicated a 60% increased likelihood to purchase specialty crops at retail venues such as supermarkets and farmers markets.<br><br>Target: By 6/30/16, 78% of participants surveyed will indicate an increased likelihood to purchase specialty crops at retail venues such as supermarkets and farmers markets. | Results: Overall, approximately 80% of both the intervention and control respondents were very likely or somewhat likely to buy the featured specialty crop. Although there was not a significant difference between the intervention and control groups on the surface, in Year Two additional questions were asked to find out why people said they were unlikely to buy specialty crops. While there was not a significant difference between the control and intervention groups on most reasons, the evaluation did find that the control group was less likely to not buy specialty crops because they did not like the item. |

In summary:

Year One evaluation results indicated that the group that received the PEP intervention was significantly more likely to remember the seven key MyPlate messages compared to the control group. The intervention group was significantly more likely to have used MyPlate knowledge to prepare healthier foods for their families. Two-thirds of the clients who received recipe cards indicated that they used them at home to prepare the exact, or a modified version of the recipe.

Year Two evaluation results support and align with the findings of the year one evaluation. Seventy-five percent of clients who received recipe cards indicated that they used them at home to prepare the exact, or a modified version of the recipe at home.

Successful outcomes of the project include:

- 11 food banks partnered with 25 pantries to implement PEP.
- Reached 282,000 clients through implementation of PEP.
- Increased participants' awareness of MyPlate and the benefits of making half their plates fruits and vegetables (specialty crops).
- Increased participants' likelihood of preparing/offering specialty crops to their families.
- Developed 24 specialty crop lessons and 46 specialty crop recipes.
- Received positive feedback from participants and food pantry staff and volunteers.

## Beneficiaries

Clients who received food assistance from partner food banks and their agencies had increased access to specialty crop items through CAFB's Farm to Family program, recipes, and information about the specialty crops they were receiving at the distribution.

CAFB has been contacted by organizations in other states (South Carolina and Oklahoma) interested in implementing PEP.

CAFB has shared PEP model at the United States Department of Agriculture Western Region Office's (USDA WRO) SNAP-Ed summit and Food Distribution Program on Indian Reservations (FDPIR) conference.

PEP reached 282,000 clients through pantries directly implementing the program. (This number does not include out-of-state food banks or entities outside of the SCBG grant who may have accessed materials on CAFB's website.)

## Lessons Learned

Successes:
Food banks and food pantries had success implementing PEP and promoting specialty crops

- The packaged and quick nature of the intervention made it possible to take advantage of the time clients spent waiting for the food distribution to start and offer lessons in the line.

Challenges and Lessons Learned:
Capacity

- Staff and volunteers at food pantries typically have high workloads in order to run the food distributions successfully. This made committing consistently to implement PEP challenging.
- There was a higher than expected amount of turnover of volunteers and staff. PEP trainings were needed approximately 1-2 times per year to support program implementation and ensure new volunteers are trained to increase self-efficacy in educators, which led to greater and longer engagement with the program.
- Capacity at sites varied in terms of staff ability to implement the program in the original way intended with small groups in the line before the distribution. PEP needed to be flexible and to accommodate different distribution models sites. For example, distribution flow made PEP presentations in plenary in front of a group more effective at the sites.

- Evaluations were challenging because of the partner sites' capacity. Evaluating the sites using interviews was also challenging because some interviewers were volunteers and had less training than evaluators or produce education coordinator. After hearing sites express the need for flexibility, and having collected two years of control and case survey evaluation data, CAFB adjusted the Year Three evaluation to collect findings from the field based on how partner sites adjusted the program to fit their distribution models.

Predictability

- Partner sites sometimes did not know ahead of time which specialty crop would be coming to them, which led to challenges planning and preparing for the PEP lesson. To mitigate this, CAFB encouraged sites to order enough recipe cards to restock all of the recipe cards available so that they would have the materials and would then be able to easily grab whichever recipes they needed even if they did not find out what the produce item was going to be until just before the distribution.
- Sampling was challenging for partners to commit to if the site did not have a kitchen, extra volunteer capacity, and/or advance knowledge of what specialty crop would be delivered.

Repetition

- There was fatigue expressed around the activities, lessons, and recipes, expressed by some sites who said that their clients got tired of hearing the similar lessons, and had already tried the recipes.
- The MyPlate board was used heavily and wearing out quickly. CAFB switched from foam core to chloroplast and that worked to extend the lifespans of the boards.

Unexpected outcomes

- Food banks and partner pantries expressed more excitement and enthusiasm for the program than expected.
- Food pantries that were not previously receiving specialty crops, or receiving low amounts, received more from food banks and reported clients taking more. In addition, at least one pantry reported getting more local donations of fresh produce once local stores found that they were doing PEP.
- Produce Education Coordinator was invited to present PEP at USDA WRO's FDPIR conference.
- PEP was leveraged to receive a Walmart grant that funded refrigeration units at six pantry sites. After having the refrigeration units for one year, sites reported having increased capacity to accept and store more specialty crops to distribute to their clients.

Outcome measures not achieved

Outcome 3: Increase likelihood of low-income clients to purchase specialty crops at retail venues such as supermarkets and farmers markets.

It appeared that both control and intervention groups were willing to purchase specialty crops at retail venues with the same frequency. Year Two evaluation results showed that clients receiving PEP were less likely to not buy specialty crops because they disliked them than the control group. More research may be needed to better understand this.

## Additional Information

Attached is the CAFB PEP Final Evaluation Report

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 38 | **Project Title:** Bring the Farmer to Your School Program | |
|---|---|---|
| **Grant Recipient:** Sustainable Economic Enterprises of Los Angeles (SEE-LA) | **Grant Agreement No.:** SCB13038 | **Date Submitted:** December 2015 |
| **Recipient Contact:** James Haydu | **Telephone:** (323) 463-3171 | **Email:** James.haydu@see-la.org |

## Project Summary

The California Department of Public Health (CDPH) reports that 38% of California children ages 9 to 11 are currently overweight or at risk of becoming overweight. A recent CDPH needs assessment also showed rates of overweight and obesity were about 20% higher among children from CalFresh homes. A significant cause of these alarming trends is low intake of fresh fruits and vegetables among California children. The CDPH Network for a Healthy California reported in 2011 that only 24.6% of children from CalFresh-eligible households consumed the recommended five servings of fruit and vegetables each day.

The Bring the Farmer to Your School project addressed these negative public health trends by improving nutritional awareness of students, and increasing consumption of California specialty crops. Farmers were trained by a Registered Dietitian to teach curriculum proven to improve nutritional knowledge and healthy behavior patterns among students. The project introduced urban students to the variety of specialty crop career opportunities.

Without significant and timely intervention focused on reversing these trends, California children will continue to increased risk of serious health problems, including heart disease, type 2 diabetes, and certain cancers. Targeted nutrition education focused on school-age children may be the most successful means of affecting long-term positive behavior changes leading toward reduced risk of chronic diet-related disease. According to the Institute of Medicine's (IOM) 2007 study, *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth*, "It may be easier to change children's health behavior than adults' behavior. Childhood offers the opportunity to provide the solid foundation needed for healthful lifelong eating patterns." Studies also show clear links between good eating habits and improved academic performance and a more active lifestyle. A comprehensive educational experience that uses food and farming as an opportunity to teach about not only nutrition, but many core curricular areas including mathematics, science, language arts, social studies and history can be an effective approach toward enhancing both student health and academic performance.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Sustainable Economic Enterprises of Los Angeles (SEE-LA) was successful in meeting or exceeding all targeted progress toward goals. The project staff worked closely with the Los Angeles Unified School District (LAUSD) Program Liaison and administrative staff to provide access to LAUSD campuses for specialty crop farmers to conduct presentations. Although the process to provide access was delayed until January 31, 2014, project staff worked to achieve other project deliverables in a timely manner. The Project Coordinator and LAUSD Program Liaison identified 170 Title I schools (project goal is 175) to target for intervention. Schools

served 250, 500, or 750 students depending on school size and past participation. At each target school, a Lead Teacher and/or Principal was contacted and recruited to assist with presentation scheduling, coordination, and evaluation activities. Lead Teachers were sent welcome orientation letters in November and December 2013 to begin the process of scheduling specialty crop farmer presentations. Once Lead Teachers expressed interest in participating, the Project Coordinator sent updated scheduling information and verification forms to begin the process of scheduling specialty crop farmer visits for each participating school.

Concurrently, in November and December 2013, the Project Manager and Project Coordinator recruited 15 California specialty crop growers to partner as farmer educators. All specialty crop farmer educators recruited were required to attend a two-hour in-person Farmer Educator Orientation meeting. Many of the farmer educators were already highly adept at teaching school-age children. Through the life of a specialty crop farmer, the program aimed to bring the fields of specialty crop agriculture, nutrition, and health alive for students. Farmer Educator Orientations were led by the Project Manager, Project Coordinator, and LAUSD Program Liaison in January and February 2014. Orientations provided farmers with the most recent nutrition education guidelines from U.S. Department of Agriculture (USDA) MyPlate, as well as a list of specialty crop careers to present to students at each presentation. Farmer educators were also required to offer samples to all students of a wide variety of produce, many of which would be new and unknown to students, and to encourage increased daily consumption of California-grown specialty crops.

From November 2013 – January 2014, SEE-LA program staff worked with the project evaluation consultant to design program evaluation materials measuring success at achieving measurable outcomes. The final student survey was finalized in January 2014, and baseline surveys of 400 elementary students were conducted in March 2014. Follow-up (end-line) student surveys, as well as farmer educator and Lead Teacher evaluations, were conducted in May 2014.

Farmer educator presentations began in late January 2014. A total of 80,355 students at 164 schools received a hands-on, interactive 30 minute lesson about good nutrition as it relates to California specialty crops, and California specialty crop careers from a farmer educator. A total of 316 presentations teaching about nutrition and the importance of increased fruits and vegetables, and basic agricultural concepts were also introduced.

Because all farmer educators are California specialty crop growers, only California-grown specialty crops are provided as samples to students. Farmer presentations were reviewed by program staff to ensure that all content, particularly as relates to specialty crop careers, includes only information about California specialty crops. Evaluation materials also reflect only those produce items and careers which are 100% related to specialty crops.

The LAUSD Teacher Liaison was essential in providing the necessary coordination and communication among and between Lead Teachers, Farmers, Project Coordinator, and other SEE-LA staff. Lead Teachers continued to be responsive to project staff and Farmers, though challenges were again encountered in getting timely communication from some Lead Teachers. Participating Farmers continued to update and improve presentations to include the latest USDA dietary guidelines and information about California specialty crop careers. The project evaluation consultants conducted a first-rate evaluation and report outlined above.

## Goals and Outcomes Achieved

As noted above the Project Coordinator worked with the LAUSD Liaison to identify 170 target schools and Lead Teachers to assist with scheduling farmer visits at schools. From January to November 2014, a total of 80,355 students at 164 schools received a hands-on, interactive 30 minute lesson about good nutrition, California specialty crops, and California specialty crop careers from a farmer presenter. Sentient Research worked with Program Coordinator and Program Manager to design evaluation tools (student, teacher, and farmer surveys), and administered pre-tests to students in March 2014, with follow-up post-tests in May 2014.

The outcome measures were short-term, focused on changes in students' knowledge and behavior from pre-test (March 2014) and post-test (May 2014).

The project served 80,355 students, compared to the project goal of 80,000 students. Farmer presentations were conducted at 164 schools, compared to the project goal of 175 schools. Some schools received multiple farmer visits serving additional students from different grade levels.

The project evaluation did not show a clear improvement in students' consumption of fresh fruits and vegetables. However, students' knowledge of specialty crop careers did increase significantly.

Baseline data were collected prior to the *Farmer in the Classroom* program start from March 4th to 14th, 2014 and the follow-up data were collected in those same classrooms two months after the *Farmer in the Classroom* visit from May 7th to 20th, 2014. For each class at baseline and follow-up, the evaluator distributed the survey instrument and provided the same instructions to each class. The evaluator read the questions and response options aloud, as appropriate, as students filled out the survey instrument. Students were asked to raise their hand if they had any questions and were asked to complete the assessment silently without sharing responses aloud to prevent bias. The *Farmer in the Classroom* student survey instrument (see Appendix 1 in Exhibit K – "Student Impact Evaluation Report") was designed to collect a host of measures relevant to program outcomes among elementary school students. The measures included the consumption and appeal of healthy foods such as fruits and vegetables; access to fruits and vegetables in the home; perceived parental consumption of healthy foods based on the reported frequency of parental consumption of fruits and vegetables; and knowledge and interest in specialty crop careers. In addition, students were administered the Food Preference Questionnaire where they were asked to provide a preference rating for a series of fruits, vegetables and herbs. The fruits, vegetables and herbs were those produced by specialty crop farmers participating in the program that the students might have had the opportunity to sample during the farmer presentations.

Participating teacher perspectives on the program were collected as well. A teacher survey instrument was developed and administered during the student follow-up data collection in May 2014.

A summary of the evaluation report's findings is below:

- Student responses did not indicate a 10% increase in all performance measures from baseline (benchmark) to post-measure.
- *Knowledge of California Specialty Crop Career*s: Significant knowledge gains were demonstrated by students on questions related to specialty crop career opportunities with an increase in correct answers from baseline to follow-up on all questions. Students correctly named 14% more specialty crop careers from baseline to post-measure.

- *Food Preference Questionnaire:* Significant increases in preference were observed for lemons, limes, and onions from baseline to follow-up with more students liking these items *a lot* rather than *a little*. Though not significant, other positive trends were seen in the appeal of many fruits and vegetables.
- *Fruit and Vegetable Consumption Preference*: Significant declines from baseline to follow-up were observed for *liking to try new vegetables* and *liking to eat fruits for snacks instead of chips or cookies*.
- *Access to Fruits and Vegetables at Home:* A significant decline was observed in reported access to fruits at home at follow-up compared to baseline. No significant change was seen in access to vegetables at home.
- *Parental Consumption of Fruits and Vegetables at Home:* A significant decline in the frequency of parental consumption of vegetables was reported by students at follow-up compared to baseline.
- *Interest in Specialty Crop Careers:* Significantly less students said *yes* to being interested in a job involving fruit and vegetables when they grow up at follow-up compared to baseline.

A total of 80,355 LAUSD students at 175 Title I schools received a unique presentation from a local farmer teaching about the nutritional benefits of eating more fruits and vegetables and specialty crop farming as a career. Students showed a significant increase in knowledge of specialty crop careers, and significant increase in preference for three specific specialty crops.

## Beneficiaries

The specialty crop farmer educators presenting at those schools and students at LAUSD Title I schools were the project beneficiaries. Through this project, farmer educators offered samples of a wide variety of produce, many of which were new and unknown to students, and encourage increased daily consumption of California-grown specialty crops. Students were also introduced to the idea of specialty crop farming as a career, many for the first time.

Fifteen California specialty crop producers offered their teaching services and their produce sampled by students. The project was particularly helpful for smaller scale specialty crop farmers who are new to the industry and may not yet have well-established marketing and sales operations. During the year-long project, 80,355 LAUSD students at 175 Title I schools received a unique presentation from these local specialty crop farmer educators about the nutritional benefits of eating more fruits and vegetables and farming specialty crops as a career.

## Lessons Learned

Farmer to School visits were planned to begin as early as November-December 2013, once participating schools had been identified. However, due to delays in the administrative process to allow access to the school campuses, the first specialty crop farmer visit did not take place until late January 2014. For projects involving agreements with school districts or other similar organizations, potential delays in navigating a large bureaucracy should be anticipated.

The two hour orientation with farmer-educators proved to be very effective in introducing the new specialty crop career component. More time with farmers-educators to specify and review their presentation material, both before classroom visits begin and throughout the school year, would be beneficial, although may be

difficult to schedule due to the farmer-educators' schedules and travel distances. The "follow-up" lesson plan on specialty crop careers provided to farmer-educators for teachers to use with students proved to be effective in teaching the specialty crop career component of the curriculum. Additional educational materials to teachers to complement the other classroom presentations conducted by farmer-educators would be valuable.

Interestingly, the project evaluation showed the program's most successful impact on students' knowledge was in the specialty crop career-related topics. Consideration should be given to either increasing the amount of time for each presentation to 40 minutes, or eliminating the specialty crop career section to focus on the main project objective, the specialty crop nutrition education component. Another significant outcome measure not fully achieved was the change in student nutrition knowledge and increase in consumption of fruits and vegetables. Since survey data did show a significant increase in students' knowledge of specialty crop careers, it is possible that the new focus on careers detracted from the effectiveness of the nutrition education lessons. For future projects, SEE-LA would plan to either increase the total amount of time for each presentation to 40 minutes, or eliminate the specialty crop career section to focus more on the main project objective, the nutrition education component. Other organizations conducting similar projects should consider limiting the number of objectives in order to focus on one core objective, (e.g. specialty crop nutrition education or specialty crop agricultural education).

Another unexpected outcome was the incorporation of garden education with the farmer-educators' lessons at some school sites. Schools that had school gardens, or were just starting to build one, were significantly more invested in the project goal, and students at these schools seemed to have more foundational knowledge of specialty crops and nutrition education, and were therefore more involved in the farmer-educator's lesson.

One outcome measure not achieved was the number of schools served. The project goal was 175 schools and the actual number served was 164; however, the project goal of 80,000 students was exceeded and more significant than the number of schools targeted for this project. Organizations conducting similar projects should consider which target is more significant for their project.

The program gained exposure to other organizations working on nutrition educated-related issues in LA County and with LAUSD. In particular, the LA County Department of Public Health (LACDPH) Nutrition Education Obesity Prevention (NEOP) program learned of the Bring the Farmer to Your School program due to overlapping programming at a small number of LAUSD schools. NEOP has since approached SEE-LA about conducting similar specialty crop farmer-taught classes to parents of LAUSD students in the 2015-16 school year.

## Additional Information

Additional information about the Bring the Farmer to Your School program can be found at http://www.seela.org/bring-the-farmer-to-your-school-program/.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 39 | **Project Title:** Fresno Food Commons Prototype Implementation | |
|---|---|---|
| **Grant Recipient:** Trust for Conservation Innovation | **Grant Agreement No.:** SCB13039 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Karen Schmidt<br>Kvetka Smith | **Telephone:** (805) 798-1629<br>(415) 458-3665 | **Email:** karenjschmidt@sbcglobal.net<br>kvetka@t4ci.org |

## Project Summary

Fresno County is one of the most productive agricultural regions in the world. Paradoxically it also is one of the nation's leaders in poverty and food insecurity. Fresno has enough food and agricultural expertise to feed its citizens. But the existing system is failing to deliver that food to the people who need it most. There is growing recognition of the need for infrastructure across the food value chain that is designed and scaled to serve local markets with locally produced fresh foods. And there is enormous interest among community leaders in holistic solutions that not only improve food access but also retain and re-circulate wealth in the local economy, create secure, well-paying and dignified local jobs, and steward the land and environment.

This project was designed to address these needs by increasing access to and consumption of locally grown specialty crops by the residents of Fresno County and enhancing the financial and environmental performance of specialty crop growers in the region. Specifically, this project aimed to 1) support the building, acquisition, and/or repurposing of infrastructure to efficiently process crops from small and mid-scale growers in the region for sale to local retail and institutional buyers; 2) expand marketing, wholesaling and retail channels for local specialty crop products in diverse urban and rural neighborhoods; 3) design a training and HR program to equip new and existing specialty crop growers with the management and business skills to be successful Fresno Food Commons partners; and 4) support acquisition of land and other assets for use in local specialty crop production by a community-based land trust.

The need for increased access to fresh healthy food in Fresno is stark and urgent: Fresno is one of the poorest and most food insecure regions of the United States, where 28% of adults live in food insecure households, 12% of the population has low access to grocery stores, 85% of students qualify for free and reduced school meals, and 59% of urban residents are SNAP/EBT recipients.

However, demand for fresh, local, and source-identified products is growing among this population. Food Commons Fresno surveys at eight mobile markets in food deserts conducted during the grant period indicate that low- and middle-income residents here would purchase more fruits and vegetables if they were readily available in their neighborhoods. For many, fast food or small markets with limited, expensive, and low quality produce are their only food access points, and inadequate public transportation is a barrier to purchasing healthier food products.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Processing

1A. Investigations confirmed the limited availability of mid-scale processing to serve small and mid-size specialty crop growers in the region.

1B. The team explored a number of potential partnerships with third-party small and mid-scale fruit and vegetable processors in Fresno. The project team is in the process of developing a partnership with a farm to adapt and incorporate their fruit preserve operations into Food Commons Fresno (FCF), and is continuing to explore a collaboration to implement a turn-key mid-scale fruit and vegetable processing model that has been successfully developed in other parts of the country.

1C. The project team is developing a business plan for a specialty crop processing facility in conjunction with multi-use community food hub in south Fresno. A direct public offering is being planned as a key vehicle to secure community and institutional investments to fund development.

1D. FCF entered into an agreement with the Public Health Institute/Cultiva La Salud, leveraging funding from Cal FreshWorks, to adapt its packing facility for use in value-added specialty crop processing for mobile vendors. Facility modifications are underway and operations are targeted to begin in the fall.

Produce Aggregation and Sales

2A. FCF successfully launched local specialty crop produce box sales and wholesale specialty crop distribution in May 2015. Produce box specialty crop sales through June 2016 totaled $515,856 and wholesale specialty crop sales totaled $82,948. FCF is purchasing from at least 30 local specialty crop growers and value-added producers, and is actively recruiting additional suppliers.

2B. FCF's wholesale produce e-commerce hub has been fully operational since October 2015 utilizing technology partner Local Orbit.

2C. A variety of multilingual (English, Spanish, and Hmong) marketing collateral materials have been designed, produced and distributed in the community. Project team members regularly speak at community events and forums such as the Organic Stone Fruit Jubilee and Earth Day. FCF is partnering with the Public Health Institute, Cultiva La Salud, Fresno Metro Ministries, the Fresno County Department of Public Health, and Fresno Unified School District to expand marketing and education in neighborhoods with limited access to fresh produce, utilizing public elementary schools as a physical drop site and locus for education and outreach to school and neighborhood workers and families. The project team is actively working with suppliers to build relationships and market products to a growing list of restaurant, institutional and retail buyers. Eight mobile markets supported by other funding have been used to conduct customer surveys and promote produce box sales, as well as to test potential future retail sites.

2D. The project team is planning a retail produce outlet in conjunction with plans for a multi-use community food hub. The team conducted eight mobile markets to distribute specialty crop products in underserved neighborhoods, collect data, and promote specialty crop produce box sales. At the mobile markets 354 surveys about produce buying habits and preferences were completed. The wholesale hub is selling produce in two retail outlets and is exploring partnership with a third site.

Training and Human Resources Program Development

3A. Assessment of training resources indicated that available programs on food safety, food handling, and agricultural practices are sufficient to meet Food Commons' needs in the near-term. Technical

assistance and financial support to specialty crop growers on food safety certification, organic certification, production planning and quality control have been identified as future needs.

3B. The team is actively seeking funding and partners to utilize the specialty crop grower guidelines developed earlier in this project to engage regularly with growers on production planning, quality assurance, and continuous improvement of agricultural and conservation practices.

3C. The packing team has undergone initial food safety training and received Serve Safe certification. The team is continuing to work with board members and local and national advisors to codify HR policies and procedures.

Land Trust Development

4A. The project team established a trust board and governance structure and developed an initial strategic plan identifying key acquisition priorities and targets. The project team is actively pursuing two farm acquisition/donations near Fresno, and exploring several other farm acquisition/donation opportunities in the region to secure land for specialty crop production.

4B. Lease agreement templates have been developed, and negotiations are underway to implement the trust's first farmland lease agreement.

This project solely benefited Specialty Crops only.

Thirty-plus specialty crop growers have been FCF's most important partners, providing high quality products and supporting all marketing and education efforts.

- Advise on business and market development.
- Collaborating on outreach and education in low-income neighborhoods and schools.
- Partnering on e-commerce hub development.
- Key advisor on organizational development and community and government relations.
- Supporting the efforts to plan, fund and develop a specialty crop food processing and distribution hub in the divested neighborhood of southwest Fresno.

## Goals and Outcomes Achieved

Goal 1: Expand access to healthy, safe California specialty crops at school, at work, and in the neighborhoods of Fresno County residents. FCF successfully launched retail and wholesale local produce businesses that have increased access to healthy local fruits and vegetables by low- and middle-income residents of the Fresno region. Total specialty crops sales over the grant period are just under $600,000 and growing. Over 25,000 produce boxes have been delivered to over 1,500 customers in the region, and at least 10,000 additional residents are being reached by the marketing, outreach and educational materials. Activities included launching and promoting a produce box delivery business, developing multilingual marketing and education materials, conducting presentations, outreach and market surveys at mobile markets and community events, and conducting focused outreach and produce box host site development in low-income neighborhoods in partnership with public elementary schools and community organizations.

Goal 2: Enhance the marketability and competitiveness of specialty crops through the development of local markets for Fresno and San Joaquin Valley producers. Over 30 different specialty crop growers are selling their products through local FCF channels, with sales approaching $600,000 to 1,500 retail customers and more than 30 institutional, restaurant and wholesale customers. Activities included developing e-commerce

hubs for both retail and wholesale sales and order fulfilment; launching a packing facility; conducting marketing, outreach and promotions to recruit restaurant, institutional, retail market, CSA and other wholesale customers in addition to direct retail customers; and evaluating needs for small to mid-scale processing capacity to serve local growers and local markets, and commencing development of a commercial kitchen facility to meet that need.

Goal 3: Expand stewardship practices and invest in the next generation of specialty crop producers in Fresno County and the San Joaquin Valley. The project team worked with over 30 specialty crop growers including young and disadvantaged small farmers to improve their product quality, production planning and market readiness and to communicate the benefits of organic and sustainable agricultural practices to customers and potential customers through print, electronic and video materials, thereby increasing understanding of and demand for their products. The project team also developed a nonprofit land trust that is working to secure land and other food production assets that will support farmland stewardship and sustainable agricultural practices to meet community food needs into the future.

FCF has the infrastructure and systems in place to continue growing sales of local specialty crops, increasing the number of residents buying local specialty crops, and increasing the number and market readiness of local specialty crop growers participating in this value chain. The long-term goals include increasing the local market for specialty crop growers in the region by an estimated $20 million per year (currently at $600,000), training at least 50 farmers and food system workers each year (currently at 30 farmers and 15 food system workers), and increasing access to affordable fresh produce for at least 20,000 Fresno residents (currently selling to over 1,500 households and reaching at least 10,000 with marketing and outreach activities).

FCF has achieved all of the goals for the grant period with the exception of measure 3.1, the number of farmers participating in Food Commons Fresno training or certification programs. Through the project, staff have directly engaged with 30 specialty crop growers during the grant period and the supply base is growing, but it will take another year or more to reach the target of 50 participating growers.

Performance Measure 1.1: Increase sales of source-identified Fresno County and San Joaquin Valley specialty crop products in participating neighborhoods, including neighborhoods with limited supermarket access.

Benchmark: Not previously collected.
Baseline: $18,000 (1 participating grower).
Target: Increase of 15% comparing the first month with the last month of the project.
Progress: $599,207 (3,229% growth; 30 participating growers to date)
Discussion: FCF is continuing and steadily growing produce box sales and wholesale specialty crop sales to restaurants, retailers and institutional customers.

Performance Measure 1.2: Increase the number of retail and food service outlets selling source-identified Fresno County and San Joaquin Valley specialty crop products.

Benchmark: Not previously collected.
Baseline: 0 new outlets.
Target: Increase of at least 10 outlets from first to last month of the project.
Progress: 20 new outlets
Discussion: Current outlets include 10 restaurants, 2 retailers, 4 Community Supported Agriculture (CSA) businesses, and 4 institutional buyers.

Performance Measure 1.3: Increase the number and acreage of producers growing specialty crops for sale to local retail markets (in addition to farmers markets and other direct sales).

Benchmark: Not previously collected.
Baseline: 0.
Target: Increase of 25 farmers and at least 200 acres first to last month of the project.
Progress: 29 growers / 300+ acres added
Discussion: Data on acreage of suppliers is incomplete at this time; actual acreage is likely substantially higher.

Goal 2: Enhance the marketability and competitiveness of specialty crops through the development of local markets for Fresno and San Joaquin Valley producers.
Performance Measure 2.1: Increase sales of specialty crop products by participating specialty crop producers in local markets.

Benchmark: Not previously collected.
Baseline: $18,000 (1 participating grower to date).
Target: Increase in sales of 15% for participating specialty crop producers.
Progress: $30,844 (171% growth) (20 participating growers to date)
Discussion: Assisted in the startup of the Gnarly Carrot market in North Fork, CA. Assistance included help with Food Facility plans submitted to the Madera County Environmental Health Department and access to local specialty crops. Previously, the farm had a membership store. The Gnarly Carrot opened 4/1/16. FCF also began selling produce in April to an Asian market, and are selling to four retail CSAs and buying clubs.

Performance Measure 2.2: Provide new local buyer contacts established by local specialty crop producers.

Benchmark: Not previously collected.
Baseline: 0.
Target: Provide at least 5 new local contacts for purchases reported by participating growers.
Progress: 20
Discussion: Since launch in May the hub is delivering specialty crops from at least 29 growers to 20 local restaurant, institutional and retail buyers.

Goal 3: Expand stewardship practices and invest in the next generation of specialty crop producers in Fresno County and the San Joaquin Valley.
Performance Measure 3.1: Number of specialty crop producers participating in Fresno Food Commons-related training and certification programs.

Benchmark: 0 (pre-start up).
Baseline: 0
Target: 50 by year 3.
Progress: 8 participating producers, 9 pending
Discussion: At least 29 new growers are now supplying specialty crops to FCF and will be evaluated using the grower standards protocol.

Over the course of this grant FCF sold nearly $600,000 in locally grown specialty crop products from 30 different growers in the Central Valley region. Delivered over 25,000 produce boxes to over 1,500 customers/households in the region, including many low- and middle-income families in neighborhoods with limited access to fresh, high quality fruits and vegetables. With demand for local high quality produce steadily

growing, we expect the number of participating specialty crop growers, the number of consumers reached, and retail and wholesale sales to double or more over the next 18-24 months.

## Beneficiaries

Beneficiaries of this project include specialty crop growers in the Central Valley who experienced increased revenue and market presence from the project's sales and marketing activities, and residents of Fresno who experienced increased access to fresh high quality local produce.

Beneficiaries included 30 specialty crop growers directly participating in our market channels, with total revenues of almost $600,000, and over 1,500 retail and wholesale customers with increased access to fresh local produce. The project team expects revenues to reach $1.5 million over the next 18-24 months, with attendant economic and health benefits continuing to grow.

## Lessons Learned

Perhaps the most important lesson from this project was both the time and effort that was required to find the right people to staff and implement the project, and the value of investing that time and effort to recruit and train those people. The project required people with a combination of business and interpersonal skills, flexibility to adapt to constantly changing circumstances and challenges, and passionate commitment to the project's goals and principles. Although the recruitment process meant a slightly slower ramp up on project implementation, taking the time to find the right people paid off enormously in the form of a highly effective and thoroughly engaged and committed team that outperformed on virtually all measures and are positioned to continue growing the project's impacts well beyond the conclusion of the grant.

The project team also learned, not surprisingly, that an undertaking of this size and complexity inevitably takes longer than expected, that plans have to be adjusted on the fly both to deal with unforeseen issues and to take advantage of unforeseen opportunities, and that investing up front in extra capacity and infrastructure

One of the best unexpected outcomes of this project has been the strong interest and support in the work from the residents in the low-income neighborhood where the first facility was located. The initial produce packing team was hired almost entirely from the neighborhood in response to "Now Hiring" signs posted in the window. These team members have become some of the greatest advocates and ambassadors, enlisting their family members, friends, and neighborhoods schools and churches to participate in learning about, buying and consuming more locally grown fresh fruits and vegetables.

Engagement of more farmers in training and certification requires resources and expertise that went beyond the scope of this project. It would be beneficial to see dedicated funding and partners to provide the training technical assistance that will enable a greater number and diversity of small farmers to participate in the local supply chain and market channels.

## Additional Information

Please see the attached.
Visit the website at: www.foodcommonsfresno.org.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 40 | **Project Title:** Developing Farmer to Consumer Relationships in the Faith Community of the North San Francisco Bay Area | |
|---|---|---|
| **Grant Recipient:** Interfaith Sustainable Food Collaborative, a project of Trust for Conservation Innovation | **Grant Agreement No.:** SCB13040 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Kvetka Smith | **Telephone:** (415) 458-3665 | **Email:** kvetka@t4ci.org |

## Project Summary

Approximately 50% of Sonoma County farmers earn less than $10,000 in farm income. The project facilitates economic development by assisting them with access to direct markets through connections with faith-based groups. Many North Bay farmers markets are saturated and have waiting lists for farmers who want to sell their products. The project developed local marketing relationships connecting producers, including beginning and small-scale farmers, to a new-base of consumers that are concerned about production practices.

Several national religious movements are encouraging local congregations to support purchasing of local food. Many faith groups are already working on food access issues through food pantries and meal programs. This project was designed to facilitate relationship building and resource sharing to ensure local farms and faith groups do not have to reinvent the wheel as they facilitate purchases of specialty crops.

At the same time, many local families are in need of ready access to affordable, healthy food. According to the Sonoma County Food System Alliance's Food System Assessment released in July 2011, an estimated 50,000 Sonoma County residents, or 9.5%, live below the Federal Poverty Level (FPL) in 2010. The California Budget Project found that the minimum income needed to make ends meet for a family in Sonoma County in 2007 ($77,069 for two working parents and two children) was 3.5 times higher than the FPL. The real poverty rate in the project area is likely significantly higher than the official statistics indicate, meaning many families who have incomes above the FPL face tough choices when it comes to buying healthy food versus paying for other basic necessities such as rent, transportation, utilities, and medical care.

This project was needed to help the large number of farmers in Sonoma and Marin Counties to increase sales. Strong local economies and healthy families are the backbone to a successful food system and communities. By increasing direct marketing outlets for specialty crop producers, the project works to increase economic development and increase healthy food access, therefore supporting vibrant food system and communities in the North Bay Area.

The project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

To achieve goals, project staff performed outreach, developed materials, collected baseline data, facilitated networking through conferences and roundtables, provided technical assistance, negotiated agreements between farmers and faith-based groups, and collected data on impacts. Project staff recruited farmers and faith-based groups to be active participants in the project. The Interfaith Sustainable Food Collaborative (IFSC) made calls and held follow-up meetings to assist faith-based group leaders coordinating CSA or farm

stand relationships with local specialty crop producers. Project staff also organized three annual conferences, and 22 separate roundtable training workshops, to recruit farmers and faith-based groups to be active participants in the project. Technical assistance was given to faith groups to facilitate agreements with farmers; provide resources; and provide mediation assistance to help launch site-specific projects. Evaluation was integrated throughout and included surveys, key informant interviews, focus groups, and event evaluations. A resource guide on lessons learned regarding direct marketing via CSA drop-sites and farm stands was developed and made available on a demand-response basis.

All project activities were focused solely on the sale and marketing of California specialty crop products. The Project Director, the finance team, and the Executive Director reviewed all expenses to ensure that all funds were used to solely enhance the competiveness of specialty crops.

Project partners included faith-based groups, private farm businesses, non-profit agricultural advocacy organizations and technical consultants. The project as a whole promoted specialty crop working partnerships between faith-based groups and local farms. Congregations hosted marketing sites for specialty crops including CSA "drop-sites" and farm stand sales locations as described elsewhere in this report. Beyond these partnerships that were fundamental to the project, there are many ways partners contributed. At least 20 different congregations hosted conference or roundtable training events at their sites. These were consistently provided at no cost to the project. At least 8 farm partners attended workshops to make presentations to explain the mechanics of CSA programs in general and specifics to their operations. Workshops typically had one or more farmers participating to make sure the faith-based groups understood the farmer perspective. Several farms participated in more than one workshop. Community Alliance with Family Farms (CAFF) held events for local farms looking for direct marketing opportunities. Farms to Grow, Inc. helped the project team identify African American farmers for culturally appropriate CSA and farm stand produce. MIPS Computation worked with the project team to design a mapping system on the ISFC's website to show which congregations are engaged in specific food system activities, such as CSAs and farm stands. 18 faith-based groups hosted project roundtable discussions. 8 specialty crop producers presented and marketed their farm to faith-based group representatives at project roundtable discussions.

## Goals and Outcomes Achieved

Project staff have been successful in advancing all project goals through outreach, technical assistance, trainings, annual conferences, and developing resource materials. To date, project staff have identified 29 farms and 57 faith-based groups that have interest in establishing direct marketing relationships promoting California specialty crops. Highlights from the two year and nine month grant period include: 22 trainings organized with over 250 attendees; 29 farms and 44 faith-based representatives given technical assistance by project team; and 13 CSA and 12 farm stand sites established or developed.

Goal 1 was to increase specialty crop marketing by promoting customer relationships between producers and the Northern California faith-based community.

Objective A was to conduct outreach to at least 20 faith-based groups regarding opportunities to host on-site farm stands or Community Supported Agriculture drop-offs. Project staff reached more than 600 faith-based groups in Sonoma and Marin Counties to encourage distribution of direct marketed specialty crops and to promote the Conference and roundtables held during the reporting period via email, calls, and direct mail.

Objective B was to promote opportunities to provide CSA drop-offs and farm stands to at least 100 local farms. Project staff promoted opportunities to provide CSA drop-sites and farm stands to over 400 local farms. From this outreach, which included targeted emails as well as calls and farm visits, the project team identified 28 farms interested in partnering with faith-based groups to market specialty crops.

Objective C was to facilitate 16 CSA farms gaining 300 new member subscribers by establishing relationships between farms and religious institutions. Project staff facilitated 5 (Laguna Farm, Singing Frogs Farm, Foggy River Farm, Full Belly Farm, and First Light Farm) CSA farms gaining or retaining 101 new member subscribers by establishing relationships between farms and faith groups; this includes the team establishing or developing 13 CSA drop sites at faith-based sites. Please note that 5 farms served multiple faith-based sites through their CSA programs. In addition, 200 families received access to local fruits and vegetables through farm stands. Some faith groups that expressed interest in hosting a CSA drop-site ultimately did not advance CSA projects. Often, this was due to lack of volunteer or staff capacity to organize and manage a project. 11 of 13 faith-based CSA sites are still operating and one plans to begin CSA drops after the close of the project period.

Objective D was to establish or develop 12 farm stands at faith community sites to facilitate purchases from congregants from local farmers. Project staff established 12 farm stands at faith community sites to facilitate purchases from congregants from local farmers. Some faith groups that expressed interest in hosting a farm stand ultimately did not advance farm stand projects. This was similarly due to lack of volunteer capacity to organize and manage a project, or other factors beyond the control of project ‘champions’ at specific sites. Five of these sites are committed to continue developing and will begin farm stand sales after the close of the project period.

Goal 2: Advance training, technical assistance, and networking to facilitate direct sales of specialty crops to faith-based institutions.

Objective A was to develop educational materials in the form of fact sheets and a workshop curriculum to assist faith-based groups with decisions about establishing and managing on-site CSA programs. Project Staff developed educational materials in the form of fact sheets and workshop curriculum to assist faith-based groups with decisions about: sales of specialty crops; food sampling and commercial kitchen use; and establishing and managing on-site CSA or farm stand programs. The ISFC team finalized two “How-To” tool kits on CSA and farm stand projects with local farms including a list of specialty crop producers seeking direct marketing relationships with faith-based sites. Materials were circulated to all conference and roundtable attendees, and provided as part of technical assistance on a site-specific basis.

Objective B was to develop educational materials in the form of a fact sheet and workshop curriculum to assist farmers with decisions about establishing and managing CSA relationships with faith-based groups. Project staff refined and circulated educational materials, including fact sheets on Supplemental Nutrition Assistance Program (SNAP) licensing and farmer utilization of SNAP redemption that is essential for farmers running CSAs or farm stands serving the SNAP-eligible population. Project staff developed a sample Memorandum of Understanding (MOU) for CSA farms doing produce box drops at churches and other faith-based sites.

Objective C was to organize six roundtable discussions for 20 faith-based group leaders interested in promoting local food access by offering on-site CSA's, or farmstands. Project staff organized 22 roundtable discussions for 253 farmers and faith-based group leaders interested in promoting local food access by offering on-site CSA's, or farmstands. This significantly exceeded the target goal for the number of workshops. The roundtable workshops highlighted successes and challenges from several different perspectives and models for hosting and operating a farm stand or CSA drop site. Combined, the 22 events attracted 253 individuals representing 80 different congregations and 6 farms. The workshops featured speaker representatives of: farms including What's Up Farm, Laguna Farm, First Light Farm, Valley End Farm, Green Gulch Farm, Foggy River Farm, Tierra Vegetables and Singing Frogs Farm; faith-based groups including Village Baptist Church, Bethlehem Lutheran, Congregation Shomrei Torah, and First Presbyterian Church of San Anselmo; and the USDA's Federal Nutrition Service. The roundtable discussions in the last twelve months of the project evolved to be more targeted trainings as the project team attempted to focus CSA drop-site and farm stand development in more rural, less populous locations in the project area (such as Monte Rio, Tomales, and Cloverdale).

Objective D was to provide technical assistance to at least 40 farmers and faith-based group representatives to facilitate direct marketing of agricultural commodities. Project staff provided technical assistance to at least 29 farms and 44 faith-based group representatives to facilitate direct marketing of agricultural commodities.

Farms that received technical assistance include:
Roots of Creation, Bloomfield Organics, Natural Gardening Company, Cielo Azul Farm, Paul's Produce, What's Up Farm, Russian River Vineyards & Farm, Quarter Acre Farm, Ortiz Brothers, Laguna Farm, Singing Frogs Farm, First Light, R. Kelley Farm, Foggy River Farm, Scott Family Farms, Oaks of Hebron, Valley End Farm, Green Gulch Farm, Tierra Vegetables, Sonoma Heritage, Frog Hollow Farm, Shooting Star CSA, Happy Acre Farm, Rancho Piccolo, Full Belly Farm, McKinley Family Farm, Feral Heart Farm, Grace Farms, and Coyote Family Farms

Faith based groups that received technical assistance include:
United Church of Cloverdale, Greater Powerhouse COGIC, Wat Lao Saysettha, Village Baptist Church, Faith Lutheran Church, Windsor Presbyterian Church, Episcopal Senior Services, Congregation Beth Ami, Bethlehem Lutheran Church, Center Spiritual Living, Congregation Kol Shofar, Congregation Shomrei Torah, First UMC San Rafael, Holy Spirit, Islamic Center of North Marin, Redwood Forest Friends Meeting, San Francisco Theological Seminary, Sebastopol United Methodist Church, St. Paul's Episcopal Church of Healdsburg, Unitarian Universalist Congregation of Marin, Good Shepherd Episcopal Church, United Methodist Church of Sonoma, First Congregational Church of Sonoma, Catholic Charities of Santa Rosa, Hessel Church, First Missionary Baptist Church, Redwood Adventist Academy, Sleepy Hollow Presbyterian Church, Congregation Shir Shalom, St. Vincent De Paul Church, Wat Mahabuddhaphumi, Santa Rosa Alliance Church, St. Theresa, St. Philips, Sonoma Lighthouse Church, St. Andrews Episcopal Mission, St. Andrews Presbyterian Church, Cross and Crown Lutheran, First Presbyterian San Anselmo, Osher Marin JCC, Rodef Shalom, St. Vincent Church, Vineyard Hills, Sonoma Jewish Family and Children Services.

Goal 3 Promote CSAs, Farmers' Markets and Farm stands; and project services to 30,000 consumers affiliated with faith groups.

Objective A was to promote local opportunities to sign-up with local CSA's to at least 7,500 individuals affiliated with 10 faith-based groups in Sonoma and Marin Counties by placing articles in congregational newsletters. Through targeted calls, multiple email campaigns, placing articles in congregational newsletters, and media coverage circulated via the Santa Rosa Press Democrat, Sonoma County Gazette, and La Voz, project staff promoted local opportunities to sign-up with local CSAs or host farm stands to 54,900 individuals affiliated with over 500 faith-based groups and readers of at least 6 public media outlets serving Sonoma and Marin counties. Opportunities to purchase produce through CSAs and farm stands were promoted through media coverage of project related work from: local NPR affiliate KRCB, Solutions Magazine, the Santa Rosa Press Democrat, Petaluma Argus Courier, the Sonoma County Gazette, and La Voz; these outlets have a combined circulation of over 45,000.

Objective B was to promote the conference to at least 40 faith-based groups in Northern California with a focus on Sonoma and Marin Counties. The three annual conferences were promoted to over 500 faith-based groups in Northern California with a focus on Sonoma and Marin Counties. Project staff were able to promote the 2016 conference to over 600 faith-based groups due to a new partnership with the Interfaith Council of Contra Costa County and its 110 member following.

Goal 4: Evaluate impacts of farm to consumer relationships developed through the project.

Objective A was to develop an on-line survey to evaluate project impacts to be completed by farmers and faith-based group representatives in order to improve future programming. Objective B (above) was to promote and administer the survey to all farmers, faith community representatives, and CSA subscriber members affiliated with the project. Project staff developed and promoted three on-line surveys to over 600 faith groups and 410 local farms to evaluate project impacts and identify direct marketing opportunities. In total, the surveys were completed by 44 farmers and faith-based group representatives in order to improve project planning. Results included: 10 new faith groups expressing interest in establishing a direct marketing relationship with local specialty crop producers; and 9 newly identified specialty crop producers expressing interest in establishing a direct marketing relationship with local faith groups. Project staff used survey data to provide technical assistance to faith groups and farms expressing interest in having a CSA or farm stand relationship with local specialty crop producers.

Objective B was to conduct two focus groups, one with faith community program representatives and one with participating farmers to identify opportunities to improve programming and educational resources. The focus group with faith community program representatives was held in fall 2014. This was conducted in Spanish which was key to understanding issues of mono-lingual Spanish speakers participating in the CSA program at St. Paul's Church in Healdsburg. Findings from the focus group are discussed in the Lessons Learned section of this report and include the need for cooking demonstrations to increase knowledge of culturally appropriate ways to prepare produce from the CSA boxes including beets and other vegetables. Due to scheduling issues related to seasonal activity and geographic distance of participating farm partners, project staff chose to do key informant interviews instead of focus group serving farmers. Project staff met directly with farmers in spring 2015 and again in winter 2015 to assess programming issues that could benefit outreach or implementation work for the remainder of the project period. This included meetings with representatives of First Light Farm, Singing Frogs Farm and Laguna Farm.

Objective C was to conduct 12 key informant interviews with faith-based group leaders to assess trends regarding attitudes towards and participation in CSA's, farmstands and farmers markets. Feedback from program representatives was collected one on one by project team members and partnering lay organizers.

Twelve individuals were interviewed including: representatives of 6 faith-based partners, 2 CSA program clients and 4 farmers. In addition, ISFC staff supported one of the project sites, Village Baptist Church, distributed a survey to clients to identify opportunities to improve programming. The modest-size congregation received 15 responses which was a strong response.

To summarize: it is important to ensure CSA's provide culturally appropriate produce offerings; in some cases a farm stand will be a better fit than a CSA for low-income customers; and in congregations organized in a hierarchical manner, it is important to get buy-in from lead clergy early in the process of starting a project.

Objective D was to develop a lessons learned article in order to facilitate smooth operation of future faith-based community relationships with farmers. The lessons learned article was developed in the final quarter of the project. It was included in the IFSC's July 2016 Newsletter and the CSA Toolkit. In addition, the article is available through the ISFC's website www.interfaithfood.org.

Although planned outcome measures for the project were not long term, the CSA and farm stand relationships that exist between local specialty crop producers and local faith-based groups and their members will continue. Based on 101 CSA customers retained reflects approximately $58,176 in income for six of the partnered farms annually beyond the life of the project. Further, there are long-term impacts of the project that are difficult to quantify including: stronger knowledge of an appreciation of local farms, seasonal produce, and health benefits due to consumption of specialty crops.

The outcome measured was dollar volume of products marketed to faith-based institutions and their members through the project. Project staff projected establishing at least 12 new farm stands and 101 new CSA subscribers. Baseline was zero farm stands and 4 CSAs. To date, the project has established 13 CSA sites. The 101 customers have a positive impact on the partnering farmers' revenue of approximately $58,000 per year. In addition, the 12 farm stand sites result in an estimated 200 farm stand purchases of approximately $10 per purchase. Farms sites: First Pres San Anselmo, St. Paul's, Islamic Center, Bethlehem Lutheran, First UMC San Rafael, Kol Shofar, Shomrei Torah, Friends Meeting House, SFTS, Windsor Presbyterian Church, Catholic Charities, Village Baptist Church, Sleepy Hollow Presbyterian, Redwood Adventist, Episcopal Senior Housing, Wat Lao, Faith Lutheran, St. Andrew's Episcopal, and Shir Shalom.

Major successful outcome of the project include: 13 CSA and 12 farm stand sites marketing local specialty crops were developed. 604 families purchasing specialty crops at CSA and farm stand sites. One "How-To" Tool Kit guide was developed for faith-based groups interested in marketing California specialty crops through CSA.

## Beneficiaries

Beneficiaries included specialty crop farmers in Sonoma and Marin counties that depend on direct marketing and local consumers including low-income families who seek access to healthy produce. Outreach served 400 farms from the Certified Producers lists obtained from Agricultural Commissioners in targeted counties, and

the project team promoted 28 specialty crop producers interested in marketing partnerships with local faith-based groups.

At least 8 specialty crop producers received increased revenue due to sales from partnerships established or developed through the project. At least 5 of these producers had relationships with more than one congregation. The number of consumers benefitting from consumption of local specialty crops through the project is approximately 604, assuming 4 individuals served per 101 households participating in the CSA programs and 200 purchasing at farmstands. In addition, approximately 54,000 consumers benefitted from awareness of opportunities and information about local CSA's and farmstands described in the media.

## Lessons Learned

One key lesson learned during a focus group held for CSA participants in fall 2014 was how important the cultural appropriateness of the specialty crops are to consumers purchasing produce at faith-based sites. The project team learned from CSA participants that it is not enough to provide fresh or affordable produce if the participants get produce that is not a regular part of their cooking culture. Similarly, the project team found that if participants do not know what the produce is then they probably do not know how to cook it; thus, cooking demonstrations and/or taste tests can be a small but crucial piece to the success of the marketing and increasing sales of California specialty crops.

As the project advanced, project staff recognized that fewer introductory roundtable workshops were needed, and more of the problem-solving for project site organizers at the early stages of planning. This led to customized, focused agendas at some congregations including those located in Cloverdale, Monte Rio, and Tomales. In addition, the staff learned that depending on the faith-based group and the national religious body it is affiliated with, outreach and organizing should target different individuals. More specifically, in congregations organized in a hierarchical manner it is important to bring the lead clergy in to project planning early on. However, in other congregations lay leaders serving as volunteers have the authority to advance projects without significant involvement from the clergy. Unexpected outcomes included a better understanding of how income levels of targeted consumers impact the suitability of farmstands instead of CSAs. Project staff found that, in some cases, a farmstand was more appropriate for a congregation serving a high percentage of low-income people.

All key goals were achieved. Subscription numbers for CSA membership were below those projected due to factors including: some targeted congregations had more low-income participants and required SNAP purchase incentives. Project staff now secured 2 year funds to provide SNAP incentives. Other factors included that some local residents wanted to participate in the CSA in the winter or 'school year' but the farm they had selected only offered a summer and fall program. Finally, changes in leadership, both at the volunteer and staff level, impacted the ability of several congregations to launch programs on schedule or at all.

## Additional Information

Argus Courier 4/19/2013 Article:
http://interfaithfood.org/static/media/uploads/argus%20courier%20article.pdf
Press Democrat 6/14/2016 Article:
http://interfaithfood.org/static/media/uploads/pressdemocrat_fini_article_june2016.pdf
Other materials are available via website: www.interfaithfood.org.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 41 | **Project Title:** Oak Park Farmers Market | |
|---|---|---|
| **Grant Recipient:** Sacramento Neighborhood Housing Services, Inc. | **Grant Agreement No.:** SCB13041 | **Date Submitted:** December 2015 |
| **Recipient Contact:** Sharon Eghigian | **Telephone:** (916) 452-5356 | **Email:** sharon@nwsac.org |

## Project Summary

The Oak Park neighborhood and surrounding areas have been identified as "food deserts" with a high volume of convenience/liquor stores and relatively low access to affordable, locally grown produce. Oak Park is a low-income, ethnically diverse neighborhood of 16,000 residents. According to recent census data, more than 65% of Oak Park households have an income of less than $35,000 a year.

The purpose of this project was to leverage and increase benefit for specialty crop farmers of the Oak Park Farmers Market through increasing specialty crop sales, increasing the number of specialty crop vendors, and increasing the market's customer base, including Cal-Fresh Electronic Benefit Transfer (EBT) customers. The project built on past success to continue the expansion of a specialty crop "Word of the Week" promotion, in which customers learned the word and nutrition facts about that week's specialty crop.

The project was important and timely because the Oak Park Farmers Market had the opportunity to reach new customers, including low-income customers moving towards self-sufficiency, and support increased and long-term consumption of locally grown specialty crops. The project also provided opportunities for the market's specialty crop vendors to further develop relationships with current and new customers.

Through the 2011 Specialty Crop Block Grant Program Project 41: *Oak Park Farmers Market*, NeighborWorks Sacramento provided the specialty crop promotion approximately 10 times during the 2012 and 2013 market season. The current project was enhanced by providing the specialty crop promotion weekly (May through October) for the 2014 and 2015 market season. Increasing the number of times that the specialty crop promotion was provided at the market helped to attract new customers and continue to increase Facebook traffic.

## Project Approach

Goal 1: Increase access and sales to locally grown specialty crops in the low-income community of Oak Park and the surrounding communities.

- Activity - Implement a targeted marketing plan to reach 100 potential new specialty crop vendors.
    - Through a combination of visiting local farmers markets, making cold calls, and being introduced to specialty crop vendors through current relationships with specialty crop vendors, project staff made contact with more than 500 potential specialty crop vendors during the grant period. The Manager culled down a list of several thousand farmers to a list of 400 potential specialty crop vendors, and continues to reach out to and build relationships with many of these vendors.

- The Farmers Market Manager participated in the California Small Farm Conference in 2014 in order to learn more from other Farmers Market Managers about marketing, recruiting vendors, and new regulations impacting specialty crop farmers.

- Activity - Follow-up with 50 potential new vendors via phone, e-mail, and face-to-face meetings
  - Project staff followed up with more than 250 potential specialty crop vendors through phone calls, e-mails, visits, and provided applications to more than 100 specialty crop vendors during the grant period.

- Activity - Participate in 8-12 visits to specialty crop vendors
  - During the grant period, project staff participated in four visits to specialty crop vendors at farm sites. The target number of visits was not completed due to staffing issues. Using other project staff to complete these visits was not a strong option, as the Farmers Market Manager had the knowledge necessary to review farmer operations and to check for farmer and product integrity issues (i.e. wholesaling produce).

- Activity - Add and retain 4-6 new specialty crop vendors
  - During the grant period, project staff added four new specialty crop vendors. The Oak Park Farmers Market had a total of 11 specialty crop venders during the 2015 market season. During the grant period, the Farmers Market Manager increased focus on recruiting new specialty crop vendors through follow-up with potential vendors and visiting local farmers markets.

Project staff have learned that an increase in customer sales goes hand in hand with adding more vendors. Additionally, increasing the Oak Park Farmers Market customer base would also allow an extended market season. In 2014, the Oak Park Farmers Market season was extended from October to November.

Goal 2: Increase pounds of specialty crop produce sold at the market by 150% (from 60,000 lbs./year in 2012 to 150,000 lbs./year by 2015)

- Activity - Specialty crop “Word of the Week” promotion
  - Through this promotion, customers received $5 in coupons to be spent on the purchase of specialty crops only. NeighborWorks Sacramento secured funds from another source to pay for the specialty crop coupons. Project staff ensured that specialty crop coupons were only used for specialty crop vendors by printing "for fruits and vegetables only" on the weekly coupon, and by educating vendors and customers about the promotion. There have not been challenges with monitoring coupon usage. During the market hours of operation, signage was used to ensure that both customers and vendors understood which vendors (i.e., only specialty crop vendors) could accept the specialty crop coupons. Outreach for these specialty crop coupons included posting the specialty crop each week of the market on the Oak Park Farmers Market Facebook page, and “boosting” the page to reach more people on Facebook. Project staff also promoted the specialty crop promotion by distributing flyers monthly in English and Spanish to the Sacramento Food Bank, local WIC clinics, social service centers, and by e-mailing approximately 150 people each week. In addition, there were advertisements in the spring and summer editions of the Sacramento Natural Foods Co-op Reporter, a quarterly newspaper.

- Specialty crop farmers self-reported estimated sales of approximately 75,000 lbs. of specialty crops during the 2015 season. Project staff have determined that these numbers underreport the actual pounds of specialty crops sold and that tracking growth in EBT sales is a more accurate representation of growth in specialty crop sales. Total EBT sales grew by approximately 15% in 2014, and 5% in 2015.
    - Specialty crop farmers self-reported 2015 dollar sales, including EBT sales, were approximately $140,000. Using an average of $1 per pound of produce, and estimating that 80% of sales were sales of specialty crops, approximately 112,000 lbs. of specialty crops were sold in 2015.
    - Specialty crop farmers self-reported 2014 dollar sales, including EBT sales, were approximately $142,000. Using an average of $1 per pound of produce, and estimating that 80% of sales were sales of specialty crops, approximately 114,000 lbs. of specialty crops were sold in 2014.

The Oak Park Farmers Market sells non-specialty crops. In order to ensure that SCBGP funds were used to solely enhance the competitiveness of specialty crops only, project staff tracked numbers for every market week for specialty crop farmers in several areas, including: pounds of produce sold, types of produce sold, numbers of specialty crop coupons redeemed, EBT sales and WIC sales.

Project staff are not using specialty crop funds for any activities that are not related to increasing the competitiveness of specialty crops. Outreach efforts were tracked for the specialty crop promotion, and project staff measured the increase in traffic on the market's Facebook page in order to measure awareness of the promotion of specialty crops; the Oak Park Farmers Market Facebook page has over 3,000 followers. Project staff used time sheets and narrative report back-ups to document time spent conducting efforts to reach specialty crop farmers and for specialty crop outreach. Project funds continued to be used to directly and solely enhance the competitiveness of specialty crops.

## Goals and Outcomes Achieved

Goal: Increase retention rates of specialty crop vendors participating at the Oak Park Farmers Market

Performance Measure: Number of specialty crop vendors participating each week and total number of specialty crop vendors participating during the season.

Target: By 2014, the average weekly number of specialty crop vendors will be increased to 19 and by 2015 the average weekly number of specialty crop vendors will be increased to 24.

Result:

- The average weekly number of specialty crop vendors in 2014 was nine.
- The average weekly number of specialty crop vendors in 2015 was seven.

This goal was not met due to several factors:

- There has been an increase in Farmers Markets in the Sacramento area. During the last three years, two new Farmers Markets have opened on the same day and time. Both are located within two miles of the Oak Park Farmers Market. Another farmers market opened less than one mile away, and operates on Thursday evenings. Another new farmers market opened in November 2014 on Sunday mornings; this new market is less than three miles away. Each of these Markets draws a portion of the Oak Park Farmers Market's customer base. One of the project goals was to increase access to specialty crops to low-income families living in a low-income area, which has been successful, as indicated by an annual increase in EBT sales; however, competition for new vendors has become greater.
- The Oak Park Farmers Market typically recruited smaller farmers who may have had capacity issues preventing participation in the market consistently. Project staff recognize that capacity building takes time, and the desired results may be realized later as a result of this project.
- The drought conditions in California in 2014 and 2015 severely impacted the ability of the market's smaller farmers to grow crops. Several of the farmers who hoped to participate in the market through the end of the 2014 and 2015 seasons were not able to do so.
- Due to staffing, the Farmers Market Manager was not able to complete the level of outreach and follow-up with vendors that were planned for the 2014 season.

Goal: Increase access and sales to locally grown specialty crops in the low-income community of Oak Park and the surrounding communities.

Performance Measure: Cal-Fresh, EBT, and WIC sales of specialty crops.

Target: By 2014, will increase Cal-Fresh EBT sales to $1,300/week and by 2015, will increase EBT sales to $1,500/week.

Result:

- 2014 Cal-Fresh EBT sales: average of $1,350/week
- 2015 Cal-Fresh EBT sales: average of $1,370/week

This goal was met in 2014, but fell slightly short in 2015. The growth that was expected in 2015 did not occur due to several factors, including less participation by vendors impacted by the drought, and less than anticipated growth in customer base, due to the increased number of farmers markets in the Sacramento area.

Specialty Crop Promotion: Project staff promoted specialty crops by posting information about the “Word of the Week” on the Facebook page beginning in May and running weekly through October for both 2014 and 2015. Project staff provided $5 dollars (5 x $1 coupon) per family, educated coupon recipients about the nutritional value of each specialty crop "Word of the Week", provided recipes with that week’s specialty crop, and explained why the Oak Park Farmers Market was running the promotion. The coupons were only good for that market day. The specialty crop vendors turned in the coupons each week to the Farmers Market Manager and were reimbursed the following week. Both customers and specialty crop farmers have indicated that the Specialty Crop Promotion has helped with building customer loyalty. Project staff anticipate that these customer/vendor relationships will continue to grow.

During the grant period, the Oak Park Farmers Market redeemed $7,205 in specialty crop coupons in 2014 and $5,205 in specialty crop coupons in 2015. This translates to approximately 14,500 pounds of specialty crops purchased through the Specialty Crop Promotion.

NeighborWorks Sacramento did not achieve the project goal for the anticipated increase in vendors for 2014 and 2015. The expected outcome for the average number of weekly vendors by the end of the grant period in 2015 was 24 specialty crop vendors each week. Actual average number of specialty crop vendors per week was 7 in 2015.

Project goals for the anticipated increase in pounds of specialty crops sold in 2014 and 2015 were not met; however, as noted below in the "Lessons Learned" section, project staff believe that specialty crop vendors did not accurately report the pounds of produce sold. This is true for a variety of reasons, including challenges in understanding how to complete the weekly sales sheet, changing poundage numbers for carton/crate size, and difficulty accurately tracking that information during the hectic market day. Since the EBT sales numbers have continued to rise, project staff believe that actual poundage numbers are higher than what specialty crop vendors report back at the end of the market day.

Weekly data was collected during the market season on the following: cash sales, EBT sales, specialty crop redemption, pounds of produce sold, number of vendors participating, and WIC sales. This data was gathered for each vendor. Project staff gathered data in categories of specialty crop vendors and non-specialty crop vendors and used data from each market year as a starting point for measuring increases in pounds of produce sold and EBT and cash sales.

EBT sales have continued to grow over the course of the project. The EBT sales at the Oak Park Farmers Market increased approximately 15% in 2013 and 2014 and approximately 5% in 2015.

## Beneficiaries

This project benefitted the specialty crop industry by increasing the volume of specialty crops sold at the Oak Park Farmers Market. Specialty crop vendors that participated at least once during the 2014 and/or 2015 market season benefitted from the completion of this project. Many of these vendors are beginning and/or socially disadvantaged farmers. The project also benefitted families in the primarily low-income community of Oak Park and surrounding neighborhoods in Sacramento by increasing their access to locally grown fresh produce. Low-income families that participated in the EBT incentive and specialty crop incentive were able to stretch their limited dollars to purchase more healthy food for their families.

NeighborWorks Sacramento made the decision to open the Oak Park Farmers Market in a low-income area to increase food access for lower-income families and to support healthy economic development in the area.

The groups that benefitted from this project include the specialty crop industry, with increased knowledge of specialty crop nutrition and benefits through the specialty crop "Word of the Week" promotion, a total of approximately 25 specialty crop vendors that participated at least once during the 2014 and/or 2015 market season of May through October, and the approximately 600 people per week that shopped at the Oak Park Farmers Market during the market seasons of 2014 and 2015.

## Lessons Learned

The Oak Park Farmers Market completed its sixth year of operations in October 2015, which coincided with the end of this project period. Outcome measures were based on projections of continued growth and expansion. Project staff did not anticipate the impacts of the drought, and the impact of several new farmers markets opening within three miles of the Oak Park Farmers Market. These markets are located in more affluent neighborhoods, which helps increase the stability of their market sales. By contrast, approximately 30% of the Oak Park Farmers Market sales are through EBT sales.

Project staff were also challenged in gathering accurate information from vendors for cash sales and pounds of produce sold each week. Project staff worked diligently to improve this process and make it as easy as possible for vendors to provide this information (i.e., developing forms, meeting individually with vendors at the end of the market to gather information). It was determined that the market's EBT sales were the most accurate gauge of sales and produce sales.

As noted previously, the impacts of the drought and the increase in new farmers markets impacted ability to fully meet project goals, namely increasing and retaining specialty crop vendors and increasing produce sales.

## Additional Information

There is no additional information to report.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 42 | **Project Title:** The HEAL Project: EAAT (Engaged Active Agricultural Tasters) | |
|---|---|---|
| **Grant Recipient:** The HEAL Project | **Grant Agreement No.:** SCB13042 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Amy Bono-Kruckewitt | **Telephone:** (650) 918-2422 | **Email:** Amybk@thehealproject.org |

## Project Summary

The addition of Engaged Active Agricultural Tasters (EAAT) to The HEAL Project (THP) programs will actively engage students in the production, preparation and consumption of California specialty crops (CSCs) as a regular school-day activity, encouraging kids, their parents and siblings to become life-long consumers of CSCs. Schools are in a unique position of not only conveying information about health and the importance of consuming lots of fruits and vegetables every day, but also providing regular opportunities for all students to practice the essential skills to do so. By integrating a weekly lesson into the school day that actively involves very young public school students in the growing, harvesting and creative preparation of CSCs, EAAT can counter the pressure for kids to consume highly processed, sugary, fatty snacks, and instead become life-long advocates and consumers of CSCs.

Children and their parents are subjected to marketing of sugary drinks, fatty snacks and highly processed foods; the negative health outcomes are well documented. California's (CA's) small farmers do not have access to marketing apparatus to deliver alternative messaging nor do school districts or teachers. EAAT will relate CSC produce with current research that shows healthy eating and regular physical activity play a crucial role in preventing heart disease, cancer and stroke; the three leading causes of death among adults 18 years or older. Engaging students from a very young age in healthy eating and regular physical activity has proven to help lower their risk of obesity and related chronic diseases during childhood.

This project did not build upon a previously funded Specialty Crop Block Grant Program (SCBGP) project.

## Project Approach

Activity: Deliver EAAT tasting at THP and Coastside Children's Programs Summer Camps
Description: Tastings delivered during the 2014, 2015, and 2016 summer camp sessions.

Activity: Deliver EAAT tastings at school events, health fairs, and other community venues such as Boys and Girls Clubs
Description: THP expanded tastings to four new community venues: Moonridge Community Center, Pillar Ridge Community Center, The Boys and Girls Club of Half Moon Bay, and Half Moon Bay Library. THP participated in health fair tastings at New Leaf Market in 2014/15 and school events such as graduation night in 2015/16.

Activity: Deliver to 2nd & 3rd graders: two schools: weekly garden-based lessons on health, agriculture and environment, addressing CA science and health standards
Description: THP delivered weekly garden programming at Hatch and Farallone View Elementary Schools throughout the grant time period.

Activity: Purchase health department-approved food carts
Description: Pacific Coast Farmers' Market Association generously donated two health department approved food carts to THP. Carts have been and will continue to be used for food prep and tastings at the San Mateo County School Farm.

Activity: Secure safe-food handling certification for all staff/volunteers
Description: All staff handling food for EAAT tastings have received their food handlers permit.

Activity: Design program to demonstrate and distribute healthy snacks within classroom sessions
Description: THP hired an EAAT coordinator in the fall of 2014 to design, schedule and lead tastings at various school sites and community venues.

Activity: Secure calendar clearance for THP Graduation/Family Night/year
Description: Grad nights were held in January of 2015 and 2016

Activity: Solidify relationship and buying plan with Farmers' Market Management/Operator – Issue MOU for CSC coupons and purchasing agreements
Description: Plan in place with two cooperating entities.

Activity: Farmers' Market Coupon Training for Coastside Farmers' Market, Pacific Coast Farmers' Market and East Palo Alto Farmers' Market farmers regarding SCBGP eligible produce
Description: Annual trainings provided

Activity: Develop and integrate new curriculum that includes info/demos on CSC food prep, nutrition, history, and economic significance
Description: Every EAAT Tasting completed in a classroom or on the farm provides the following background information about the CSC: nutritional significance, how to prepare it, brief history, and economic significance to CA. This information is disseminated verbally and occasionally with the support of posters, power point presentations or hand-outs.

Activity: During market season, create produce purchasing plan through Farmers' Markets to identify best produce and price
Description: THP staff shop for produce at certified Farmers' Markets that are closest to their respective homes and purchase from a number of different vendors.

Activity: Award travel stipends to a total of 20 eligible schools for farm site visits for 2014/15 and 2015/16
Description: THP awarded travel stipends to a total of 43 individual classes from 7 different schools from September 2014 – June 2016.

Activity: Provide CSC samples to students and their families during at least two school events at participating elementary schools
Description: THP provided CSC samples to students and their families at THP Program graduation night for 3rd grade students at Hatch and Farallone View Elementary Schools in 2015 and 2016.

Activity: Negotiate MOU with one school for expansion to additional site in 2014/15

Description: In 2014/15 THP expanded tasting sites to include El Granada Elementary. In 2015/16 THP expanded to include Pilarcitos Alternative High School in tastings.

Activity: Develop all CSC specific surveys, develop survey administration protocols, monitors survey administration, data collection and conduct data analysis. Write reports based on data.
Description: Surveys have been developed and administered. Results of surveys used in generating reports.

Activity: Develop and manage cooking demonstration(s)
Description: THP Farm instructor manages cooking demos on farm, THP Instructor at Farallone View (FV) Elementary manages cooking demos at FV, and EAAT Coordinator manages tastings and cooking demos at Hatch Elementary, El Granada Elementary School, and other community sites.

Activity: Oversee survey development, monitor survey administration and ensure data collection and entry protocols are established and followed. Analyze survey results and provide annual pre/post test reports.
Description: See results of surveys in next section

Activity: Additional labor required for EAAT CSC planting, growing, harvesting and deliveries. Also monitors and corrects student planting.
Description: Farm laborer was hired and assisted with the above mentioned activities in 2015 and 2016

This project did not benefit commodities, only specialty crops.

Project Partners:
Coastside Farmers' Market made in-kind contributions including: The provision of booth space at the Half Moon Bay Farmers' Market and administrative support for THP farm stand

A farmer generously donated 2.5 acres of farmland for the establishment of the San Mateo County School Farm, where students participate in EAAT tastings/cultivation of CSC's.

Cabrillo Unified School District provides in-kind support in the form of office space to THP administrative team and classroom and garden space for THP educators.

Parent Teacher Organizations provide matching funds for the support of THP's Intensive Garden Programs (IGP) at Hatch and Farallone View Elementary Schools.

## Goals and Outcomes Achieved

The main activities completed to achieve the performance goals are as follows:

1) Leading classes from across San Mateo County on farm field trips where students engaged with growing, harvesting, preparing and tasting California Specialty Crops.
2) THP Intensive Garden Programs held at Hatch Elementary and Farallone View Elementary. During the school year IGP classes are offered to approximately 350 students in 2nd and 3rd grades get the opportunity to prepare and sample CSC's, sampling a new CSC every week.
3) EAAT tastings held at other school venues and community locations, such as El Granada Elementary, Pilarcitos Alternative High School, and the Boys and Girls Club of Half Moon Bay.

For each of the 3 outlets for EAAT programming listed above, participating students were given a voucher packet worth $10 (initially $5, but bumped to $10 in project year 2). The distribution of vouchers was meant to provide an incentive for students to shop at the Farmers' Market and increase the likelihood of becoming a regular shopper, thereby uplifting the CSC industry as a whole. The hiring of an EAAT tastings coordinator helped to streamline the efforts of program implementation.

For a sample population of each of the program groups listed above a survey was given to determine attitude and behavioral changes related to CSC's to determine if multiple exposers to CSC's produced a more favorable attitude towards consumption.

Outcomes were measurable within the duration of the project and will continue to sustain and grow beyond the grant period.

Total number of students who participated in EAAT programs during the entire funding period: 13,452
THP significantly exceed their goal of reaching 1,450 students annually. THP was able to meet their goal of providing EAAT tastings on a weekly basis to 350 2nd/3rd grade students enrolled in THP's Intensive Garden Programs. Due to increased field trip numbers throughout the duration of the grant program and due to the new venues THP offered EAAT programming, THP was able to reach many more students than initially projected.

The overarching goal of this program was to increase enjoyment, understanding and consumption of CSC fruits and vegetable creating life-long consumers/advocates. THP believes this goal has been met. While it remains to be seen if participating students will become life-long consumers/advocates, THP believes they provided valuable programming at a critical time in students' development of food preferences that helped introduce students to CSC's in a fun, engaging way. Please see below for results of a self-survey that looked at attitudes and beliefs about consumption of fresh fruits and vegetables before and after participating in EAAT programming.

Goal: 25% increase in voluntary post-curriculum participation in THP-sponsored garden/farm-based extramural programs. The largest increase in post-curriculum participation that THP has seen is in summer camp enrollment. Enrollment more than doubled since summer camps started in 2014, with an overall increase of 133%. An overwhelming majority of student registrants are coming from schools that have been exposed to our programming through farm field trips, EAAT tastings, or IGP classrooms.

Goal: Sales of approximately 20 CA growers at four Farmers' Markets to THP students and families will increase significantly in the 1st year. $16,353 in voucher money has been redeemed by CA growers from eight different markets over the course of the project. Thirty-one individual CA growers saw increased sales due to the voucher program at the two Coastside markets, Half Moon Bay and Pacifica.

Attitudes and behaviors self-survey of farm field trip participants:

| **Question** | **Pre (% who agree)** | **Post (%who agree)** |
|---|---|---|
| I like trying new fruits and vegetables. | 63% | 76% |
| I think fresh food from a farm tastes good | 56% | 78% |

| Question | Pre (% who agree) | Post (%who agree) |
|---|---|---|
| Visiting a farm makes me want to eat more fresh fruits and veggies | 41% | 53% |
| I ask my family to buy fresh fruits and veggies | 47% | 71% |
| Eating fresh fruits and veggies will make me healthier | 82% | 91% |

As stated previously, the overarching goal of this program was to increase enjoyment, understanding and consumption of CSC fruits and vegetable creating life-long consumers/advocates. In a survey of students who participated in THP garden intensive classes, 53% believe that because of what they learned in THP programs, they choose to eat more fruits and vegetables at home. 43% reported that they ask their parents to buy more fruits and vegetables for their family to eat. Of the 350 students enrolled in garden intensive programs that equates to 186 and 151 students, respectively. 79% of students reported that they enjoy trying new fruits and vegetables. In a survey of parents of students who participated in THP garden intensive classes, 62% believe that since their child's participation in THP classes they have noticed their child eats more fruits and vegetables at home and 52% believe that since their child's participation in THP classes their whole family eats more fruit and vegetables at home. This data was gathered at graduation night, after students had been exposed to weekly tastings for an entire school year.

The numbers listed above highlight the successful outcomes of this project by showing that there has been an overall increase in students' enjoyment, understanding and consumption of CSC fruits and vegetables.

## Beneficiaries

All participating schools and organizations benefitted from the completion of this project. Schools and organizations benefitted from the addition of hands-on nutrition based programming to their existing curricula.

CSC growers benefitted from the completion of this project through increased sales in CSC's from THP voucher program to a new group of customers and from the direct purchasing of CSC's for the purpose of EAAT tastings.

Total minimum number of unique farmers who saw an increase in sales due to purchases for EAAT Tastings and voucher redemption: 60
Total number of project dollars spent directly on CSC's: $10,740
Total number of dollars received by CSC growers in the form of vouchers: $16,353

Due to limited administrative resources, THP was unable to track data on how many individuals went to the farmers market to use vouchers and then became returning customers.

## Lessons Learned

Due to much staff turn over during the duration of this project, THP had difficulties maintaining continuity of tracking. In the future it would be beneficial to have very clear and easy to navigate tracking protocols from the very beginning so even if staff turns over, the data that needs to be collected will be easier to collect.

The voucher program proved to be very challenging to develop and administer. From developing the vouchers to getting vendors on board and trained to accept them, to assembling and distribution, to tracking. Each step was very labor intensive and required more administrative time that THP's small office staff was prepared for. While the vouchers did encourage students to visit the Farmers' Market, it was not the most efficient way given the limited resources of THP.

Consolidating shopping trips for EAAT tastings proved to be efficient and timesaving. Several staff members who were responsible for leading EAAT tastings would rotate shopping days. When it was a staff person's week to shop, they would purchase CSC's for EAAT tastings at a Farmers' Market nearest their house and bring it to the THP office Monday morning to distribute to the rest of the staff. This made it so that not every staff person needed to carve time out of their schedule every week to go to the Farmers' Market to purchase crops for tastings.

Because of this project, THP was able to branch out to populations not usually seen in regular THP programming. Boys and Girls Club, Pilarcitos High School and El Granada Elementary welcomed EAAT programming as a way to enrich curricula for their students. In general, the support of the SCBGP allowed THP to reach more students than ever before, and increasing enrollment in farm field trips and summer camp programs. With this increased enrollment in fee based programming,
.
Overall THP believes goals and outcome measure were achieved with this project.

**Additional Information**

Half Moon Bay Review articles about EAAT program:
http://www.hmbreview.com/community/a-lesson-in-taste/article_d59f5222-135e-11e4-a6ca-001a4bcf887a.html?mode=print

http://www.hmbreview.com/food_and_drink/students-stir-up-healthy-food/article_2e92ce84-38bc-11e6-9e83-ab3a7b09e703.html

http://www.hmbreview.com/community/celebrating-autumn-through-education/article_44a2f85e-9932-11e5-85b1-7bd494184abd.html

The Daily Journal article about THP programming, including EAAT:
http://www.smdailyjournal.com/articles/lnews/2015-10-12/school-farm-promotes-healthy-eating-heal-project-offers-experiential-learning-for-county-students/1776425151684.html

A link to THP website explaining EAAT program:
http://thehealproject.nationbuilder.com/programs

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 43 | **Project Title:** Online Irrigation and Nitrogen Management Tool for Cool Season Vegetables | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Oakland Cooperative Extension | **Grant Agreement No.:** SCB13043 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Wendy Ernst | **Telephone:** (530) 754-3944 | **Email:** OCG@ucanr.edu |

## Project Summary

California is the main producer of cool season vegetables (CSV), such as lettuce, cole, and spinach crops for the United States. CSV produced on the central coast are valued at $2.13 billion annually, and critical to regional and state economies. These crops require high inputs of water and nitrogen (N) fertilizer to reach economical yields and market quality. Nitrate discharges from CSV production has contaminated surface and ground water supplies in these regions. Since the adoption of the Agricultural Discharge Order by the Central Coast Regional Water Quality Control Board in March 2012, growers have come under increased water quality regulations, and may face future restrictions on the use of N fertilizer. To meet these water quality objectives, growers will need to improve both irrigation and N management of their crops.

This project expanded a new online tool, CropManage (cropmanage.ucanr.edu), aimed at helping growers efficiently manage N and water to maximize production of CSV and minimize environmental impacts to ground and surface water. CropManage (CM) makes use of available weather, soil, and crop data to provide in field decision support to growers in using water and N fertilizer efficiently for producing CSV. Growers can access CM online using their smartphone, tablet and office computers. Water and N fertilizer recommendations provided in CM are based on research done by the University of California (UC) research and timely, site-specific data. Currently, CM is calibrated and piloted for commercial lettuce production. In order to become a fully useful tool for commercial vegetable producers, CM needed to be expanded to the range of vegetable crops grown on the central coast. This project addressed the goal of environmental stewardship and conservation by assisting vegetable farmers in reducing inputs of N fertilizer and water, thereby conserving and protecting the safety of ground water supplies.

This project built upon the 2011 Specialty Crop Block Grant Program Project 16: *Improved Tracking of Transpiration Coefficients in California Specialty Crops*, which evaluated the accuracy of using the weather-based irrigation recommendations of CM and the National Aeronautics and Space Administration (NASA) Satellite Irrigation Management Support (SIMS) in replicated field trials. The results of these trials demonstrated that following CM and SIMS guidance reduced water use by 30% relative to standard irrigation practices for broccoli and lettuce, while maintaining crop yield and quality. The potential for nitrate leaching was also minimized by reducing the amount of water applied to these crops. The current project built on these results by: 1. Adding additional commodities to CM to address the entire CSV system; 2. Adding a N fertilizer decision support tool; and 3. Linking CM to NASA SIMS, which should result in a more comprehensive and easier to use web tool for managing water and N fertilizer.

## Project Approach

The main objective of this project was to expand CM to include additional CSV's, such as broccoli, cauliflower, cabbage, and spinach, and adding new capabilities such as linking to Landsat satellite information through the NASA SIMS system.

Task 1: Collect supplemental plant development data (canopy development, rooting depth, N uptake) for CSV crops (broccoli, cauliflower, cabbage and spinach). Collection of data from commercial vegetable fields to supplement previous data collected was completed. Biomass, canopy cover, and root depth data were collected from three commercial fields of broccoli, cauliflower, cabbage, and spinach. Tissue samples were analyzed for N content by calculating the N uptake at various stages of development of these crops.

Task 2: Develop algorithms for crop coefficient, root development, and N uptake models for CSV. Algorithms were developed for the water use coefficient (Kc), root development, and N uptake for all CSV crops of the proposal. Algorithms for CSV crops were added to CM. Enabling CM users to track and receive decision support for the water and N use for these CSV. Algorithms were evaluated in field trials described in task 6.

Task 3: Evaluate accuracy of SIMS fractional cover and crop coefficient estimates for CSV fields using existing Normalized Difference Vegetation Index (NDVI) ground -truth data. This task was completed using previous canopy data collected at commercial vegetable sites between the years 2011 and 2013. To conduct the comparison, polygons were identified in each satellite image that corresponded to the actual field where ground measurements were taken. A total of 31 field sites and 76 SIMS canopy estimates were used for the analysis. The correlation between SIMS and ground measured estimates of canopy cover was highly statistically significant with an $R^2$ value of 0.87.

Task 4: Enhance SIMS fractional cover and crop coefficient algorithms for CSV. Based on the results of the SIMS analysis, project participants revised models used in SIMS for estimating the canopy cover of CSV crops. Specifically, the project team statistically fit quadratic polynomial equations to satellite and ground estimates of canopy cover by crop type. Regression fits for the various crop types ranged from 0.86 to 0.98 (Table 1). These equations could be used to improve the estimates of canopy cover from SIMS LandSat NDVI data.

Table 1 summarizes coefficients fit to equation 1 which estimated fractional cover based on SIMS LandSat satellite NDVI data for various specialty crop types grown on the Central Coast.

$$Fs = A \times G^2 + B \times G + C \qquad [1]$$

Where Fs = fractional cover estimated with SIMS, G = fractional cover determined on the ground with a NDVI digital camera, and A,B, and C were fitted coefficients.

Table 1. Summary of coefficients fit to quadratic equations relating satellite and ground estimates of canopy cover for CSV and strawberry crops

| Crop type | N | A | B | C | $R^2$ |
|---|---|---|---|---|---|
| peppers | | -0.336 | 1.1378 | 0.0725 | 0.96 |
| lettuce | | -0.718 | 1.4272 | 0.1031 | 0.86 |
| strawberry | | -0.5666 | 1.2519 | 0.1718 | 0.93 |
| broccoli | | -0.6587 | 1.4634 | 0.1271 | 0.98 |
| cauliflower | | -0.6585 | 1.2626 | 0.1825 | 0.88 |
| cabbage | | -0.1924 | 0.8148 | 0.2764 | 0.98 |
| cole crops | | -0.5666 | 1.2619 | 0.1718 | 0.93 |

n = number of sample comparisons, $R^2$ = regression coefficient

Task 5: Conduct software development for linking CM and SIMS tools. The UC programmers developed a WebAPI (application protocol interface) that allowed linkage with the SIMS tool. In addition, the California State University of Monterey Bay (CSUMB) collaborators developed a WebAPI for SIMS that allowed CM to attain estimates of canopy cover from LandSat Satellite images of commercial vegetable fields.

Task 6: Field test linked CM/SIMS tools in commercial CSV fields**.** Three commercial field trials were conducted during the last reporting period that compared CM guided approach to managing water and N fertilizer to the growers' standard practices. Trials were conducted in two commercial broccoli fields and one spinach field. Data was summarized.

Task 7: Conduct two workshops/trainings for growers and industry representatives on using CM tool. Results and progress of the project were presented at nine educational meetings between October 2014, and March 2015. A total of 458 participants attended these meetings which were held in Davis California, Woodland California, Fresno California, Reno Nevada, and Lynden Washington. In addition, trainings on using the CM tool were conducted in Watsonville, California on January 26, 2015 and in Salinas, California on March 31, 2015. The three hour workshops provided step-by-step training on using the CM tool for managing water and N in CSV. Approximately 70 participants attended these two workshops.

Task 8: Evaluate CM performance outcomes. Programmers for CM added capabilities to monitor the number of water and fertilizer events that users entered per month into the decision support tool. This capability allowed the project team to track user activity. CM use steadily increased during the last 5 years. CM provided more than 1,000 decisions per month during the peak of the growing season.

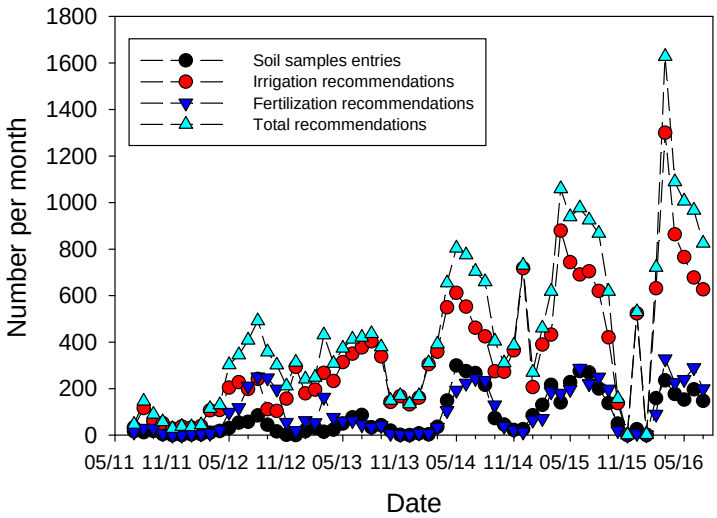


Figure 1. Monthly recommendations and soil sample entries in the CM database

This project solely benefited specialty crop commodities.

CSUMB and NASA partners were responsible for linking SIMS to CM. The Senior Research Scientist and Adjunct Faculty with CSUMB also led the data analysis comparing SIMS estimates of crop canopy cover to ground estimates.

## Goals and Outcomes Achieved

The performance goal for this project was to quantify that CSV growers were improving water and N fertilizer management.

Activities completed: The project leaders conducted three trials in commercial CSV fields to demonstrate potential fertilizer and water savings that could be achieved by using the CM tool to guide fertilizer and irrigation management. CM software was augmented to track usage of the online tool for making fertilizer and irrigation decisions. Growers who used CM were surveyed to determine how they had changed their fertilizer and water management practices. Additionally, an independent nonprofit agency surveyed growers who used CM to determine the usefulness of the software for improving irrigation and N fertilizer management.

The adoption of CM by central coast CSV growers was a long term goal of this project. There were more than 1,000 registered users. During the project, three field demonstration trials, two workshops, and more than ten presentations were completed in order to promote the use of the CM tool.

Field trials conducted during the project demonstrated that N fertilizer could be reduced by an average of 30% while maintaining yield and quality of CSV. This result met the target for the expected measured outcome outlined in the projects original proposal. Based on surveys of growers, user registration, and attendance at workshops, it was estimated that 5% of the CSV growers on the central coast used the online CM tool to help guide their fertilizer and irrigation decisions. This result met the short term benchmark of the project.

However, the project team hoped to continue to increase the use of the tool during the upcoming years through further outreach and improvements in the user interface.

As shown in Figure 1, CM provided approximately 400 fertilizer and water recommendations per month during peak production season before beginning this project. Use of CM steadily increased during the life of the project, providing as many as 1,400 recommendations per month during the same period in 2016.

The CM online decision support tool for fertilizer and water management was expanded to include broccoli, cauliflower, cabbage, and spinach. Field trials conducted during this project demonstrated that fertilizer N can be reduced by an average of 30% without significant impacts to yield or quality. CM registered users increased by approximately 40% during the project duration. Lastly, growers using CM reported reducing fertilizer N use by 20 to 30%.

## Beneficiaries

The beneficiaries of this project were CSV growers and shippers, and water users in the coastal valleys of California. CSV were produced on 331,633 acres on the coast and were valued at $2.13 billion annually. In Monterey County alone growers planted approximately 100,000 acres of broccoli, cauliflower, cabbage, and spinach with an estimated value of $860 million.

This project directly benefited the 1,015 registered CM users by increasing the number of vegetable commodities supported by this online decision support tool. The project also helped growers who used the CM tool to reduce fertilizer N by as much as 30% compared to their use of N before the project was implemented.

## Lessons Learned

The user interface for the CM software needed to be continually updated to match improvements in technology. Computer programming costs greatly increased during the project which required a shift in project funds to cover the extra costs. Grower adoption of online apps such as CM could be improved by providing an intermediate application that can streamline the user interface so that navigation within the application and data entry is simplified for field workers and farm managers.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 44 | **Project Title:** Creation of a Water Quality and Nutrient Management Training Program for California Strawberry Growers | |
|---|---|---|
| **Grant Recipient:** California Strawberry Commission | **Grant Agreement No.:** SBC13044 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Jason W Sharrett | **Telephone:** (805) 264-5250 | **Email:** jsharrett@calstrawbery.com |

## Project Summary

Agriculture is a significant contributor to impaired water quality in California's central coast region. The California strawberry industry which produces 88% of the United States' strawberries is the largest agriculture industry by value on the central coast. New water quality regulations affecting the region's growers in 2012 require the implementation of best management practices (BMPs) to reduce the negative impacts of agricultural production on water quality. Recent evaluations by experts from the University of California Cooperative Extension (UCCE), Monterey County, and California Polytechnic State University, San Luis Obispo (Cal Poly SLO), identified irrigation systems on many strawberry farms indicate poor distribution uniformity (DU) from inefficient system design and management practices. Some irrigation systems in these studies had DUs lower than 60%. Since strawberry growers in California utilize drip irrigation systems for application of fertilizers, inefficiencies not only waste water but also increase leaching of nutrients. Most irrigators on strawberry farms have no formal training in irrigation system operation, and training opportunities are extremely limited. Additionally, surveys of strawberry growers indicate most irrigation systems are designed and installed by on-farm employees with limited or no formal training on system design. To address these deficiencies, the California Strawberry Commission (CSC) developed and delivered a statewide-bilingual irrigation and nutrient management training program comprised of four classes that cover the basics of irrigation system management, basic system design principles, irrigation scheduling and fertigation management. This program is designed to equip strawberry growers and irrigators with the knowledge and skills necessary to establish and operate efficient strawberry irrigation systems to conserve water, apply nutrients effectively, and enable growers to comply with the new and emerging water quality regulations.

The timeliness of this project could have not been more perfect. The grant was approved in 2013, the same year in which a drought emergency was declared for the entire state and continues to persist today. In particular, strawberry growers in the Pajaro Valley and the Oxnard/Ventura area have experienced reductions in available water, increases in the price of water, and an overall decline in the quality of the irrigation water. The onset of the drought highlighted the importance of good water management as well as the need for training for the irrigators and ranch foreman. This was evident in the level of participation and demand for the classes during 2014 and 2015.

The project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

The following summarizes the activities performed during the grant period:

- Preprogram needs assessment: The CSC Grower Education Team completed this task by developing and implementing a project called Strawberry Water Assessment and Management Project (SWAMP). The goal of SWAMP was to assess the current state of water and nutrient management on strawberry ranches and determine the industry training needs related to irrigation and nutrient management. This project was designed and implemented by a team of irrigation and water quality experts assembled by the CSC grower education team. Through a collaborative process, the team successfully evaluated 15 ranches for the irrigation system DU. The team also carried out interviews with farm managers that communicated the results of the DU evaluation and explored the irrigation and nutrient management challenges and the training needs for the participating companies. The findings from this project helped to prioritize the training topics and serve as a baseline for the evaluation of the program effectiveness

- Curriculum Development: Project staff worked with project partners from the University of California Cooperative Extension (UCCE) to develop the training curriculum, hands-on demonstrations and decision support tools to address the irrigation and nutrient management challenges identified through the pre-project needs assessment. As a result, a total of four classes were developed. Each class was designed to last about four hours and includes both classroom and field based activities that highlight the BMP's that mitigate the common challenges with irrigation and nutrient management in strawberry production
    - Class 1- Irrigation System Operation and Troubleshooting: This class focused on the best practices related to irrigation system management which included activities and demonstrations that introduced the participants to standard operating procedures for managing and monitoring pressure/flow as well as steps to take when troubleshooting system performance.
    - Class 2- Irrigation System Design: This class focused on introducing participants to the irrigation design process which included an overview of the system components and the decision-making process, field demonstrations of common irrigation design challenges, as well as demonstrations for designing for common scenarios found in strawberry production. Some activities included field demonstrations that highlighted the core design principle as well as group activities that focused on designing irrigation blocks for strawberry production.
    - Class 3: Irrigation Scheduling for Strawberry Production: This classes taught participants how to make decisions related to when to irrigate and for how long. Participants learned about the concepts of evapotranspiration (Et) and soil moisture monitoring and how to use that information to make effective scheduling decision during different stages of crop development. Salt management was also a major topic in this class.
    - Class 4: Fertigation Management for Strawberry Production: This class covered the basics of plants nutrition, processes and procedures for calibrating injection equipment, and procedures for calculating injection time and rate. Field exercises reinforced these concepts and prepared participants for implementation on their ranches.

- Hosted trainings: 35 bilingual classes covering the above topics were offered throughout the strawberry growing regions including Watsonville/Salinas, Santa Maria and Oxnard. 700 individuals from 106 strawberry companies participated in the trainings during the grant. Of the participants, approximately 70% were irrigators, 25% ranch managers and 5% other.

- Field based interviews of workshop participants: Field visits/interviews occurred with a sample of program participants during the beginning of year 2 and were repeated during the last three months of the project. These field visits focused on collecting information regarding the implementation of pressure management practices that were shared as part of Class 1. The information collected during these visits served to establish a baseline of practice implementation for program participants as well as a means to measure the extent of practice implementation as the project progressed. Data from these activities serve to report on the overall outcomes for this project and will be reported later in this report.

- Follow-up DU analysis: Performance of 17 strawberry irrigation systems were evaluated in Watsonville/Salinas, Santa Maria and Oxnard districts. These studies were performed on 11 ranches that participated in the training classes and six ranches that did not participated in the trainings. Data from these follow-up evaluations have been analyzed and compared to the pre-program study to determine the extent to which the training programs is improving irrigation system management in the industry.

This project only benefited growers of specialty crops, specifically strawberries.

Partners in the project and their contributions are as follows:

- UCCE Monterey County - Supported the pre- and post-program assessment, curriculum development, and implementation of all the trainings.
- UCCE Ventura - Facilitated trainings in Ventura County and helped to develop curriculum for the irrigation scheduling class.
- Hanson Ag Center - Allowed free use of the facilities for all trainings in Ventura County.
- Hartnell College - Allowed free use of their Ag Technology campus for training in Salinas.

## Goals and Outcomes Achieved

Activities that were completed in order to achieve the performance goals and measurable outcomes defined in the approved project include the following:

1. Performed a pre-program analysis of the DU on 15 strawberry ranches. This analysis evaluated the design, performance and operation of the drip systems. The data from this study served to set the baseline performance as well as identify areas that should be focused on for the training program.

   During the last six months of the program, project staff and consultants completed a follow-up DU evaluation on 17 ranches. For this round of evaluation, 12 of the evaluated ranches had participated in the training and five ranches had not participated. Results from this evaluation were compared to the study completed in 2013 to measure the impact the program had on the program participants. For both the pre- and post-program assessment, ranches were chosen at random.

2. Field visits/interviews with a sample of program participants occurred during the beginning of year 2 and were repeated during the last three months of the project. These field visits focused on collecting information regarding the implementation pressure management practices that were shared as part of Class 1. The information collected during these interviews/observations served to establish a baseline of practice implementation for program participants as well as a means to measure the extent of

practice implementation as the project progressed. Data from these activities serve to report on the overall outcomes for this project and will be reported later in this report

The outcome measures set forth in the project were limited to the timeframe of the proposal. Nonetheless, as with all educational and training program it can be expected that information and practices will be implemented on an ongoing basis into the future. As an example, many of the participants during the last 12 months of training may not be able to implement the recommend practices until the beginning of a new cropping cycle.

- The goal of this program was to equip growers with the with the knowledge and skills necessary to establish and operate efficient strawberry irrigation systems that conserve water, apply nutrients effectively, and enable growers to comply with water quality regulations. From a program design standpoint, this program was able to develop the core curriculum, target it to the right audience and deliver it directly to 700 strawberry industry employees from 106 companies during the course of the project. This accomplishment falls short of the original target that called for participation from 280 farms reaching 70 percent of the California strawberry industry. While the project fell short on the participating companies, the actual % of strawberry acres impacted from the project was at least 70%. There are an estimated 400 strawberry growers, however, more than half of those growers have ranches of less than 25 acres. The majority of the participation in the program occurred with companies who have multiple ranches and control a greater percentage of strawberry production in the state. In retrospect, the participation indicator should have been acres impacted rather than the number of companies that participated.

- Project staff also planned and carried out two program monitoring activities to measure the extent to which the program participants changed behaviors as a result of participation in the training program. The first activity was a needs assessment at the beginning of the project to establish the baseline performance of strawberry irrigation systems by using DU as the metric. Then towards the end of the program, a similar study was completed to measure the impact the program had on the company. The second activity called for performing field based interviews of a sample set of program participants after the training to measure the extent to which the companies were adopting the practices shared in the training classes. For the field interviews, the primary focus was on the information share during the pressure management class since this was the most highly attended class with the clearest set of practices that could be implemented on any ranch and required less skill to implement.

  The project outcomes and results follow:
  - Outcome #1: California specialty crop strawberry farms participating in the training program will indicate improved DU of irrigation systems through implementation of BMPs for drip irrigation system design and operation.
    - Benchmark: 90% DU for irrigation systems that participate in the program.
    - Baseline Results: From the SWAMP study that was completed in first months of the project, it was established that the average DU for the 15 evaluated ranches was 83%. This number is higher than 75% average that was provided by the UCCE based on their own studies. As a result, project staff decided to reset the target DU from the 85% to 90% for ranches participating in the program.
    - Follow-up results: The average DU for the 17 ranches that were evaluated at the end of the project was 83%. This is exactly the same DU as was measured during the initial SWAMP

study. Of the 17 ranches that were evaluated, 12 participated in the training program and 5 had not participated. When comparing the average DU for these two populations, the average DU for the non-participating group was nearly 7% lower than for the group that participated. It is also worth mentioning that the DU varies significantly from the beginning of the season to the end of the season. For the initial baseline study in 2013, the evaluation was completed in January, very early in the production season. Due to some scheduling delays in the project, the follow-up DU study was not able to be completed in the Oxnard region until mid-May towards the end of their production season. As expected, ranches in Oxnard showed a much higher rate of plugging than was measured in the initial study. Plugging is a common problem that impacts irrigation systems as the season progresses. If a system exhibits plugging, then the DU tends to be very low. Despite the four additional months, the average of 78% for the ranches in Oxnard in 2016 was exactly that same as 2013. If plugging had not been a problem, the average DU would have likely been closer to 86%. This would represent a significant improvement in the irrigation systems for that region.

- Outcome 2: California specialty crop strawberry farms participating in the program will increase implementation of BMPs for irrigation system operation. The primary indicator for this outcome is the percent of participants that are monitoring pressure using the BMPs shared during the first class. This includes using a single, reliable pressure gauge with a Schrader valve adapter to measure pressure at the irrigation block valve with every irrigation.
    - Benchmark/Target: To increase BMP implementation on 90% of the farms participating in the program.
    - Baseline: At the beginning of the project only 17% of the surveyed farms fully implemented the pressure monitoring practice while 58% implemented some elements of the practice but not all. The remaining 25% did not implement any part of the practices.
    - Follow-up Results: For the 11 ranches that participated in the training and were surveyed in 2016, 41% were fully implementing the pressure monitoring protocol after participating in the irrigation training. This represents a 60% increase over the baseline but falls well short of the very optimistic target of implementation by 90% of the participating rans. Of the six non-participating ranches, not a single ranch fully implemented to pressure monitoring protocol.

The most successful outcome of the project was when the results from the two outcomes are compared. The DU of the five ranches that participated in the training and implemented the practices on the ranch, their average DU was 89%. This is well above the overall average of 83% when looking comparing the performance of all the ranches. This suggest that the practices that are the focal point of the trainings are targeted at the right practices that achieve improvements in irrigation system performance and that targets set for system improvement are realistic. The challenge moving forward will be to look at the reason the different participants are not implementing the practice and provide the support necessary at the ranch level to overcome those challenges.

## Beneficiaries

The direct beneficiaries of the program were the approximately 400 California strawberry growers and irrigators. Efficient irrigation systems lead to cost savings for growers by conserving water and nutrients. Through participation in the program, growers will be able to comply with current and

emerging regulations. Specific groups and other operations that benefitted from the completion of this project's accomplishments are described below:

- Irrigators (70% of participants)
  - –The average strawberry irrigator is:
    - Only speaks Spanish
    - 38 years old
    - 11.5 years on the job
    - 5.7 years of education
    - Responsible for an average of 121 acres of strawberries
    - Works a 12-hour day
  - Strawberry Ranch Managers - 20% of participants
  - Growers (Owner/Operators) – 5% of participants

Over the course of the project, 700 individuals from 106 strawberry companies participated in 35 classes.

## Lessons Learned

Project staff learned that:

- Bilingual training is key: The trainers have to speak Spanish. Interpretation is simply not an effective way to engage a group of irrigators. During the first year of this project, some trainings were presented in English and interpreted to Spanish by an interpreter using headsets and some training were presented 100% in Spanish. Without fail, the classes that were presented in the native tongue of the participant generated more discussion and questions from the participants. After the first year of training, project staff worked with consultants to make sure all content could be presented in Spanish. Then based on demand, project staff would organize a training for English speaking participants.

- Get out of the classroom and into the field: Interactive-hands-on training is critical for these topics and audience. The majority of irrigators that participated in the trainings have very little formal education but have decades of experience in farming. Therefore, it is imperative find ways to teach the complex subjects of irrigation and nutrient management in a way that is meaningful, engaging and respectful of their life experience. This program was successful at this by providing a mix of hands-on training coupled with in class activities/presentations. More than half of each of the four classes were taught using a demonstration irrigation system that was designed by project staff and consultants to highlight the core challenges as well as the best practices that were the focus of the training program. While this style of training is certainly more labor intensive, it is necessary to cover these subject in a way that will engage the participants.

There were some unexpected outcomes that were an effect of implementing this project, which follow:

- A model for training in the state: The irrigation and nutrient management training program has attracted attention of other industry groups, academia and farm advisors. Project staff receive requests to speak at meetings or to host a training somewhere in the state. There has also been some discussion among farm advisors across the state to use the model of training developed through this program to create a statewide

training curriculum for irrigators and ranch managers. The bottom line is that there is a real need for the type of training that was developed in this grant. While project staff are somewhat limited to working within strawberries, the curriculum developed will be made available to anyone that is interested.

The project team was able to achieve most of the tasks and activities for the grant but did not necessarily fully achieve the outcomes that were set forth at the beginning of the grant.

- More meaningful metrics: More focus on the acres implementing the practice rather than the number of companies participating. This is a direction all of the CSC training programs have been moving in during the last couple years. As the strawberry industry is consolidated, the number of companies are decreasing while the acreage for each company is increasing.

- Timing: Timing is everything for this type of training. Project staff constantly ran into barriers with scheduling training due to the complex nature of the production cycles throughout the state. Project staff found it much easier to get a group from one company to meet for a day than to get them to commit to four classes over two days at a central location.

- Provide follow-up support: This program reached a broad range of strawberry companies throughout California. While some companies implemented some of the practices from the training, the project did not achieve the desired level of implementation. Some reasons for this could be the inability for the participants to apply what they learn from a demonstration system (theoretical system) and apply that to the system on their ranch or more simply could be that the boss was not at the training and has not told the irrigator to do it. These reasons and many others were discovered while doing the follow-up irrigator surveys and DU studies. These follow-up visits almost always generated questions or some desire for clarification on the practices taught in the training. This presented an excellent opportunity for the project staff to review the BMP's from the training and use the irrigators' own system to demonstrate the practices. This type of follow-up not only helped the irrigator but also helped to establish dialogue with the grower and/or ranch manager that may not have attended the training, and provides an opportunity to share practices taught in the training and how they can benefit from implementing them. In any future training, this component will be built into the program design.

## Additional Information

Website to access training presentations and decision support tools. http://tools.calstrawberry.info/

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 45 | **Project Title:** Temecula Valley Winegrower Research and Demonstration Project | |
|---|---|---|
| **Grant Recipient:** Rancho California Water District | **Grant Agreement No.:** SCB13045 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Justin Haessly | **Telephone:** (951) 296-6942 | **Email:** haessly@ranchowater.com |

## Project Summary

The Temecula Valley Winegrower Research and Demonstration Project (Project) was a pilot project that focused on the use of technologies for implementing Regulated Deficit Irrigation (RDI) as a best management practice in Temecula Valley winegrowing operations. The purpose of the Project was to help local winegrape growers understand how RDI could help them to enhance their water use efficiency while improving the quality of their red winegrape varieties. The Project included research that 1) quantified the amount of water required for producing high quality red winegrapes in the Temecula Valley, and 2) monitored soil salinity under varying irrigation conditions to gauge its effects on red winegrape quality. The Project also included demonstration to local growers of the methods employed for implementation of effective RDI programs.

Rising imported water costs threaten the economic viability of regional winegrape vineyards. The cost for Rancho California Water District (RCWD/District) to purchase imported water has more than doubled since 2004; the cost has been passed through to vineyard owners who experienced a rate increase of 109 percent over the past decade. This increase significantly outpaces the growth in value of the regional winegrape crop (up 55 percent over the last 10 years), and poses a difficult business challenge for growers. Adoption of RDI practices promoted through implementation of the Project could decrease water costs for growers, thereby helping them to remain in business.

Another potential challenge for regional vineyards involves water quality. Increases in salinity of water provided by RCWD are likely due to a change in source blend. Historically, half of RCWD's imported water demand was met using California Bay-Delta imports; however, this source has become limited due to drought and environmental restrictions. As a result, a blend of Colorado River water with higher amounts of salinity is used. Research indicates vineyard performance is adversely affected by salty irrigation water, and in theory, long-term implementation of RDI practices could contribute to increase salt deposition into soils. Therefore, the Project examined salt content within the vineyard research areas where RDI was implemented to determine whether or not soil salinity increased during the Project timeframe.

The project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

One vineyard site was chosen as the location for Project implementation. A single irrigation block from the site was divided into three sub-blocks, each of which was retrofitted to include an automatic meter reading (AMR) sub meter, a control valve, and an automatic irrigation controller. Wireless telemetry technologies were installed within each sub-block, including soil moisture and salinity monitoring probes. Each sub-block represented a different research treatment, and was irrigated according to a different RDI method:

1. The first treatment was irrigated at 50% of evapotranspiration (ET) throughout the growing cycle

2. The second treatment was irrigated at 50% of ET between fruit set and verasion, at 10% of ET from verasion through harvest, and at 100% of ET from harvest through leaf senescence.
3. The third treatment was irrigated at 10% of ET from fruit set to verasion, at 50% of ET from verasion through harvest, and at 100% of ET from harvest through leaf senescence.

Wireless telemetry technologies installed in the test blocks were used to remotely track water consumption, soil moisture data, and soil salinity data for each of the research treatments. Weekly site visits were conducted for assessment of irrigation system performance, for determining irrigation frequency requirements, and for collecting data related to vine growth and fruit quality. Upon harvest, fruit from each of the treatment blocks was used to make wine for determination of wine preference.

The overall scope of the project did not benefit commodities other than specialty crops.

The Project partners included RCWD, Riverside County's University of California Cooperative Extension (UCCE Riverside), South Coast Winery (SCW), and the Temecula Valley Winegrowers Association (TVWGA). Following are the contribution to the Project made by each of these partners:

*RCWD:* As Project Manager, RCWD directed implementation of the Project. Specific contributions of RCWD included identification of the research site, oversight of irrigation system installation/retrofits at the research site, implementation of RDI irrigation methods for each research treatment, tracking and analyzing water consumption at the research site, scheduling and conducting demonstration activities.

*SCW:* As Project partner, SCW provided one acre of mature Tempranillo grapes within their existing vineyard operation for conducting the research, and provided a staff member who, for the first year of the Project, participated in the collection of vineyard research data. In addition, they provided testing services for quantifying winegrape quality, fermented and bottled finished wine from each of the research treatment areas, and provided testing services for wine phenolics (i.e. the measurement of phenolic compounds in finished wines). SCW also presented the results of the Project research at the Wine Innovation and Quality Conference held in Napa, CA in both 2014 and 2015. Another very significant contribution to the Project by SCW pertains to the role they played in publishing a two-page written article about the Project in the July 2016 edition of *Wine Business Monthly*, a publication for wineries and growers, titled *Winemakers Trials: Deficit Irrigation Early in Season Saves Water and Improves Red Grape Quality.* (*http://www.winebusiness.com/wbm/?go=getArchives&pubYear=2016*)

*UCCE Riverside:* As Project partner, UCCE Riverside participated in the design of the research study and enlisted the assistance of the University of California Davis for helping with the design. UCCE Riverside provided input on how the Project should be implemented, analyzed data collected as part of the study, and participated in one of the demonstration workshops. UCCE Riverside also provided a Staff Research Assistant who, for the second year of the Project, participated in the collection of vineyard research data.

*TVWGA:* As Project partner, TVWGA allowed the Project team to present the results of the Project at their annual Temecula Grape Day event. In addition, they assisted with the advertisement of demonstration workshops.

## Goals and Outcomes Achieved

The activities that were completed in order to achieve the Project's performance goals and measurable outcomes include the following:

*Identify Research Site*
RCWD identified South Coast Winery's vineyard as the location for where the Project would be implemented. Further, RCWD worked with SCW and the University of California Davis to identify a one-acre block of Tempranillo grapes as the specific area within the vineyard that would be used for research purposes.

*Retrofit Site for Research Capabilities*
RCWD hired a contractor to retrofit the irrigation system within the block of Tempranillo grapes chosen for the research to accommodate the research study design. RCWD also hired a separate contractor to install wireless telemetry devices within the research area for enabling the remote collection of Project data. Lastly, RCWD staff installed water sub-meters for each of the research treatments.

*Conduct the Research*
RCWD partnered with South Coast Winery and UCCE Riverside to conduct the research. RCWD implemented the RDI schedules, monitored soil salinity, and analyzed water consumption for each research treatment. Both SCW and UCCE Riverside participated in the collection and analysis of vineyard data throughout two growing seasons including stem water potential, shoot growth, canopy shaded area, and harvest weights. SCW performed laboratory analysis of fruit quality prior to harvest. These data included total acidity, pH, and Brix. Lastly, SCW created finished wines for each of the research treatments and conducted blind taste tests to measure preference for the wines created from each research treatment.

*Conduct Demonstration Workshops*
A total of four workshops were conducted, two of which took place in Temecula, CA, and the other two in Napa, CA. In Temecula, CA, RCWD, SCW, and UCCE Riverside presented the results of the Project at Temecula Valley's annual Grape Day Festival in 2014, and at RCWD Headquarters in Temecula in 2015. In Napa, CA, SCW presented the results of the research at both the 2014 and 2015 Wine Innovation and Quality Conference.

Outcomes projected for the Project include: 1) decreasing winegrape growers' investment in crop production through decreased irrigation water purchases, and 2) increasing the value of their crops (i.e. wine quality improvements) through implementation of RDI strategies. While the Project proved that these outcomes were possible on the property where the research was conducted, it is going to take time for the winegrape growers within the Temecula Valley to learn how to implement regulated deficit irrigation and to adopt the strategy as a best management practice. RCWD will continue to provide outreach about RDI to the local winegrape growing community to encourage its adoption through dissemination of information and through implementation of more projects that demonstrate the implementation of RDI through use of emerging technologies.

The goals established for the Project included: 1) researching the minimum quantity of water required for producing high quality specialty crop red winegrapes in the Temecula Valley, 2) monitoring soil salinity under varying irrigation conditions to gauge its effects on red wine grape quality, 3) demonstrating to local growers methods used for implementation of effective RDI programs, and 4) transferring knowledge gained through the research to the regional winegrowing community through a demonstration effort consisting of three workshops. Following is a summary of the work that was performed to support these goals:

*Research Water Quantity*
One vineyard site was chosen as the location for Project implementation. A single irrigation block from the site was divided into three sub-blocks, each of which was retrofitted to include an AMR sub meter, a control valve, and an automatic irrigation controller. Each sub-block represented a different research treatment, and was irrigated according to a different RDI method:

1. The first treatment was irrigated at 50% of ET throughout the growing cycle.
2. The second treatment was irrigated at 50% of ET between fruit set and verasion, at 10% of ET from verasion through harvest, and at 100% of ET from harvest through leaf senescence.
3. The third treatment was irrigated at 10% of ET from fruit set to verasion, at 50% of ET from verasion through harvest, and at 100% of ET from harvest through leaf senescence.

Wireless telemetry technologies installed in the test blocks were used to remotely track water consumption. Weekly site visits were conducted for assessment of irrigation system performance, and for determining irrigation frequency requirements.

*Monitor Soil Salinity*
Soil salinity was monitored within each of the research treatment areas through use of soil probes in conjunction with wireless telemetry technology and through collection of soil samples that were sent to a laboratory for analysis.

*Demonstration & Knowledge Transfer*
Demonstration and knowledge transfer were accomplished through the completion of four workshops, two of which were conducted in Temecula, CA and two of which were conducted in Napa, CA.

The Project's expected measurable outcome was improved viability of the region's winegrape economy. This outcome was to be achieved through decreasing winegrape growers' investment in crop production and increasing the value of their crops through implementation of RDI strategies. The targets were to decrease the investment in crop production, achieve a 29% reduction in applied irrigation water and to increase crop value by 25% through wine quality improvements. The research conducted as part of the Project showed that through implementation of RDI, application of irrigation water could be reduced and wine quality could be improved.

*Reduced Application of Irrigation Water*
In 2013, the year prior to the Project implementation when RDI was not being used as an irrigation strategy at the property where the research was conducted, water use at the property was 1.09 acre feet per acre (AF/acre). In 2014 and 2015, within the portion of the property where the research was implemented, water use was reduced. Actual water use for the research area was variable depending on the RDI treatment used.

The following table shows water use for each of the research treatments during 2014 and 2015 and how it compared to water use during 2013:

| Year | Treatment | Water Use (AF/Acre) | % Change From 2013 |
|---|---|---|---|
| 2014 | Sustained RDI | 0.94 | -14% |
| | Post-verasion RDI | 0.80 | -27% |
| | Pre-verasion RDI | 0.81 | -26% |
| 2015 | Sustained RDI | 0.86 | -21% |
| | Post-verasion RDI | 0.65 | -40% |
| | Pre-verasion RDI | 0.69 | -37% |

For the pre- and post-verasion RDI treatments implemented during 2015, the target for reductions in irrigation water applications was exceeded. Overall, the water consumption data shows that the targeted 29% reduction is achievable for growers who adopt RDI as a management practice.

It is likely that the adoption of the practice among Temecula Valley growers will be a long-term process that will extend beyond the term of the grant agreement. For this reason, it is difficult to measure precisely the water savings that occurred beyond those realized at the research site as a result of the Project. However, the Project team did perform a comparative analysis of usage between the year prior to Project implementation (2013), and the two years following Project implementation (2014 and 2015) among winegrape growers within the Temecula Valley to whom the Project results were advertised to identify changes in water use that may be attributable to the Project efforts. The following table shows aggregated water use for Temecula valley winegrape growers during 2014 and 2015 and how it compared to water use during 2013:

| Year | Crop | Water Use (AF/Acre) | % Change from 2013 |
|---|---|---|---|
| 2013 | Winegrapes | 1.69 | N/A |
| 2014 | Winegrapes | 1.82 | +8.4% |
| 2015 | Winegrapes | 1.49 | -11.4% |

These water use data were obtained from meter reads taken from water meters that serve winegrape growing properties. These usage data were adjusted for differences in weather and total irrigated acreage between each of the growing seasons. The data shows that there was an 11% decrease in usage in 2015 (the year when most of the outreach regarding the Project took place) when compared to 2013. However, the data has its limitations.

Because some of the water meters serving winegrape growing properties also supply water to winemaking facilities and ornamental landscapes, true vineyard water use at those properties could not be isolated from total water use including facilities and landscapes. In addition the effects of drought regulations imposed during the Project period on water use could not be quantified. Despite the limitations of the data, the Project team, based on information it does know, is confident that the Project had a positive effect upon water use efficiency within the winegrape growing community.

It is RCWD's goal to assure all growers within the Temecula area that RDI is the best irrigation practice. Therefore, RCWD will continue to advertise the results of the research and to encourage the adoption of RDI well into the future.

*Wine Quality Improvements & Increased Crop Value*
For the wine quality research component of the Project, three different wines were fermented under identical conditions from the grapes harvested within the researched block of Tempranillo grapes. Each of these wines corresponded to a research treatment (i.e. a different RDI strategy). In addition, wine was made from an adjacent block of Tempranillo grapes that was irrigated according to the grower's normally implemented irrigation schedule. These four types of wines were made following the 2014 and 2015 harvests.

For both the 2014 and 2015 harvest years, these wines were served to wine makers from all over the State of California during a blind taste test. In both years, the preference among the wine makers was overwhelmingly in favor of the two research treatments for which the most aggressive forms of RDI were implemented (i.e., the least amount of water was used). Additionally, the least preferred of the four wines was that made with the grapes harvested from the block of grapes adjacent to the research trial, which had been irrigated according to the grower's normal irrigation schedule.

In terms of increased crop value, neither the grapes used to make these wines, nor the wines themselves were sold at market, so it was not possible to measure increases in dollar value for the research block. However, the winemaker who makes the Tempranillo wines indicated that they could charge 25% more for the wines that were preferred during the blind taste tests. Other methods that could be used to measure changes to the value of local crops that resulted from implementation of the Project include: 1) taking a survey that asks growers to provide crop value information, and 2) using data from the Riverside County Crop Report to ascertain changes in the value of Riverside County winegrapes on a dollars per ton basis. It was learned during Project implementation that the first option is not a viable one since winegrape growers will not reveal contracted crop value amounts for proprietary reasons. The second option could be used; however, the 2015 Riverside County Crop Report is not yet available. In its endeavors to continue the research beyond the term of the grant agreement, RCWD will look at effective ways to measure changes in crop value.

The major successful outcomes of the Project include:

1. The Project research proved that high levels of water savings could be achieved through implementation of RDI.
2. The Project research proved that winegrapes grown using less water and more aggressive forms of RDI produced finished wines of better quality within the researched areas.
3. While the results of the Project were intended to be advertised primarily to winegrape growers within the Temecula Valley, they ended up being featured at the prestigious Wine Quality and Innovation conference in Napa, CA for two consecutive years. In addition, a discussion of the results was published in *Wine Business Monthly*, the industry's leading publication for wineries and winegrape growers. This extra advertisement resulted in outreach being conducted beyond the scope of the Project, which could lead to statewide benefits.

## Beneficiaries

The Project is designed to result in more efficient water use and water savings among RCWD's agricultural customers. Furthermore, increased water use efficiency and water savings in one customer class benefits all RCWD customers through improved District-wide water supply reliability. Therefore, the beneficiaries of the Project include all of RCWD's 44,430 customers including its agricultural, residential, commercial, and landscape customers. In addition, since the Project results have been presented to winegrape growers from different parts of the State of California, the Project beneficiaries include water users statewide.

At a minimum, the beneficiaries of the Project include all of RCWD's 44,430 customers including its agricultural, residential, commercial, and landscape customers. All of RCWD customers benefit from the Project because efficient water use and water savings in one customer class (i.e. agricultural customers) benefits all customers through improved District-wide water supply reliability and rate stabilization. In addition, since the Project results have been presented to winegrape growers from different parts of the State of California, the Project beneficiaries include water users statewide.

## Lessons Learned

Overall, the Project team learned that the regulation of grapevine water status throughout the lifecycle of the vine is an important tool to use for the management of winegrape and wine quality. The project team learned that RDI has no short-term detrimental effect on grapevine development or grape quality in the Temecula region and that the red wine made from grapes grown under RDI conditions were actually preferred by winemakers.

The Project was originally intended to benefit only water users within RCWD's service area; however; interest in the Project grew beyond this area and into the northern part of California. The results of the Project were presented twice, once in 2014 and once in 2015, at the Wine Innovation and Quality Conference held annually in Napa, CA. In addition, an article was written and featured in the July 2016 edition of *Wine Business Monthly*, the wine industry's leading publication for wineries and winegrape growers, detailing the results of the Project. Because of the expanded area to which the results of the Project were demonstrated, it can be said that it has benefited winegrape growers throughout the State of California.

The original intent of the Project was to conduct research on RDI, advertise its results to local winegrape growers, have them adopt RDI based on the positive research results, and then measure the water savings and crop value benefits achieved by those growers who adopted RDI. The Project team learned that the expectation for growers to adopt RDI within the two-year Project term was overly optimistic. Convincing local winegrape growers to adopt RDI is going to be a long-term effort that will extend beyond the duration of the Project. For this reason, RCWD will continue to advertise the results of the research and to encourage the adoption of RDI well into the future.

In addition, the RCWD will continue to conduct research on RDI, the results of which will also be used to encourage the adoption of RDI by local winegrape growers. These future research efforts involve the deployment of sap flow monitoring devices and associated software in Temecula Valley vineyards. The devices will be used to further research the effectiveness of the three methods of RDI that were implemented as part of the Project, and to advertise the effectiveness of the RDI methods in increasing water use efficiency and enhancing finished wine quality. The idea behind this continued research effort is to find better and more

accurate ways to quantify vine water deficit for the purpose determining more precise irrigation frequency and runtimes as they pertain to RDI implementation (i.e. better RDI). The hope is that through implementation of the devices, water use efficiency can be increased beyond the levels realized within the Project's research block and finished wine quality can be further improved. Through this longer term research and demonstration effort, the RCWD anticipates that more local winegrape growers will adopt RDI practices.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 46 | **Project Title:** Improving Water Quality in California Nursery Crops using Polyacrylamide | |
|---|---|---|
| **Grant Recipient:** University of California, Davis | **Grant Agreement No.:** SCB13046 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Steve Tjosvold | **Telephone:** 831 763-8013 | **Email:** satjosvold@ucanr.edu |

## Project Summary

Water quality is impacted by the production of nursery crops when nutrients, pesticides, and sediment run off site. Directly and indirectly these pollutants may impact surface and ground water, fish and wildlife, and the overall quality of the environment. The California nursery industry is a large intensive industry often located in environmentally sensitive areas. The industry is regularly one of the highest users of fertilizer nutrients and pesticides per acre of any other California agricultural crop. Sediment from potting soil and nursery beds commonly enter waterways in water runoff and leads to siltation, which is the leading cause of water quality problems in rivers.

Cost-effective management tools need to be developed to help mitigate water quality issues associated with the nursery industry. Many trials in field crops have shown that linear anionic polyacrylamide (PAM) can significantly reduce sediment, nutrient, and pesticide water pollution. However, PAM has not been tested for this purpose when applied as an amendment in potting soil used in nursery production. This novel method of applying PAM needed to be evaluated and optimal PAM rates for potting soils determined.

Federal and California water quality regulations require that nurseries implement practices to minimize impairments to water quality. Total Maximum Daily Loads (TMDL) of nutrients, pesticides and sediment have been adopted by the Central Coast, Los Angeles, and San Diego California Water Quality Control Boards (RWQCB) where most of the nurseries are located. In the Central Coast RWQCB, a recently updated agricultural order stiffened regulations for discharge of these pollutants into surface water bodies on the Central Coast.

Many nursery operators have limited options to improve mitigation efforts. The use of retention ponds and recycling can control irrigation tail water, but these practices can be expensive and may not be suited for all nurseries since they require a significant amount of land to move and contain runoff. Nursery operators can use drip irrigation for 15 gallon or larger pots to increase irrigation efficiency and reduce runoff. But drip irrigation is not practical for the most commonly produced 1 gallon and 5 gallon potted plants since these plants are moved frequently and would require a complex system of individual irrigation tubes for each pot. Cost-effective management tools need to be developed and PAM as a soil amendment needed to be evaluated.

This project did not build upon a previously funded SCBGP project.

## Project Approach

Activities were performed to address the following objectives:

(1) Determine optimal PAM rates in potting soils that reduce turbidity, total dissolved solids, and nutrient loss in pot leachate.

(2) Ensure that the selected range of PAM concentrations are compatible with nursery crops and determine PAM residual effect and release rate into soil leachate.
(3) Ensure that the selected range of PAM concentrations are compatible with nursery crops and determine PAM residual effect and release rate into soil leachate.
(4) Determine PAM impact on water quality in nursery field trials
(5) Transfer information to growers through local and statewide presentations, newsletters, and other publications.

Final Approved Activities and Timeline in Work Plan with Results and Conclusions:

| Activities | Timeline | Results and Conclusions |
|---|---|---|
| Leachate from PAM-treated and untreated pots will be measured every two weeks for water quality factors. | Oct 2013-Jun 2014 | Desirable ranges of PAM were found in the range of 25 to 400 grams per cubic meter of soil based on significant lowering of turbidity, turbidity and total soluble solids (TSS), soluble phosphorus (P) and total P with potting soils containing some sand. This desirable effect was not found with potting soils with mostly organic products. PAM at desirable ranges was found to moderately increase water holding capacity of potting soil. This could be desirable in some potting soils and crops. |
| Potting soil will be sampled, chemical and physical properties measured twice | Oct 2013-Jun 2014 | |
| Growth and development characteristics will be measured every two weeks in a nursery crop grown from planting to a saleable stage in potting soil treated with the range of the PAM rates.<br>Plant water use will be carefully evaluated during the trials.<br>Soil settling and total porosity will be measured at harvest. | Jul 2014- Jul 2015 | Three nursery crops species (*Epilobium*, *Heterotheca* and *Gaura*) were grown from planting to harvest in a commercial nursery with various desirable PAM rates. No adverse effects were observed and no significant differences in fresh and dry weights were found at harvest between untreated and PAM-treated plants.<br><br>Growth and plant quality measurement were made on an *Osteospermum* crop grown in a research greenhouse.<br><br>Additional growth measurements were made in the final commercial nursery experiments with lavender (*Lavandula*) crops. Again, no differences were found between untreated and PAM-treated plants at the 100 gram rate. |

| Activities | Timeline | Results and Conclusions |
|---|---|---|
| PAM concentration will be measured periodically in the pot leachate. | Jul 2014- Jul 2015 | Data indicated that most of the measurable PAM could be detected leaching in the first ten irrigations. PAM in leachate measured up to 100 ppm at the 400 gram rate. Additional measurements in the final field experiments also confirmed this leaching rate for the 100 gram rate.<br><br>PAM concentrations were determined in an *Osteospermum* crop at the first irrigation, mid-point of cropping, and at harvest. PAM was only detectable at the first irrigation. |
| Turbidity measured from leachate collected from 5 soil mixes with various portions of sand. Pots will be treated with various rates of PAM. | July 2015- Sept 2015 | PAM decreased turbidity of leachate with increasing portions of sand in a redwood potting soil. The effect was seen in soils containing from 5 to 20% sand with the largest effect at 15% sand. The desirable effect increased with increasing PAM rates. |
| Leachate from treated pots will be collected and measured for turbidity over successive irrigations in a simulated nursery system. | Oct 2015 – Feb 2016 | |
| Collect runoff water periodically from replicated and randomized PAM-treated and untreated plants/blocks from three nurseries. Turbidity, total suspended solids, nutrients and PAM concentration will be measured every two weeks in leachate from individual pots and collectively as tailwater from plant blocks. | Feb 2016-May 2016 | PAM significantly decreased turbidity and TSS of leachate in potting soils containing sand. PAM significantly decreased total and soluble phosphorus in soils with sand and in one soil with mostly organic products. No differences were found between treated and untreated pots for any of the tested nitrogen factors (nitrate, ammonium, and organic nitrogen). |
| Dissemination of project results at industry meetings and workshops. Grower articles and newsletters published. Meeting and grower attendance, industry newsletters, and associated contacts will be continued. Final project results will be written for scientific publications (late 2016), and expected to be published (early 2017). | Jul 2015-Jun 2016 | Four presentations were given:<br>1.January 22, 2015 – 26 growers in Watsonville, California<br>2.March 8, 2015 – 22 academic colleagues at the University of California, Davis<br>3.September 29, 2016 – 30 growers in Watsonville, California<br>4.October 25, 2016 – 85 attendees in Watsonville, California<br><br>The scientific publication was started and expected to be published in early 2017. |

The overall scope of the project solely benefited specialty crops.

Significant contributions were made by:
The University of California Cooperative Extension (UCCE), Watsonville's Staff Research Associate, involved with implementation, evaluation, and planning.

UCCE, Salinas's Water Quality Farm Advisor was involved with evaluation of data and planning.

The United States Department of Agriculture, Idaho was involved with PAM analysis and quantification of leachate samples.

Suncrest Nursery, Watsonville, California provided commercial nursery beds and potting soil for field evaluations.

Monterey Bay Nursery, Watsonville, California provided commercial nursery beds and potting soil for field evaluations.

Berger (formerly Sunland Garden Products), Watsonville, California provided commercial custom soil mixing facilities to formulate our soil mixes for all experiments.

## Goals and Outcomes Achieved

All goals indicated in the Performance Monitoring Plan, with some modifications in protocols, were accomplished. The project team was able to add a few additional activities to the overall Work Plan: Because PAM had unexpected and desirable water holding capacity, plant water use was carefully evaluated in greenhouse plant growth and development studies. The reduction of soil settling was another unexpected and desirable observation made, and this was also measured at harvest. Since observations indicated that soil mixes containing portions of sand were most favorably affected by the addition of PAM, an evaluation of soil mixes with five different portions of sand were evaluated with six PAM rates and leachate turbidity measured at each of ten irrigations.

With respect to the Expected Measurable Outcome, the water quality in field plots was measured with and without PAM, in different soils, at two different nurseries with a total of eight field plots. It was originally expected this evaluation to occur at three nurseries with a total of six field plots.

Performance Monitoring Plan showing a comparison of actual goals and Activities, versus accomplishments:

| Goals | Activities | Accomplishments |
|---|---|---|
| The project team will expect to determine a useful range of PAM rates. | Periodically leachate from PAM treated and untreated pots will be measured for turbidity, TSS, total N, NO3-N, total P, and soluble P Oct 2013 to Jun 2014 | Desirable ranges of PAM were found in the range of 25 to 400 grams per cubic meter of soil based on significant lowering of turbidity, TSS, soluble P and total P with potting soils containing some sand, however, not with potting soils with mostly organic products. |
| Evaluate properties of potting | Potting soil will be | PAM at desirable ranges was found to |

| | | |
|---|---|---|
| soils evaluate PAM compatibility with conventional crops. | sampled and chemical and physical properties will be measured periodically.<br>Oct 2013 to Jun 2014 | moderately increase water holding capacity of potting soil. This could be a very desirable characteristic in some potting soils and crops. |
| Ensure optimum health and quality plant growth and development with selected PAM rates. | A typical nursery crop will be planted as young plants and grown as a typical commercial crop in potting soil treated with a range of the useful PAM rates (determined in the first objective). Growth and development will be measured.<br>Jul 2014 to Feb 2015 | Three nursery crops species (*Epilobium*, *Heterotheca* and *Gaura*) were grown from planting to harvest with various desirable PAM rates. No adverse effects were observed and no significant differences in fresh and dry weights were found at harvest between untreated and PAM-treated plants.<br><br>*Osteospermum* was grown in a greenhouse in a mostly organic soil and a sand amended soil. No differences were found between untreated and PAM-treated plants.<br><br>Additional growth measurements were made in the final field experiments with lavender (*Lavandula*) crops. Again, no differences were found between untreated and PAM-treated plants. |
| Determine how long and at what concentration to expect PAM to be released into areas surrounding the treated pot in a nursery. | PAM concentration will be measured periodically in the pot leachate in the experiment described above.<br>Jul 2014 to Feb 2015 | PAM concentrations were measured in non-planted containers with simulated irrigations. Most detectable PAM was leached by the tenth irrigation. PAM concentrations were determined in an *Osteospermum* crop at the first irrigation, mid-point of cropping, and at harvest. PAM was only detectable at the first irrigation. |
| Determine the impact on water quality within and just outside the experimental field plots. | Runoff water will be collected periodically from treated and non-treated pots/ areas. Turbidity, TSS, nutrients and PAM concentration will be measured in soil leachate and tailwater.<br>Mar 2015 to Mar 2016 | Water quality of runoff from treated and untreated plots were monitored at two different commercial nurseries. There were two types of potting soils evaluated at each nursery, one soil was formulated with a significant sand component (15 to 20%) and the other soil was formulated with mostly organic amendments. Each soil either was treated with 100 g/L PAM or left untreated. All pots were planted |

| | | |
|---|---|---|
| | | with ornamental lavender. Each of the eight *plots* consisted of 200 plants in 1 gallon pots spaced "pot to pot" on typical gravel nursery beds. Plots were approximately 10 x 10 foot and built to contain most of the runoff at each irrigation. Turbidity was evaluated at every irrigation, and soluble nitrogen (N), total N, soluble P, total P, TSS and PAM were evaluated at every other irrigation. Pot leachate was measured by collecting samples of leachate from the same ten marked pots throughout the evaluation. |

Baseline data gathered:
Nursery 1 Pot Leachate
Potting soil A containing sand: PAM reduced leachate turbidity from 70.0 to 19.1 NTU; PAM reduced total soluble solids in leachate from 102.7 to 56.9 mg/L.
Potting soil B containing mostly organic products: PAM had no significant effect on measured factors.

Nursery 2 Pot Leachate
Potting soil C containing sand: PAM reduced leachate turbidity from 38.7 to 23.1 NTU; PAM reduced total soluble solids in leachate from 33.5 to 17.6 mg/L. PAM reduced total P in leachate from 0.25 to 0.14 mg/L.
Potting soil D containing mostly organic products: PAM had no significant effect on measured factors.

Nursery 1 Plot Runoff
Potting soil A containing sand: PAM did not have statistically significant impact on runoff from plots
Potting soil B containing mostly organic products: PAM increased soluble P from 2.5 to 4.0 mg/L and total P from 2.7 to 4.9 mg/L .

Nursery 2 Plot Runoff
Potting soil C containing sand: PAM reduced turbidity and TSS, but not statistically significant. PAM reduced total P in leachate from 2.3 to 1.5 mg/L.
Potting soil D containing mostly organic products: PAM increased turbidity from 4.5 to 7.8 NTU. Although this is statistically significant it is relatively very low overall. These are differences that would be undetectable to the naked eye.

PAM as tested in these experiments can have significant impact on reducing turbidity and TSS concentrations in pot leachate in potting soils containing significant portions of sand mixed with organic products (leachate is defined as the water drained from the bottom of the pot after irrigation). For sandy soils, the mean turbidity reduction in leachate from planting to harvest was 27 to 60% and the mean TSS reduction was 52 to 55%. Potting soils composed of mostly organic products had lower levels of these pollutants and PAM did not reduce these pollutants. In fact, PAM may have actually increased the suspension of some organic portions in runoff. PAM can increase P runoff by a small but significant amount, possibly by suspending organic soil fractions that have adsorbed P.

PAM was detectable in soil leachate in the first ten irrigations. PAM could be detected in runoff in the first ten irrigations at levels as high as 14 ppm. Therefore, PAM was distributed in gravel beds from treated pots. Its effect after deposition in gravel beds and on subsequent crops was not tested.

Gravel beds help reduce turbidity and TSS in runoff, possibly by filtering out the pollutants as the runoff moves laterally through and off the beds. The project team was not able to detect significant reduction of these pollutants with PAM in runoff. PAM reduced turbidity and TSS in tail water for sandy potting soils, but not by a statistically significant amount. Therefore, the project's target to reduce the turbidity of tail water by 25% over six months was not demonstrated. The team however, was able to detect significant reduction of these pollutants in leachate. These leachate pollutants may eventually move from the area under the pot or around the pot. It is suspected that irrigation rates do not move them well but perhaps rainfall and especially heavy rainfall could move them. Rainfall unfortunately did not occur during field testing so this could not be observed or tested.

PAM at all rates tested in these experiments had no deleterious effects on plant growth and quality. The testing occurred in nursery and greenhouse production on a wide range of ornamental plant species.

## Beneficiaries

This project benefited the California growers of nursery and floriculture crops who grew in potting soil. Most all California nurseries have mandated water quality mitigation needs and this project provided new knowledge and, in many cases, a method to help.

Nearly all of the California growers of nursery and floriculture crops either use potting soil or receive propagative material in potting soil. Based on the 2012 Census of Agriculture there were 1,306 ornamental crop nurseries in California.

## Lessons Learned

Future testing should be done in the field on multiple sequential crops or for a period of a year or longer. This would help to evaluate the long term effect of PAM on water quality and the effect of rainfall events. This project was able to determine the effects of PAM in a snapshot of time, it would also be beneficial to see the potential long term effects of using PAM. Future research work should look at leaching and runoff during winter so rain events could be tested to look at their effect on water quality.

It was fortuitous that preliminary evaluations with PAM happened to be with soil containing sand. With those profound results with turbidity, the team began the formulation of the proposal that led to this project. It was surprising that similar significant results could not be detected in potting soils containing mostly organic products.

## Additional Information

Presentations:
"Nuggets of Knowledge" presented at the California Association of Nurseries and Garden Centers (CANGC) Monterey Bay Chapter (January 22, 2015 in Watsonville). This included a description and demonstration of the effect of PAM amendments on leachate turbidity to 26 growers.

"Polyacrylamide as a Soil Amendment to Improve Water Quality in Nursery Runoff" (March 8, 2015 at the UC Davis). This was presented to 22 academic colleagues.

"Polyacrylamide as a Soil Amendment to Improve Water Quality in Nursery Runoff" (September 29, 2016). Technical Program, Berger Soil Products, Watsonville California. This was presented to 30 local growers.

"A Novel Approach for Sediment Control with Polyacrylamide in Container Nursery Production" (October 25, 2016), California Nursery Conference, Watsonville, California. This was presented to 85 attendees.

Figure 1. Effect of PAM at various rates (0, 50, 100, 400 g/m3 on turbidity of soil leachate. Potting soil contained 15 percent sand and 85% organic products. Image here are of leachate collected after third irrigation. Deionized water on the far right for comparison.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 47 | **Project Title:** Salt-tolerant Lettuce and Spinach Varieties | |
|---|---|---|
| **Grant Recipient:** United States Department of Agriculture, Agricultural Research Service | **Grant Agreement No.:** SCB13047 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Beiquan Mou | **Telephone:** (831) 755-2893 | **Email:** beiquan.mou@ars.usda.gov |

## Project Summary

Salinity is a major constraint to crop production in all major lettuce and spinach districts of California. The seawater intrusion has continued to move farther inland into groundwater aquifers beyond city limits of Castroville and Salinas because of continuing overdraft conditions for municipal and agricultural uses in the coastal regions. In the Central Valley, salts accumulate in farmland due to irrigation water from the Sacramento-San Joaquin Delta contaminated with brackish water from the San Francisco Bay, a shallow saline water table, and a lack of adequate drainage outlet. In the Imperial Valley, salts in irrigation water from Colorado River must be carefully managed to prevent yield losses.

The water quality problem is exacerbated by the climate change. Global warming leads to higher sea levels, which intensify saltwater intrusion in coastal California. Raising temperatures also promote water transpiration from plants and evaporation from soil, leaving more salts behind in soil. Forecasts show that global warming over the next several decades will take place irrespective of any action taken today. Thus the development of crops that can cope with abiotic stresses like salinity may well be the single most important step that can be taken to adapt to a warming planet. However, breeding a new variety takes time, often about 10 years. The ability to breed new varieties is undermined by the rapid loss of the genetic diversity of plants, which is also accelerated by climate changes. Therefore, there was a pressing need to mitigate the increasing salinity stresses through improvement of leafy vegetables for present needs and future conditions. Project staff proposed to screen and identify salt-tolerant lettuce and spinach germplasm and cultivars to adapt to the changing environment. Completion of this project will reduce future crop loss and production costs, conserve water resources, and improve the profitability and sustainability of these important specialty crops.

This project did not built on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Project staff compared and selected the growth mediums suitable and salt concentration for the study of salt tolerance in lettuce and spinach, and found that rock wool cubes were much more efficient than sand culture for this study. Using the improved protocol, project staff first preliminarily screened 3,800 lettuce genotypes and 525 spinach varieties for salt-tolerance.

Based on preliminary screening, 174 lettuce and 60 spinach cultivars and germplasm accessions were selected and re-tested with two trials in sand cultures using pots under greenhouse conditions. Overall, salinity decreased lettuce shoot fresh mass (FM) and dry mass (DM), increased DM/FM ratio and chlorophyll index, and had no effects on photochemical efficiency. Great variation in salt tolerance exits among lettuce genotypes. Generally, genotypes with high growth potential were relatively salt-sensitive based on the

percentage of growth reduction, while those with relatively high salt tolerance commonly had low growth potential under control condition.

## Goals and Outcomes Achieved

Using the improved protocol, project staff preliminarily screened more than 3800 lettuce genotypes and 525 spinach varieties for salt tolerance in greenhouse based on the percentage of growth reduction under salt stress. Varieties with less salt sensitivity, which was defined as: (fresh weight of plant grown without salt – fresh weight of plant grown with salt) / fresh weight of plant grown without salt, were considered to be salt-tolerant.

Based on preliminary screening, 174 lettuce (50 butter head, 35 crisphead, 30 romaine, 25 leafy, 15 wild genotypes and 19 commonly grown cultivars) and 60 spinach cultivars and germplasm accessions were selected and re-tested in sand cultures using pots under greenhouse conditions. Four week after salt stress, shoot fresh and dry weight, leaf chlorophyll index and fluorescence were measured. Salt tolerance was compared based on the percentage of fresh weight reduction under salt stress.

Based on the greenhouse studies, 56 lettuce varieties with the least salt sensitivity from greenhouse tests and 16 commonly grown cultivars were selected and screened salt tolerance in field with two trials from April 2015 to June 2015 and from July 2015 to September 2015. Similarly, 36 spinach varieties were selected for field trials. Plant fresh and dry weight, size, and core length were measured under salt-stress and control conditions. Soil salinity levels in the field was also monitored.

In order to identify critical physiological traits associated with salt tolerance, 20 genotypes of romaine lettuce with diverse salt tolerance were selected and grown in the greenhouse with sand cultures using pots. Four weeks after salt treatment, physiological traits including shoot fresh and dry weight, leaf area, root dry weight, leaf gas exchange (photosynthesis rate, stomata conductance and transpiration), chlorophyll fluorescence (photochemical efficiency, photochemical yield and electron transport rate), and leaf spectral reflectance, were measured.

The long-term success of the project will be judged by the percentage of lettuce and spinach acreage that is planted with salt-tolerant cultivars in California. This will be measured by mail and telephone surveys of seed companies for the percentage of lettuce and spinach seeds sold with the salt-tolerant trait three years after the completion of the project.

The goal of this project was to screen and identify salt-tolerant lettuce and spinach germplasm and cultivars to adapt to California's changing environment. Out of more than 3800 lettuce and 525 spinach genotypes from the preliminary screening, project staff selected and screened 164 lettuce and 60 spinach genotypes for salt tolerance in greenhouse using sand cultures with two trials. Based on the results of greenhouse study, 56 lettuce varieties with the least salt sensitivity and 16 commonly grown cultivars were further selected and screened for salt tolerance in field with two trials from April 2015 to June 2015 and July 2015 to September 2015. Similarly, 36 spinach varieties were selected and screened in field trials. The salt tolerance of lettuce and spinach germplasm and cultivars was screened and compared in greenhouse and field trials during the project period. Salt-tolerant lettuce and spinach varieties were identified for each lettuce type and spinach.

During preliminary screening, the shoot fresh weight of 3800 lettuce and 525 spinach genotypes under salt stress and control condition was measured and analyzed. During greenhouse study, shoot fresh and dry weight, leaf chlorophyll index and fluorescence of lettuce and spinach genotypes under salt stress and control condition were measured and analyzed. During field trials, plant fresh and dry weight, size, and core length were measured under salt-stress and control conditions. Soil salinity levels in the field was also monitored. During physiological traits study, shoot fresh and dry weight, leaf area, root dry weight, leaf photosynthesis rate, stomata conductance and transpiration, photochemical efficiency, photochemical yield and electron transport rate and leaf spectral reflectance were measured. Baseline data were collected though these activities and salt-tolerant varieties with less than 50% reduction in fresh weight under salinity stress conditions have been identified for each lettuce type and spinach.

Some lettuce varieties showed salt tolerance (less than 15% reduction in fresh weight) such as Morgana, Amerika, PI 358020c, PI 342515 (butterhead), Laura (crisphead), PI 289023, PI 273577, PI 278066, PI 177425 (romaine), PI 171676a, PI 177423, PI 358018b, PI 342477 (leaf). Three poster and one oral presentations were made during professional conferences.

## Beneficiaries

Salt-tolerant cultivars will directly benefit lettuce, spinach, and spring mix growers and product companies through improved production with reduced water quality, and seed companies by increasing global seed sales. The completion of this project will benefit all lettuce and spinach growers, product companies and seed companies in California. Data from this project were disseminated in extension publications, professional meetings of American Society for Horticultural Science (ASHS), biannual meetings of California Leafy Greens Research Program regularly attended by more than 250 growers and industry personnel, and professional journals such as HortScience and Journal of ASHS with more than 3,200 subscribers.

Direct beneficiaries include all lettuce and spinach growers, 107 lettuce, 67 spinach, and 25 spring mix product companies and more than 30 seed companies with thousands of personnel involved in growing, processing, and distribution of lettuce and spinach products and seeds in California.

## Lessons Learned

It is necessary to find a postdoctoral researcher with sufficient knowledge and skill to carry out the research. The postdoctoral job advertisement, job application, applicant screening, hiring, and relocation process took considerable time. The postdoctoral research associate also had to pass background check before hiring. It took more than six months from October 1, 2013 before postdoctoral researcher could start working on this project.

Even with a late start, project staff designed high-throughput experiments to screen a large number of lettuce and spinach varieties quickly and efficiently using rock wool cubes. Each time 24 rock wool cube sheets, each with 200 cubes, were used for seed germination. Half of the rock wool sheets were used for salt treatment and another half with same genotypes for control. 204 genotypes could be screened in each time. Since rock wool is completely sterile and have optimum air/water ratio, the germination was fast and more uniform and there were more plants for measurement. Rock wool cubes are much more efficient than sand culture for screening a large number of lettuce and spinach varieties quickly and efficiently. The efficiency, accuracy and quality of the experiment were improved. The project staff used fewer replications in preliminary screening experiments, and screened as many varieties as the greenhouse space allowed. The experiment period for

lettuce preliminary screen was reduced from seven to four months, and for spinach it was reduced from five to two months. Therefore, this project caught up before March 2015 and did not need to modify the timelines of the work plan since then.

The salt tolerance of seedlings in green house screening is not consistent with that of plants in field trials, because the salt tolerance of lettuce and spinach is affected by not only environmental conditions and severity of salinity but also growth developmental stage. Even for different field trials, it is critical, in the future, to keep salt stress levels similar in order to get consistent results.

The results from two field trials were not consistent, some varieties were tolerant in summer season but were not in fall season. The inconsistency might result from not only different seasons but also different salinity treatments. The solid salts were buried in the beds to induce salt stress quickly and crops were irrigated with saline water in the summer season. During fall season, no solid salts were buried in beds since the same field was used. The different salt stress treatments might lead to different severity of salinity.

## Additional Information

Dissemination of results is as follows:

One poster and one oral presentations were made during the annual conference for the American Society of Horticultural Science (ASHS) held in August 2015 in New Orleans. One poster presentation was made during Workshop on Plant Development and Drought Stress in November 2015. And one poster presentation was made for the annual conference of ASHS held in August 2016 in Atlanta.

Chenping Xu, Beiquan Mou, 2016. Fish hydrolysates improve containerized lettuce. American Society for Horticultural Science. Annual meeting. August 8-11. Poster.

Chenping Xu, Beiquan Mou, 2015. Salinity and nutrient deficiency affects spinach growth, physiology and nutritional value. Workshop on Plant Development and Drought Stress. Pacific Grove, CA. November 1-4. Poster.

Chenping Xu, Beiquan Mou, 2015. Evaluation of lettuce genotypes for salinity tolerance. American Society for Horticultural Science. Annual meeting. August 4-7. Poster.

Chenping Xu, Beiquan Mou, 2015. Effects of salinity and nutrient deficiency on spinach growth, physiology and nutrition value. American Society for Horticultural Science. Annual meeting. August 7. Oral.

Three papers were published by, one submitted to, and one is being prepared for, peer-reviewed journals:

Chenping Xu, Beiquan Mou, 2016. Effect of fish-derived protein hydrolysates on lettuce growth and physiology. HortScience Preparing.

Chenping Xu, Beiquan Mou, 2016. Short-time effects of composted cattle manure or cotton burr on containerized spinach and soil fertility. HortScience Submitted.

Chenping Xu, Beiquan Mou, 2016. Vermicompost affects soil properties and spinach growth, physiology, and nutritional value. HortScience 51: 847-855.

Chenping Xu, Beiquan Mou. 2016. Spinach responses to salinity and nutrient deficiency in growth, physiology and nutritional values. J Amer. Soc. Hort. Sci. 141:12-21.

Chenping Xu, Beiquan Mou. 2015. Evaluation of lettuce genotypes for salinity tolerance. HortScience 50:1441-1446.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 48 | **Project Title:** Development of a Nutrient Budget Approach and Optimization of Fertilizer Management in Walnuts | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis | **Grant Agreement No.:** SCB13048 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Katherine Pope | **Telephone:** (530) 574-3794 | **Email:** kspope@ucanr.edu |

## Project Summary

Fertilizer use in the walnut industry has come under scrutiny in the wake of recent nitrate groundwater contamination findings. Improved nutrient use efficiency (NUE) would decrease the walnut industry's potential contribution to contamination, decrease greenhouse gas (GHG) emission, and save growers money. However, information on nutrient needs of walnuts was outdated, and grower assessment tools were inadequate. This project aimed to provide growers tools to increase NUE, thereby decreasing the contribution to water and air pollution while improving financial sustainability.

California's walnut growers could be better environmental stewards and save significant amounts of money at the same time. Fertilizers made up over 7% of grower operating costs. Fertilization technology has allowed growers to target tree nutrient needs more precisely in time and space. Yet, grower decisions are being made on research developed using old irrigation systems and outdated cultivars when yields were 50% lower. Detailed, walnut-specific nutrient research is necessary to empower growers to be both environmentally and economically sustainable.

This project aimed to develop beneficial management practices (BMPs) and nutrient assessment tools to increase NUE in walnuts. By more precisely targeting nutrient application to tree needs, growers would reduce overall fertilizer use, reducing costs and pollution to the groundwater and atmosphere. This project aimed to create the walnut nutrient budget necessary for this targeted application, quantifying the monthly needs of different orchard components, and estimating seasonal soil nutrient losses and contributions. To increase BMPs adoption, the project aimed to improve grower nutrient assessment techniques to assist growers in monitoring the in-season impacts of new practices, including revisiting leaf critical values, exploring optimum nutrient ratios, and revising leaf sampling protocols.

The need for improved NUE has grown every year. A 2012 study by a University of California, Davis (UC Davis) Groundwater Hydrology Professor and their colleagues, identified many wells in the Tulare Lake Basin that exceeded the Environmental Protection Agency’s maximum nitrate concentration limits. These nitrate concentrations endanger the health of tens of thousands of rural Californians. More than 50% of nitrate was estimated to come from synthetic fertilizer use. Similar concentrations could likely be found in other intensely cultivated areas of the Central Valley. Some of the highest nitrate concentrations were found in wells in alluvial fans, the most popular soil for walnuts.

This project built on the 2009 Specialty Crop Block Grant Program Project 16: *Tree Phenology Models for Climate Change Projection and Improved Water and Nutrient Management*. The project quantified minimal and optimal amounts of winter cold walnuts needed for normal spring leaf-out and flowering, including the

chill level below which yield declined, and the yield penalty of lower chill, a 15% decrease from maximum yield potential. Thus, growers could decrease the nutrient application depending on the chill accumulation the winter prior to harvest. This relationship will be included in the yield estimation calculations of the proposed nitrogen (N) budget module. This project quantified many other aspects of yield estimation including canopy cover, previous yields, and other variables. Estimating yield will allow a grower to translate the generalized pounds-of-N-needed-by-a-ton-of-nuts to the needs of a specific field in a specific year following a specific winter.

## Project Approach

Samples were collected for the walnut nutrient budget, to quantify nutrient demand in different walnut tree parts throughout the year. Various samples were collected and measurements were taken at six walnut orchards in the California Central Valley. These orchards encompassed three geographic areas (northern Sacramento Valley, northern San Joaquin Valley and southern San Joaquin Valley) and included, two different walnut cultivate varieties ('Chandler' and 'Tulare'). Leaf samples were collected from ten trees per site in April through November, 2013-2015 (April-September 2013 funded by the California Walnut Board), fruit (nut) samples and tree yield data were collected from ten trees May through October, 2013-2015 (May-September 2013 funded by the California Walnut Board), and perennial parts (branches, roots, shavings from trunks, etc.) were collected from three trees in January, April, May, July and November, 2014. In May and July each year, twenty additional trees were sampled for the development of nutrient assessment tools. Catkins, the pollen shedding flower structures of walnuts, were measured in April of 2014 and 2015 for nutrient content. The samples were dried, weighed, ground and sent to the UC Davis Analytical Laboratory for nutrient analysis.

Leaf area was measured in October-November 2014 by catching, weighing and scanning fallen leaves from three trees at each of the six monitored sites. This was done as a compliment to light interception measurements by the Lampinen lab, which took place August 2015. These measurements were used both to estimate leaf area to feed calculations of leaf nutrient use, as well as to normalize yield values to account for tree canopy size.

Nitrate movement in the soil was closely monitored at one intensively instrumented site, the 'Chandler' northern San Joaquin Valley orchard. Data from soil moisture sensors and tensiometers, as well as soil solution samples, were collected April 2014-March 2015. Samples were collected after each irrigation event during the growing season, and before and after major rain storms in the fall, winter and early spring. Water samples were analyzed for nitrate, ammonia and total dissolved N. These data were analyzed to fit the HYDRUS model, a tool which may have allowed for prediction of behavior of water and nitrate in different orchards, or with different irrigation management. Results of initial HYDRUS model fitting were presented at the European Geophysical Union - General Assembly 2015 in Vienna, Austria in April, 2015 (Geophysical Research Abstracts, Vol. 17, EGU2015-14633, 2015, EGU General Assembly 2015. Abstract: http://meetingorganizer.copernicus.org/EGU2015/EGU2015-14633.pdf). Unfortunately, upon final analysis, there was insufficient data to adequately fit the HYDRUS model. However, the data were analyzed to estimate the nitrate leaching of the orchard that was monitored under its current management practices and the data gathered will inform future nitrate leaching research.

Nutrient content data was analyzed and charted for annual and monthly demand (nutrient budget) for the three years of data. A draft manuscript of N, phosphorus and potassium content in the walnut fruit over the course

of the growing season, "Seasonal nutrient demand in mature deciduous tree species: Studies in walnut," was produced and edited for journal submission. The complete nutrient budget analysis, including all parts of the tree to which N, phosphorus and potassium were allocated, required excavation on at least one entire tree, to scale up the data gathered from perennial parts in 2014. No growers could be found who was willing to excavate a whole healthy tree in the course of the project. Redoubled effort was put into finding trees to excavate in the winter of 2016-2017, with funding from the California Walnut Board. Pending the information gathered from the excavated tree, a complete nutrient budget will be published in scientific journals, industry magazines and through a web-based tool.

Analysis of May and July leaf sample values to build an early sampling prediction model was completed. A project to gather additional data to build a better early season sampling prediction model has been funded by the California Department of Food and Agriculture (CDFA) Fertilizer Research and Education Program (FREP). The data from this project will be integrated in with the analysis of those data and published together, likely in the next 12 to 24 months. The predictive model will then be shared with a private leaf analysis lab. May and July leaf sample values were also analyzed to quantify necessary tree number and spacing for an accurate orchard leaf sample measurement by growers. A manuscript was drafted for a horticultural and grower-oriented publication to disseminate this information.

Numerous 20 to 30 minute presentations on walnut N management were given to walnut growers and others involved in walnut orchard management using research findings regarding total season N needs and the timing of demand. Over the course of 2015 and 2016, presentations were given at meetings targeting growers in every walnut production county in California (see Figure 1).

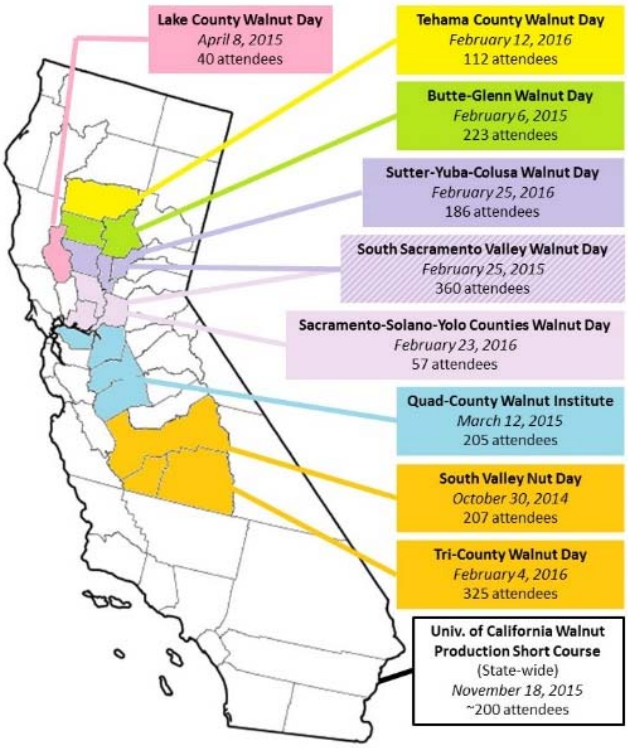


Figure 1. Walnut industry meetings at which presentations were made on nutrient management.

The general principles of nutrient management and budgeting for perennial crops were also taught to a number of Certified Crop Advisors (CCAs) at the University of California Agriculture and Natural Resources -CDFA Nitrogen Management Workshops. The timing of N demand by growing walnut fruit was included in the 2015 version of those presentations. A total of 245 CCAs that worked with tree crops, a large proportion of whom worked with walnuts, went through this training at three different locations in 2015.

Research findings were presented at a number of smaller meetings of researchers, including at the annual Walnut Research Conference, January 29, 2015 and January 28, 2016, attended by all of the UC Davis, the UC Cooperative Extension and the United States Department of Agriculture walnut researchers in California. There were also representatives from the California Walnut Board and California Walnut Commission, including growers and processors who served on the Board. Findings were also presented at the UC Pomology Education Continuing Conference (PECC) on March 23, 2015, attended by all UC tree crop researchers. PECC was a particularly important small venue through which to communicate and discuss research with farm advisors in the UC Cooperative Extension system.

In addition, the findings of this project were presented to the Nitrogen Technical Advisory Workgroup, which was charged with developing the Nitrogen Management Plan Worksheet and its implementation for the Central Valley Regional Water Quality Control Board under the Irrigated Lands Regulatory Program. The most up-to-date state of knowledge on walnut N management based on research findings was presented on April 24, 2015, at the “Nitrogen Removed Workshop” meeting of the Central Valley Water Coalitions charged with estimating the N removal of crops for future nitrate regulations and accounting. The Grant Manager, was also present at subsequent meetings by the same group on July 20, 2015 and September 4, 2015, to answer questions about N management in walnut production.

Written materials were published and disseminated based on research findings to date, to assist walnut growers in budgeting their N applications over the 2015 and 2016 growing season. “N Budgeting Following the 4 R’s,” a step-by-step guide to N budgeting for walnuts was produced and sent to recipients of the Yolo, Solano, Sacramento Orchard Newsletter (approximately 450 recipients) in April, 2015. This guide was sent to all of the walnut farm advisors in the UC Cooperative Extension system to enable sharing project-derived information with their growers. Its contents were also transformed into an article in the July 2015 edition of Western Fruit Grower magazine and the California Walnut Board (4,500 recipients). An additional article on this subject, “Following the ‘4 R’s’ Can Improve Nitrogen Delivery to Tree Nuts” was published online and in print by Western Farm Press on April 20, 2016 (see attachment 1).

The accounting department helped to track all project expenditures and ensure that grant funds were used to solely enhance the competitiveness of specialty crops.

Funding from the California Walnut Board paid for soil hydrology equipment, and the equipment and vehicles needed for sample collection to initiate the project before funding was available through the grant. The California Walnut Board then paid for approximately one-third of the salaries for the Grant Manager/post-doctoral researcher and the project junior specialists. In-kind support was provided by individuals from the UC Cooperative Extension (UCCE), Tehama County and San Joaquin County through assistance at leaf, fruit, perennial part and harvest sample collection in 2013, 2014 and 2015. In-kind support was also provided by the Department of Plant Sciences and the Department of Land, Air and Water Resources at UC Davis through the time provided to plan logistics and execution of field work, specifically harvest planning, sample processing

and educational presentations, general oversight and soil hydrology instrumentation planning. The Lampinen lab at UC Davis conducted light interception measurements at orchards as discussed above. Laboratory space was also provided for sample processing by other UC Davis laboratories. Five commercial walnut growers allowed the project team to conduct research on their property. The Project Manager managed data analysis, wrote outreach materials and gave presentations throughout the Central Valley (Figure 1).

## Goals and Outcomes Achieved

The Goal of this project was to improve the N use efficiency of California walnut orchards, through the outcomes of :

1) Increased number of walnut growers fertilizing according to the needs of the trees in each particular month or developmental stage, and
2) Increased number of growers sampling leaflets to measure the nutrient status of their trees to integrate tree nutrient status into fertilizer management decisions based on their nutrient needs.

The project activities conducted in order to build the nutrient budget were the first necessary steps towards achieving outcome 1. In order to educate growers, researchers needed to first know the amount of fertilizer required by the trees. Since the first year of monthly data was analyzed and available for growers, researchers involved in this project, mostly the Project Director, shared the timing of fertilizer needs of trees by month with growers at the meetings shown in Figure 1 and with other farm advisors and key decision-makers, who could then reinforce this information with the growers and managers. This information was also distributed in numerous publications as previously described.

Towards achieving outcome 2, the importance of leaf sampling to help inform fertilizer management decisions was also discussed at presentations listed in Figure 1. Additional funding was secured to gather additional data to improve the predictive nutrient status model, therefore that model is not yet available to growers or leaf analysis labs and has not yet been adopted.

The research necessary to make recommendations to growers regarding nutrient budgeting and leaf sampling is mostly completed, with the exception of the whole tree excavation for the nutrient budget and some remaining statistical analysis and publication of results. Growers and others involved in fertilizer management in the walnut industry were made aware of the concepts of nutrient budgeting and leaf sampling, and have begun to make changes such as splitting fertilizer among more applications in the growing season to improve N use efficiency.

Given the increased scrutiny regarding N application in agriculture in California under the Irrigated Lands Regulatory Program, and the aggressive outreach and education work of participants in this project, it is likely that many growers have improved their N use efficiency over the duration of this project. Increasing regulation will result in their continuing to do so. The results of this project, will enable growers to not just be compliant with the Irrigated Lands Regulatory Program, but to also enable them to simultaneously achieve sustainable economic yields.

| Target | Achievement |
|---|---|
| **Nutrient budget tool and leaf sampling protocol will be presented to 90% of farm advisors representing counties with 5% of the state's walnut acreage or more.** | Nutrient budget information was presented to 100% of UCCE farm advisors representing 5% or more of the state's walnut acreage at the 2015 and 2016 Walnut Research Conference and the 2015 UC Pomology Education Continuing Conference. The revised leaf sampling protocol was completed and will be presented at the next Walnut Research Conference in January, 2017. |
| **Nutrient budget tool and leaf sampling protocol will be presented to 25% of the state's commercial walnut growers by project researchers or collaborators.** | The concept of nutrient budgeting and initial data from the project was presented at meetings in every California county with significant walnut production (Figure 1). Attendance at these meetings totaled 1,915 people – growers, crop advisors who made nutrient management decisions, orchard managers and others industry members. An additional 245 Certified Crop Advisors were trained on the principles of nutrient budgeting in tree crops, including information on walnut budgeting. Even taking into account some double-attendance, this meeting attendance far surpassed the goal of 25% of walnut growers or those responsible for fertilizer management decisions.<br><br>The importance of leaf sampling was discussed at these same meetings, though the revised sampling protocol had not yet been developed. The nutrient budget tool and new leaf sampling protocol were discussed at annual meetings held by UCCE farm advisors winter 2016 and in the winter of 2017. This information will be in demand taking into consideration the fact that growers are now required to complete a N plan every year for every walnut orchard. |
| **Webpages will be visited 500 times in first six months of being available.** | Webpages with the nutrient budget tool are pending the necessary tree excavation in order to finalize the nutrient budget. This excavation is planned for the winter of 2016-2017. |
| **Decision support application will be downloaded (or updated for those with the almond version) 50 times in the first six months of being available.** | Decision support applications with the nutrient budget tool are also pending the tree excavation in order to finalize the nutrient budget. |

| Target | Achievement |
|---|---|
| **Grower-oriented publications containing articles on nutrient budget tools will be read by 5,000 people.** | As outlined in the Project Approach narrative, the principles of using a nutrient budget was discussed in numerous newsletter articles and industry publications, along with best estimates of that budget with the information available from the project when each article was written. The California Walnut Board's newsletter alone reached 4,500 recipients. Readership of Western Farm Press and Western Fruit Grower Magazine were each in the thousands. Additional articles will be written as the nutrient budget is finalized and tools are made available. |
| **One hundred walnut growers will submit May leaf samples in the first three years following the project.** | Additional data is currently being collected through a CDFA FREP grant to improve the accuracy of the model built during this grant. The prediction model necessary to use May leaf samples has thus not yet been finalized or made available to analysis labs. |

- Samples collected, analyzed and statistically reviewed from six sites over three years towards building a nutrient budget for two of California's most important walnut cultivars.
- Principles of using a nutrient budget and preliminary results presented to all UCCE farm advisors, 2,100+ meeting attendees, 4,500+ California Walnut Board newsletter readers and thousands of industry publication readers.
- Nutrient budget is pending tree excavation and was near completion at the conclusion of this grant.
- Leaf sampling protocol revise and in preparation for publication and dissemination.
- Early leaf sampling model under development as nutrient management tool for growers.
- Multiple journal articles in draft or in preparation.

## Beneficiaries

California's walnuts growers were the most direct beneficiaries of this project. Better information regarding the timing and amount of fertilizer needed by their trees will enable them to apply adequate fertilizer to sustain yields without spending money on unnecessary fertilizer or being out of compliance with state regulations. More broadly speaking, the groundwater-drinking residents of the state of California benefited from this project's accomplishments, because less unnecessary fertilizer application, and applications at the appropriate time, will mean less nitrate leaching into the groundwater.

This project will enable California's 4,000 plus walnut growers to decrease fertilizer use, and reduce costs, groundwater pollutants, and GHG emissions. Best estimates prior to the start of this project suggested walnut cultivation provided 70-115 more pounds of N per acre than was harvested in nuts and shells. If 20% of the remaining N were used for leaves, roots, and perennial parts, potentially 54-98 pounds of applied N were not used by the crop per acre every year. Multiplied over California's 280,000 bearing walnut acres, every year as

much as 15-27 million pounds of N were available for potential leaching or volatilization. This wasted N could cost walnut growers as much as $12-23 million a year.

By assisting growers in reducing fertilizer use, this project also aimed to enable cost savings to the public by avoiding groundwater remediation and or health costs associated with contamination. Though there were no simple figures of the costs associated with remediating nitrate groundwater contamination, short-term solutions for providing clean water to the estimated vulnerable population of 220,000 in the Salinas Valley and Tulare Lake Basin would cost, at minimum, $12-33 million. Given 90% of residents of the Central Valley relied on groundwater for at least some drinking water, mitigating continued contamination of these wells could result in significant avoided costs to well users and taxpayers.

## Lessons Learned

This project was very effective at engaging with growers to disseminate information about nutrient budgeting. Working closely with farm advisors in the UCCE system was critical. Starting the project with three farm advisors as collaborators, rather than just colleagues, was important both for ensuring they would find outlets for reaching growers and other industry participants and for ensuring the information was conveyed in a way that was clear and actionable to growers. Having the support of the California Walnut Board was also critical to success, in getting buy-in from grower collaborators who let the project team use their orchards, in having an annual venue to share results with other researchers, and in having an avenue through their newsletter to spread information learned.

The two biggest challenges of this project were difficult lesson to learn from. Firstly, it was very difficult to find growers willing to allow excavation of trees to analyze the entire tree for nutrient content, to scale up data from five sampling events of perennial tissue. Walnut prices were fairly high over the course of the project and none of the participating growers were willing to allow the removal of these very profitable trees. This was the difficulty of working with walnuts as opposed to almonds or pistachios, both of which are grown by among others, a few high-profile, large-scale growers who are less concerned with the loss of a few trees. There were no walnut growers who grow on a comparable scale of acreage.

Another significant challenge was personnel turn-over which led to numerous inefficiencies. This included the need to continually train new employees, search for data and samples when employees left, and restart statistical analyses left unfinished. In order to avoid this, systems for data storage and analysis dictated by the Project Manager need to be in place before the start of sample collection.

A positive unexpected outcome of this project was a related emphasis on water management, which could lead to overall better water stewardship. One of the keys to increased N use efficiency was to ensure the N applied stayed in the rootzone so that it could be taken up by the roots. Excessive irrigation can push water past the rootzone, carrying N with it. Good N management could also result in a modest reduction in water use by walnut growers.

As discussed above, not all targets of this project were met in the desired timeframe. Funding was secured from other sources to address the pending data collection and outreach and education. Outcome 1, increasing the number of walnut growers fertilizing according to the needs of the trees, was achieved, and more growers will continue to shift in their practices. If the project team had been able to excavate trees to complete the N budget before the end of the grant, the team would have been able to create tools that may have allowed for an

even more rapid shift in practices. Outcome 2, increasing the number of growers sampling leaflets, was also not fully achieved due to additional sampling that will be done this year to improve the model that will be used to interpret leaf sampling results. Thus, the major lesson from the outcomes not entirely achieved in this project would either be a) set less aggressive goals or b) assess progress mid-project to know if additional time and funding is required to complete the goals of the project, even if it cannot be done in the timeframe of the first grant.

## Additional Information

See attachment.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 49 | **Project Title:** Developing Soil Fumigation with Reduced Application Rate in Low Permeability Tarp Mulched Raised-Bed System | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis | **Grant Agreement No.:** SCB13049 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Ruijun Qin | **Telephone:** (559) 596-2904 | **Email:** Ruijun.qin@ars.usda.gov |

## Project Summary

California strawberry production depends highly on pre-plant soil fumigation to control soilborne diseases and weeds. Most California strawberries are grown in raised-bed systems covered by standard polyethylene (PE) film and are drip fumigated (i.e., fumigant is applied via drip lines buried in beds). Since methyl bromide (MeBr) was phased out, Telone (1,3-dichloropropene or 1,3-D) and chloropicrin (CP) have been used as the major alternatives. However, high fumigant emissions have led to increasingly stringent federal and state regulations on the use or the availability of the existing fumigants, so California strawberry growers are facing challenges in pest control. Without fumigants, the industry will suffer a serious economic loss. Good pest management tools are needed urgently to achieve optimal pest control target with reduced environmental impact.

Low permeability film (LPF), such as totally impermeable film (TIF) and virtually impermeable film (VIF), can effectively reduce fumigant emissions, improve pest control efficacy, and have the potential to allow reduced application rates in broadcast-fumigated field. However TIF performance in drip-fumigated, raised bed system has not been evaluated sufficiently for the pest control efficacy and the emission potential.
The objective of this project was to demonstrate the most efficient pest control tool in raised-bed fields through measurements of soil fumigant distribution, pest control efficacy, fumigant emission, and strawberry production under LPF. The overall goal was to help California strawberry growers increase fumigant use efficiency by using less fumigant for good pest control and reduced environmental impact to comply with environmental regulations.

USA is the top nation producing nearly 30% of the world's strawberries. California is the leading state producing 82% of USA's strawberries. More than 2.1 billion pounds of California strawberries were harvested in 2011 with a value of $2.0 billion. The productivity and the economic sustainability of the strawberry industry in California are highly dependent on preplant soil fumigation to reduce pest infestation. In 2009, approximately 0.53 million ton of 1,3-D and 1.76 million ton of CP were used in California strawberry industry. Most fumigants used for strawberries are applied through drip fumigation in raised-bed system. With the loss of MeBr and the increasingly stringent regulation on the use of fumigants, critical pathogens and weed problems have increasingly impacted California strawberry production. This project seeks solutions to multiple challenges by using low fumigant rates with LPF in raised-bed systems to improve fumigation efficacy, reduce emission, and increase production. The field data will provide information for the strawberry growers on how to effectively use fumigants and LPF and will help strawberry growers comply with fumigant emissions regulations. The project will impact directly more than 21,100 acres of California strawberry fields that are using raised-bed production systems with drip fumigation and will benefit the economic and environmental sustainability of the California strawberry industry to maintain the leading position in domestic

and international strawberry market. This project will also benefit other annual high-value specialty crop growers who grow crops in raised-bed production system with drip fumigation. In the long run, this project will benefit the state by reducing the air pollution from soil fumigant use.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

During the entire grant period, the research team held regularly scheduled project meetings and had many informal meetings to facilitate project management, solve emerging problems, and maintain effective communications. The research team communicated frequently with other project participants, e.g., growers and fumigation industries to ensure the success of the field trials.

There were two large scale field trials conducted in growers' fields. The first one was conducted from September 2014 to July 2015 at a farm located at Camarillo, California. The second one was conducted from September 2015 to June 2016 at a farm located at Oxnard, California. Since quite a large portion of the fields were neighboring a residential area, the air quality is being strictly regulated, especially regarding fumigant emission because large quantities of fumigants are used in the area every year for strawberry production. Therefore, the grower needed to use LPF in the fields to minimize the fumigant emission in their raised-bed production systems. Meanwhile, the fields suffered from pathogen problem, such as Fusarium. The weed problem was also a critical issue. The selected field status could well represent a typical coastal strawberry production region, where growers are facing big challenges in the air pollution and pest pressure.

In the trials, the farm crew helped the research team prepare soils, set-up raised beds with drip tapes installed under soil surface, and cover the beds with either LPF or regular PE film for experimental purposes. The fumigant was applied in September 2014 for the first trial and in September 2015 for the second trial. In the trials, different films (LPF and PE), different fumigant rates (non-fumigation control, full rate, and half rate fumigant), and different application methods (traditional two drip lines, new four parallel drip lines) were tested. (In the second trial, new two shallow plus two deep drip lines were added).

During the soil fumigation period in each trial, the research personnel of the University of California, Davis (UCD) and the United States Department of Agriculture – Agricultural Research Service carried out field sampling intensively. The measured parameters include fumigant emission, fumigant distribution in soil profile, fumigant under film above soil surface, residual fumigants, and pathogens in soils. The research personnel from the University of California, Agriculture and Natural Resources and UCD prepared pathogen and nutsedge bags and buried the bags in the field in order to determine the fumigation efficacy on pest control.

One month after fumigation, the farm crew of the cooperating growers transplanted strawberry plants. Then, throughout the strawberry growing season, research team evaluated regularly pest control results, crop growth, and crop production in response of different treatments.

The lab analysis and data processing on proposed parameters were conducted intensively in each lab of the research team.

The project did not enhance the competitiveness of non-specialty crops. The project was designed primarily for benefiting the California strawberry industry which produces >80% of the USA strawberry fruit. Most California strawberries are produced in plastic tarp mulched raised-bed production systems with drip-fumigation for pest control. However, fumigant emission concerns are driving many regulatory decisions that may impact productivity and economic viability of California strawberry. This research evaluated and demonstrated the impacts of alternative fumigation strategies on fumigant behaviors in soil profile, pest control, strawberry production, and fumigant emissions in LPF covered raised bed systems. The information developed and the technology transfer efforts from this project can help the California strawberry industry maintain soil fumigant availability and ensure the leading position in both domestic and international markets.

The team members have successfully conducted soil fumigation research in specialty crops for ten years and have excellent records in conducting collaborative projects.

Throughout the project period, the project director has been in charge of the overall project management and ensured that all project tasks were conducted in a timely manner. The research team has regularly scheduled project meetings and more informal communications to monitor project progress.

The research team has successfully carried out two large scale field trials in growers' fields; processing all field samples and analyzing data on fumigant emissions, fumigant movement in soil, and soil residue fumigant.

The cooperating growers and their farm crew have provided strong support on preparing fields, monitoring the field trials, maintaining strawberry growth, and harvesting the crop. Two companies have provided fumigation services including materials and application services.

## Goals and Outcomes Achieved

Two large scale field trials have been carried out successfully and all the samples have been processed and the data have been analyzed within the grant period. Based on the data of two field trials, the following outcomes have been achieved:

1) Low permeability film significantly reduced fumigant emissions from film covered raised-beds as compared to PE film. The peak emission flux was $\leq 5$ μg $m^{-2}$ $s^{-1}$ from VIF covered beds (10 times less than that from PE covered beds) in the first trial and $\leq 0.5$ μg $m^{-2}$ $s^{-1}$ from TIF covered beds (100 times less than that from PE covered beds) in the second trial. Drip tape layout did not impact fumigant emissions in general. The fumigant emissions from uncovered furrow were extremely low regardless of film type, drip tape number, and application rate, suggesting that emission from furrows should not be a concern.
2) Low permeability film retained much higher fumigant concentration than the PE film. When reducing the application rate to 50%, the fumigant concentrations under LPF is still superior to (or comparable to) the fumigant concentration under PE, indicating that the LPF covering may help growers reduce fumigant application rate and correspondingly further reduce environmental pollution. In general, the PE beds with conventional full rate fumigant did not provide satisfactory pest control results in both trials because of the high emission loss resulting in insufficient fumigant dosage for pest control. In some cases, the VIF or TIF covered beds with half rate also did not show complete pest control results, because of insufficient fumigant dosage or non-uniform fumigant distribution for pest control.
3) Both trials showed that fumigant distribution was not uniform with the conventional 2-drip tape layout even under LPF. The new 4-drip tape layout showed promising results in improving fumigant distribution

in comparison with the 2-drip tape layout. Therefore, using LPF and increasing drip tape number can be the optimized fumigation technology for achieving optimal pest control result and fumigant emission control targets.

4) The residual fumigant level was very low at the end of field monitoring [i.e., one week or ten days after the Tri-Clor fumigant (200 lb $ac^{-1}$) was applied]. As their normal procedure, after the soil fumigation period, growers will wait for a few weeks and then transplant strawberry in the fields. Therefore, the risk of the phytotoxicity should not be a concern.
5) Corresponding to the fumigant distribution results, the LPF treatments provided better weed control and pathogen control results than PE treatment or non-fumigated control. The four drip tape layout further improved pest control results than the two drip tape layout.
6) Field measurements showed that the canopy size was generally lower in the non-fumigation control. The berry production was higher in the treatments with full rate fumigant under LPF than other treatments. The 4-drip tape layout further improved berry production than the 2-drip tape layout. However, leaf greenness index and leaf conductance in general was not different among fumigation treatments.

Besides the research activities, intensive outreach activities have been conducted as follows:

1) The research findings have been presented intensively at various extension meetings and field days (e.g., Southern California Association of Pest Control Advisers meetings, Central coast strawberry meetings, the 1st Soil Management Meeting in California, the 2015 North American Berry Conference/ 8th North American Strawberry Symposium), with over 1,000 people in attendance including growers, scientists, California Strawberry Commission members, industry representatives, and governmental agencies.
2) The research findings have also been presented at Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions with over 500 people in attendance including growers, international scientists, students, California Strawberry Commission members, company representatives, and governmental agencies.
3) The research findings have been presented at American Society of Agronomy, Crop Science Society of America, Soil Science Society of America International Annual Meetings, and the American Society for Horticultural Science Conferences. There were over 10,000 people in attendance including international scientists, students, and company representatives.

As a result, the techniques have been presented to the many growers in the California strawberry industry during the entire grant period. The extension results will be further improved beyond the grant performance period, based on new extension presentations and publications.

Beyond the grant period, the research team will develop more presentations and publications based on the research findings from this project. Therefore, it can be expected that the research findings will be adopted by the California strawberry industry quickly. In the long-term, this project will be a benefit for improving air quality because of dramatic reduction of fumigant emission loss, reducing the growers' costs due to improved fumigant use efficiency, helping growers maintaining the availability of fumigant use for pest control, and promoting the understanding of soil fumigant for growers and publics.

The goals established for the reporting periods included 1) carrying out two large-scale field trials to determine a) the effective fumigant rates in TIF beds with improved efficacy on the critical pest control and good strawberry production, b) lethal fumigant dosage values on inoculum of several main pathogens, citrus nematode, and weeds being buried in raised-beds, c) fumigant emissions from tarped beds and from

uncovered furrows, d) fumigant concentration change during fumigation period and soil residual fumigant at the end of fumigation, e) the field performance of recycled plastic film; 2) carrying out extension activities to the strawberry industry in a timely manner, i.e., initially to the collaborating growers and their neighbors and expanding to more than 200 growers and interested stakeholders by the end of the grant period, as well as presenting data to scientists and regulators at international conference and publishing papers; 3) extending the research findings to the whole California strawberry industry within a few years after the grant performance period.

The actual accomplishments from the project are 1) two large-scale field trials have been conducted in southern coastal area, which can represent the coastal region of California, as the strawberry industry is faced with similar challenges. The actual accomplishments are a) the full rate (~200 lb/ac Tri-Clor) fumigant under LPF provided optimal pest control result and strawberry production, while the half rate fumigant under LPF showed comparable results as the full rate fumigant under PE; b) the LPF treatments, especially with the full rate, provided effective control of the most critical pathogen, fusarium, and the most difficult weed, nutsedge; c) LPF dramatically reduced the fumigant emissions from tarped beds while the emissions from uncovered furrow were not a concern; d) fumigant concentrations in soil profile were well determined and the LPF covering showed much higher fumigant concentration than the PE covering; e) trace level of residual fumigant level was detected at the end of fumigation monitoring period (7-10 days). Since growers normally wait for several weeks after fumigation before transplanting, the crop phytotoxicity from residual fumigant will not be a concern; f) the recycled plastic film was not included in the trials because the film was not available from the manufacturer. However, since this film was made mainly of used PE film, it is not recommended to be used for soil fumigation purpose due to the similar issues (high emission loss and unsatisfactory pest control) as PE film; g) based on field observations of extension specialists, the conventional 2-drip tape layout showed unsatisfactory pest control at the bed shoulder or bed center. To solve this emerging problem, the project team proposed and tested a 4-drip tape layout in the field trials, which further improved pest control result than the 2-drip tape layout because improved fumigant distribution was achieved. 2) Intensive extension activities have been carried out. The research findings have been delivered to the collaborating growers initially and expanded to over 1,000 growers and interested stakeholders throughout the coastal areas by the end of the grant period. 3) The research findings have been delivered to scientists and regulators, several international conferences such as Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions, American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America International Annual Meetings, and the American Society for Horticultural Science Conferences. 4) The research findings have been distributed widely to the California strawberry industry by the end of grant period. For example, most growers have adopted LPF since the growing season of 2015. Starting from the collaborating growers, an increasing number of growers are adopting the multiple drip fumigant technology. 5) Based on research findings, two or more publications will be achieved beyond the grant period.

1) Before the project, there was no comprehensive data available for evaluating the LPF performance in soil fumigant behavior (especially regarding fumigant distribution in soil profile), pest control results, and strawberry production. The outcome of this project filled the knowledge gap very well.
2) Before the project, growers rarely use LPF because of the knowledge gap and higher price. Based on the research findings of this project, almost all growers have used LPF in their fields because of the excellent fumigant emission control and improved pest control results since the growing season of 2015.

3) The LPF covering improved fumigant distribution, pest control, and berry production than the PE covering or non-fumigant control.
4) With the broad adoption of LPF, the fumigant emission can be reduced >90% of that from PE covered beds.
5) The LPF covering allow growers to reduce fumigant rate 50%, which may still show similar pest control results as a full rate fumigation under PE film.
6) This project provided a novel soil fumigation strategy by increasing drip tape numbers to improve soil fumigant distribution.
7) An increasing number of growers are adopting the multiple drip fumigation technology based on the research findings of the project.

The major successful outcomes of the projects include: 1) this project provided timely information in soil fumigation under LPF, 2) the project encouraged most growers to use LPF in their fields, 3) >90% fumigation emission has been controlled by LPF in comparison with PE, which will further improve environmental quality, 4) the adoption of LPF will allow growers to reduce fumigant application by 50%, if the current application under PE can achieve the desired pest control results in their fields, 5) this project showed a novel and improved fumigation strategy by increasing drip tape numbers under LPF.

## Beneficiaries

The project is mainly for the benefit of the California strawberry industry. Most California strawberries are produced in PE film covered raised-bed production systems with drip-fumigation for pest control. However, fumigant emission concerns are driving many regulatory decisions that may impact productivity and economic viability of California strawberry. Meanwhile, growers are facing challenges in controlling critical pests such as fusarium and nutsedge.

This project evaluated and demonstrated the optimized fumigation strategy with LPF covering and/or 4-drip tape layout on pest control, strawberry production, fumigant distribution, and fumigant emissions in raised bed systems. The information developed and the technology transfer efforts from this project may help the California strawberry industry maintain soil fumigant availability and ensure the leading position in both domestic and international markets.

The comprehensive field data was collected in the typical strawberry soils in coastal region of California, which represents the most important strawberry production areas in California. The research findings have been delivered to the strawberry industry in a timely manner, i.e., initially to the collaborating growers and their neighbors and expanding to over 1,000 growers and interested stakeholders by the end of the grant period through various extension efforts. The data has been presented to scientists and regulators at the international conferences. By the end of grant period, most growers have utilized LPF in their fields and an increasing number of growers are adopting the 4-drip tape layout in their fumigation practices. The optimized fumigation technology from this project will help growers maintain the availability of soil fumigant, meet the regulatory requirements in fumigant emission control, avoid crop loss/failure from critical pest pressure, and reduce fumigant material costs. As a consequence, the California strawberry industry will still maintain the leading position in both domestic and international market. In the long run, this project will be a benefit to the air quality of California because of significantly reduced fumigant emission.

## Lessons Learned

Several important factors contributed to the success of the project: 1) Good research team ensured the success of the project. This project is based on comprehensive research/extension activities including multiple subjects such as soil fumigant behavior, pest control, and crop productions. Meanwhile, both research and extension specialists are very important in this project. 2) Good communication among the research team and with collaborators allows the research team to achieve the optimal results. 3) Good soil preparation is the key factor in securing the success of the soil fumigation. In this project, both growers' farm crew prepared the soil very well. As a result, the good performances of LPF were well showed in the experiments. However, in case that the soil is not well prepared (e.g., the soil is too dry with many large clods), the LPF properties might be damaged and the performance of LPF might be compromised. 4) Good and sustainable performance of film is critical in retaining fumigants in soil, reducing fumigant emission, and improving pest control results and berry production. Ideally, it is necessary to have the film permeability information (before use and after 7-10 days field use) for all the available films in the market, which will help growers and regulatory agencies in selecting the right type of films and achieve the optimal fumigant emission control target. 5) Flexibility is important for conducting a successful project. For example, in this project, the recycled plastic film was dropped because it was not available. Meanwhile, based on the actual field status, the research team proposed and tested 4-drip tape layout which further improved soil fumigation results in comparison with the conventional 2-drip tape layout. 6) More field data should be collected for optimizing the 4-drip tape fumigation technology and for facilitating the adoption of this new technology. 7) As the currently available fumigants, e.g., CP and/or 1,3-D are not well distributed in the soil profile. New fumigants or fumigant application method should be studied to assure the ideal pest control targets.

Almost all the expected outcomes or results have been achieved in the project. Two major changes were made to the project due to logistical issues or updated research results. 1) The recycled plastic film is not available from the manufacturer and was dropped. Currently the production of this recycled film is stopped because the company needs to go through the environmental assessment process. Since this film is mainly made from recycled PE collected from field, its performance in soil fumigation is expected to be similar to PE. Thus, lack of this film does not have significant impact on the emissions and pest control aspects of the project. 2) 4-drip tape layout were added in the project, such as 4 parallel drip tapes or 2 shallow plus 2 deep drip tapes, with the target of improving fumigant distribution and pest control results. The new drip tape layout shows superior results compared to the conventional 2-drip tape layout. This modification further improves the soil fumigation technology, which is one of the major outcomes of the projects.

The goals and outcome measures were achieved successfully in the project.

## Additional Information

A few represenative presentations are included here. Being the farm advisor of strawberry and vegetable crops, the co-PI has played a very important role in delivering the extension results by using various methods (e.g., field visits, informal meetings and communications with growers, orgainzing extension meetings and field days, and delivering information at various meetings.) The publications are being developed by the research team and they are expected to be available beyond the grant period.

Qin, R., O. Daugovish, S. Gao, J. Gerik, T. Gordon, H. Ajwa, and B. Hanson. 2016. Improving drip fumigation for strawberry production in California. *University of California Cooperative Extension*

*Ventura County Workshop: Fumigants and non-fumigant alternatives: regulatory and research updates.* Ventura, CA, April 2016.
Qin, R., O. Daugovish, S. Gao, J. Gerik, T. Gordon, H. Ajwa, and B. Hanson. 2016. Soil fumigation with multiple drip tapes in low permeability film covered raised-bed systems. *1st Soil Management Meeting*. Salinas, CA, February 2016.
Qin, R., O. Daugovish, S. Gao, B. Hanson, and J. Gerik. 2015. Optimizing fumigation efficiency by doubling drip line number and using low permeability film in raised-bed production systems. ASA, CSSA & SSSA 2015 International Annual Meetings. Minneapolis, MN.
Qin, R., O. Daugovish, S. Gao, B. Hanson, J. Gerik and H. Ajwa. 2015. Improving fumigation efficiency by increasing drip-tape number and using low permeability film in raised-bed production systems. American Society for Horticultural Science Annual Conference. New Orleans, LA.
Qin, R., O. Daugovish, S. Gao, B. Hanson, J. Gerik and H. Ajwa. 2015. Improving fumigation technology by doubling the number of drip tapes in raised-bed production systems. *University of California Cooperative Extension Ventura County Workshop: Fumigants and non-fumigant alternatives: regulatory and research updates.* Ventura, CA.
Qin, R., O. Daugovish, S. Gao, B. Hanson, J. Gerik and H. Ajwa. 2015. Improving fumigation technology in raised bed strawberry production systems. *2015 North American Berry Conference/ 8th North American Strawberry Symposium.* Ventura, CA.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 50 | **Project Title:** Towards Sustainability of Lettuce Production through Breeding Approaches to Increase Water and Nitrogen Use Efficiency. | |
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| **Grant Recipient:** Cal Poly Pomona Foundation, Inc | **Grant Agreement No.:** SCB13050 | **Date Submitted:** December 2016 |
| **Recipient Contact:** David Still | **Telephone:** (909) 869-2138 | **Email:** dwstill@cpp.edu |

## Project Summary

Lettuce crops are the sixth, most valuable commodity and are harvested from more than 206,000 acres of land in California, but lettuce requires a dependable supply of high quality water and relatively high amounts of nitrogen fertilizers to produce a marketable crop. Water is becoming a less predictable and scarce commodity in California due to global warming. Allocations from a limited water supply are made to urban areas and the environment, resulting in less water available to support agriculture. Ironically, the nitrogen fertilizers used to produce crops volatilizes to nitrous oxide, a potent greenhouse gas, which further drives global warming. Nitrogen has other environmental impacts, including nitrate leaching, which has the potential to contaminate groundwater and drinking supplies. Developing lettuce cultivars that use less water and nitrogen will ensure the sustainability of this crop in California while mitigating environmental impacts.

California supplies the United States with approximately 76% of the commercially produced lettuce. It is a valuable commodity for this state with a farm-gate value of $1.5 to 2 billion annually. It is planted or harvested on 753 farms every day of the year. In addition to the farms that produce the crop, many allied commercial enterprises specialize in pre-harvest and post-harvest activities and processing that are needed to bring the crop to consumers. Thus, the economic impact of this crop is greater than the $2 billion farm gate value. Climate models predict more severe and prolonged droughts for California. The amount of nitrous oxides from fertilizers is underestimated by several-fold. To ensure lettuce production remains a viable industry in the state, the crop must be adapted to use less water and nitrogen fertilizers.

This project was the beginning steps to develop lettuce cultivars that are adapted to lower water and nitrogen inputs. Because the beginning and end of droughts cannot be predicted, coupled with a typical sever to eight year lettuce breeding cycle, developing lettuce cultivars with better water and nitrogen use efficiencies could not have been delayed.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

The overall goal of this project was to determine the variation in water and nitrogen use efficiency in lettuce germplasm grown under limited water and nitrogen and to identify quantitative trait loci (QTL) associated with these traits.

Detailed field studies were conducted followed by genetic analyses to establish the association between QTL and water use efficiency (WUE), nitrogen use efficiency (NUE) and components of these traits (yield, carbon (C) and nitrogen (N) concentration, C and N isotope discrimination). This study established QTL markers based on single nucleotide polymorphisms and can be utilized by other researchers and breeders to develop

cultivars with improved WUE and NUE using their own proprietary materials. Conducting a multi-year study at two locations provided knowledge of trait stability across environments and indicated the complexity of both WUE and NUE.

In each of the three years, a recombinant inbred line (RIL) population was grown that consisted of 152 F10 families that was developed from single seed descent from a cross between cv. Diplomat and cv. Margarita, an iceberg and butter head type, respectively. A total of 30 cultivars were grown as commercial checks in each production year and location. The RIL population was evaluated under two different water/N treatments, a non-limiting high water/high N and a limited water/limited N treatment (130% ETo/100%N and 65%ETo/50%N, respectively).

Horticultural quality, yield and physiological status were evaluated on plants grown under both water/N treatments. This included assessment of 152 RIL families and 30 commercial cultivars. No difference in quality was observed between the high water/high N and limited water/limited N treatments. Specifically leaf color, tipburn and premature bolting did not differ between treatments.

Yield at market maturity was measured in each of the three years for both treatments. In year 1, there were no differences in yield between the genotypes produced under high water/high N and those produced in limited water/limited N. In year two, the yield was greater in those produced under limited water/limited N, whereas in year three, yield was higher in the high water/high N treatment.

Water stress was assessed using isotope analyses of 13C. C isotope discrimination (Δ13C values) is a measure of the amount of stress experienced by the plants due to limited water availability and is integrated over the entire crop cycle. In each year of the study, there were no differences in Δ13C values between the high water/high N and limited water/limited N treatments. This indicates that despite receiving half the water, plants grown under the limited water/limited N (65% ETo/50% N) treatment did not experience stress due to water deficit. This was a surprising finding since measurements of soil water potential were substantially lower in the low water treatment plots, indicating less water available.

Water use efficiency was defined on a whole plant basis, with the amount of biomass produced per unit of water applied (grams of fresh weight at market maturity per cubic meter of water applied). From that perspective, plants grown on the limited water/limited N treatment had 64, 51 and 55% greater WUE for Years 1, 2 and 3, respectively, than those grown in the high water/high N treatment.

N use efficiency can be expressed as the amount of yield per N applied (grams of fresh weight at market maturity per Kg N applied). By this measure, plants grown under the limited water/limited N treatment had 47, 51, and 55% greater NUE for Years 1, 2 and 3, respectively, than those grown under the high water/high N treatment. N use efficiency can be observed at a cellular/tissue level by obtaining the C and N content of oven-dried plants and obtaining the ratio of C concentration to the N concentration. Using this measure, the plants grown under limited water/limited N had higher C:N ratios in all years, but were statistically significant in year 2 and year 3, but not year 1.

N use efficiency is affected by two mechanisms, 1) root uptake and transport to leaves and 2) assimilation into organic N in leaves. The leaf N concentration reflects this efficiency. The N concentration in leaves was

higher in plants grown under the high water/high N treatment than the limited water/limited N treatment in all years, but was statistically different in year 2 and year 3, but not year 1.
The mechanisms plants use to uptake and assimilate N depends on the concentration and form (ammonium versus nitrate) in the soil. Based on these results and other experiments performed in the lab, project staff postulate that the 15N isotope discrimination reflects different N forms and concentrations in the soil and metabolism used by lettuce under different N field conditions. The leaf 15N values from plants harvested at market maturity were 1.8, 1.9 and 2.2 times higher in the plants grown under limited water/limited N treatments compared to the high water/high N treatment plants.

The experiments utilized a recombinant inbred line of lettuce for the purpose of identifying and mapping QTL associated with water and N use efficiency. In each of the three years, QTL were identified and mapped for C and N isotope discrimination (Δ13C, 15N), C and N concentration, WUE and NUE. Significantly, a portion of the QTL were identified under the limited water/limited N treatment but were not present in the high water/high N treatment. This supports the previous observation that lettuce uses different mechanisms to grow under limited water/limited N than it uses to grow when water and N are abundant. Importantly, project staff observed in three genotypes, 86% of the leaf N under limited water/limited N than the best performing genotypes that were grown in high water/high N conditions.

The research conducted, specifically and directly, benefited the economic competitiveness of lettuce and no other commodities.

Two of the three lettuce crops were produced at the Yuma Agriculture Center, which is located in the center of the low desert lettuce production area. Their farming methods, climate and soil are similar to those that affect the commercial growers that operate in the low desert production area, ensuring the results obtained by this project are widely applicable to the industry.

## Goals and Outcomes Achieved

The Diplomat x Margarita RIL was grown in three production years and the water use and N use efficiency assessed at market maturity. Field performance was evaluated on the RIL population grown under high water/high N and limited water/limited N conditions.

Water and NUE were assessed using C and isotope discrimination. WUE and NUE were assessed at a whole-plant level using yield per unit of water or N applied. Isotope discrimination revealed physiological mechanisms used by the plants when grown under the high water/high N and limited water/limited N treatments.

Growing the RIL population over three years and two different areas provided assessment of the environmental stability of QTL associated with WUE and NUE and the components of WUE and NUE.

Matching funds allowed the project to develop and utilize a new genetic map and provided the basis for developing genetic markers that are anchored to the lettuce physical map and genetic maps published by other labs. Through the activities described above, each of the expected measurable outcomes were achieved. Specifically, QTL associated with WUE and NUE using two different metrics were identified. One major QTL associated with WUE explained 24% of the variation, and two QTL associated with NUE and leaf N

concentration was identified. There are no published reports of QTL associated with WUE, NUE or N concentration.

The data from this project support the conclusion that N metabolism varies quite significantly from one environment to another (field or year). The N isotope discrimination differences between the high and limited N treatments clearly indicate lettuce plants use different metabolic and mechanistic pathways to translocate and assimilate N. This work establishes the markers that are associated with WUE, NUE and the components that contribute to these traits. This work establishes methodologies for conducting WUE and NUE studies in lettuce and WUE and NUE germplasm benchmarks for lettuce researchers and breeders.

Each year, three to five undergraduate students were trained. For harvests and sample preparation, the number of students involved was as high as nine. The students learned how to organize a large project for planting, harvesting, and sample preparation. Others learned to calculate and implement irrigation based on ET, how to calculate and apply the correct amount of water and fertilizers, how to harvest and prepare samples, collect, organize, analyze and display data.

Each year of the project, a postdoc was involved in overseeing and organizing the project. The postdoc was likewise trained in the field components of the project and devised and implemented the postharvest data collection and isotope analyses. The postdoc constructed the genetic map, identified and mapped QTL, assisted and presented data for meetings and is currently involved with preparing a manuscript.

The results of this project were presented through outreach activities including oral presentations and posters presented at grower/industry conferences. Presentations to the Annual Research Conference of the California Leafy Green Research Board (CLGRB) on: 18 March 2014; 17 March 2015; 15 March 2016. Each year the conference was held in Coalinga, California and each conference included 150-200 growers and industry personnel from the lettuce industry.

Each year oral presentations were made at the field day held at the United States Department of Agriculture, Agricultural Research Service station in Salinas, California on 8 October 2013, 7 October 2014 and 6 October 2015. At each meeting, approximately 20-30 industry and CLGRB members attended.

Poster presentations were made at academic conferences:
Breeding lettuce to increase nutritional content across multiple environments. Plant and Animal Genome Conference, XXIII, San Diego, California. January 13, 2015.

Breeding lettuce for improved water and N use efficiency. Plant and Animal Genome XXIV Conference, San Diego, California, January 9-13, 2016.

Toward improved water use and N use efficiency in lettuce: mapping QTL associated with N and water use efficiency. Poster presented at the American Society of Plant Biologists Annual Meeting, Minneapolis, Minnesota, 26–30 July 2015.

The outcomes achieved in this project represent the first steps to develop the tools and knowledge needed to improve WUE and NUE in lettuce. The release of lettuce germplasm with these improved traits by public and industry breeders is several years into the future but will be based on this and similar research.

The long-term goals of this project are to improve WUE and NUE in lettuce through genetic improvement. To achieve this, the tools in form of DNA-based markers and knowledge of the physiology, morphology, biochemical pathways must be understood. Ultimately, genes must be identified that can be targeted that can materially improve WUE and NUE.

To that end, a series of short-term goals were set forth and achieved. The goals of this project were to: Identify quantitative trait loci associated with WUE and NUE. Project staff discovered multiple loci that are associated with WUE and NUE.

Assess the environmental stability of these QTL. The experiments were performed across three different years and two production locations. The data clearly indicated environmental effects on the QTL with some loci being present every year while other loci were not. Further, QTL were present in one treatment or the other, indicating different mechanisms used by lettuce to adapt to limited water/limited N. Thus, project staff fully accomplished the goals set forth for the project.

This project establishes the baseline data by identifying loci associated with NUE and WUE using both isotope discrimination and whole-plant methods. It establishes DNA-based markers that can be used by public and industry breeders in their WUE/NUE breeding program. It establishes baseline data for both WUE and NUE under high water/high N conditions that the industry uses, as well as baseline data for lettuce produced under limited WUE and NUE.

Highlighted accomplishments are: Multiple quantitative trait loci associated with WUE and NUE were identified. One QTL associated with WUE accounted for 24% of the variation. A second QTL associated with NUE was identified that accounted for 17% of the variation. A third QTL was identified with N concentration that accounted for 17% of the variation in the population. DNA-based markers were established that will facilitate breeding for improved NUE and WUE. Baseline data was established for WUE and NUE based on industry practices and under limited water/limited N inputs. Biological and genetic insight was gained from the isotope experimental approach that will establish the basis to more fully understand how to improve lettuce and directly identify the genes underlying the QTL identified in this project.

## Beneficiaries

Public and industry researchers will benefit from this project since it provides methodology for studying WUE and NUE and establishes baseline data based on whole-plant and isotope analyses. Public and industry plant breeders will benefit from this project since it identified loci and developed molecular markers that can be used to develop germplasm. The long term beneficiaries will be the lettuce industry and growers across 750 farms in California that are commercial producers of lettuce. This research will lead to producing lettuce using less water and N over 206,000 acres, and lower the environmental footprint of lettuce production.

## Lessons Learned

Irrigation management was a key component to this research project that project staff accumulated expertise in over time. Remote sensing of soil and plants would have added an additional layer to interpreting the results. Augmented experimental designs were important to keep the project costs down while screening the large number of entries needed to develop genetic maps and identify QTL.

The complexity and environmental variation of the N cycle in the field and N metabolism in the plants was unexpected but all project goals were accomplished.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 51 | **Project Title:** Biobased Matrix with Encapsulated Microbes as Substitute for Synthetic Fertilizers and Pesticides | |
|---|---|---|
| **Grant Recipient:** United States Department of Agriculture, Agricultural Research Service | **Grant Agreement No.:** SCB13051 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Charles Myers | **Telephone:** (510) 559-5769 | **Email:** Chuck.myers@ars.usda.gov |

## Project Summary

To obtain higher specialty crop yields, U.S. farmers have increasingly become dependent on synthetic fertilizers and pesticides. Use of these chemicals over the past decades has severely diminished the quality and quantity of beneficial microbes in soil as well as their capacity to carry out useful biological activities. These microbes secrete enzymes and other useful compounds that help plants fix nitrogen, produce humic acids, and solubilize sulfates, phosphates, and potassium. However, these microbes exist in low concentrations in soil due to increased chemical use. Also, only 30-40% of applied fertilizer is used by plants. The rest is lost and contaminates the environment. A novel matrix (U.S. Patent #8865214 B1) has been developed by U.S. Department of Agriculture scientists in Albany, California to encapsulate these microbes. This product contains selected naturally-occurring soil microbes encapsulated in a bio-based porous matrix made from gypsum and starch. Preliminary green house and small-scale field trials (one acre) have shown improved plant growth and yields. These matrix formulations can be used to stop and reverse the deterioration of agricultural soils caused by continuous use of fertilizers and pesticides and offer an environmentally-friendly alternative to the synthetic chemicals. The objectives of this project were to (1) further develop matrix formulations with encapsulated microbes for use on onion, strawberry, and tomato crops, (2) develop pilot scale production capabilities to produce the matrix formulations, and (3) conduct field trials with onion, tomato, and strawberry growers.

The use of bio-based matrix formulations directly aligns with the goal to implement beneficial management practices that improve farm viability and the agricultural economy as well as the environment. The use of matrix formulations is a beneficial management practice because if successful, it could result in overall higher specialty crop yields, better soil health, more sustainable agriculture, and it would help reduce the impact of agriculture on the environment. Since the encapsulated microbes may survive for more than one growing season, only a few applications may be necessary to be effective. This is an advantage over fertilizers which are typically applied multiple times during a crop growing season. The exploitation of beneficial soil microbes should improve farm viability and the agricultural economy. In addition, the replacement of fertilizer by the matrix formulation reduces environmental contamination from farming. The heavy use of fertilizers in agricultural regions of California is thought to be an important contributor to elevated nitrates in ground water. Using less fertilizers will reduce the overall amounts of nitrate fertilizers that percolate through the soil profile and into the ground water reserves.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

There were three objectives to the project. Objective 1 was to further develop matrix formulations with encapsulated microbes for use on onion, strawberry, and tomato crops. Objective 2 was to develop pilot-scale production capabilities to produce the matrix formulations. Objective 3 was to conduct field trials with onion, tomato, and strawberry growers. Initially, this work was to have been done in close association with a specific supplier of beneficial soil microbes. When it became apparent the initial company was unable to cooperate on the project, other suppliers (Flozyme Corp., Biogro, and Sentinel) were contacted to participate as suppliers for the project and efforts began to isolate phosphorous solubilizing bacteria that could be used to reduce the fertilizer requirement for phosphorous in crop growth.

A key milestone was to scale-up the manufacture of the starch/gypsum matrix material. The matrix material was originally made using an extrusion process. However, an agglomeration process was tested and found to be very effective for making the encapsulated granules. Agglomeration is inexpensive and very easy to scale-up with minimal capital costs. The milling equipment requested in the original proposal was not needed for the agglomeration process used for this project so the equipment was not purchased. The research trials were conducted on research farms instead of grower fields as originally planned for two reasons; the farmers that project staff spoke with were not equipped to run multiple treatments with replicates and the new suppliers' products were still not certified for commercial use in California. Two tomato trials and one onion trial were conducted at a farm in Escalon, California. Mineral analyses were performed. A second onion trial and two strawberry trials were performed at a research farm located near San Luis Obispo, California. Soil analyses were performed before and after the growing season.

There were several considerations that determined the approach to field trials. As mentioned earlier, the supplier of beneficial microbes that had originally agreed to collaborate on the project and had done extensive field trials in California stopped operation for two years just as the project got underway. Other suppliers were found to supply the microbes for the project. A second supplier stopped operations soon after supplying microbes for the first trial. In short, this industry sector is quickly developing and changing. A program was initiated in the laboratory to isolate beneficial soil microbes and test them in the greenhouse as a hedge against other suppliers halting production.

Fertilizer-treated controls were run in all of the trials. This was done to know whether the microbial treatments boosted the production compared to the controls without microbes. Various treatments were also run of the liquid mixtures of microbes that were encapsulated in the starch/gypsum matrix material. This was done to establish that the liquid microbial product was indeed effective and to determine whether the matrix material would be as effective as the liquid.

In the initial tomato trial, microbial products from Inogro and Sentinel Biologix were tested. The microbial products were encapsulated in the starch/gypsum matrix using the agglomeration process described earlier. The tomato trial included both the liquid product that was encapsulated in the matrix material and the matrix material itself. This trial was designed to show how effective the liquid product was in reducing fertilizer requirements compared to the matrix encapsulated product. Humic acid that did not contain any microbial additives was also tested as a control since the Inogro product had humic acid as a carrier. The humic acid control was included to determine the effect of humic acid itself on the crop production. This trial also contained an autoclaved liquid product in which all of the microbes were killed. Since the primary goal was to determine whether the treatments could reduce the fertilizer requirement, fertilizer levels of 0%, 50%, and

100% were tested. Liquid treatments were actually applied first to the greenhouse seedlings. Since the seedlings were being transplanted into the field, it seemed reasonable that by inoculating the soil in the greenhouse would lead to a better result in the field when the transplant and its soil ball were planted in the field.

The results of the first tomato trial were surprising. There were no significant treatment effects detected, even among the controls receiving a range of fertilizer from 0% to 100%. Overall, the amount of variation in the data precluded any hope of seeing any treatment effects. The most telling data was for the control samples that received no treatment other than the fertilizer treatment. The mean yield for plots receiving no fertilizer was actually higher than for the plots receiving 100% fertilization. The result could be indicative of a very high nutrient content in the field to start the experiment such that there was very little additional response on plots that received additional fertilizer. The soil analysis taken before the tomatoes were transplanted into the field showed a high level of phosphorous and potassium and moderate levels of nitrogen. The farm manager indicated that a preplant fertilizer had been applied to the field in early spring. This could have been responsible for the poor fertilizer response observed. The excessive variation in the data also made it difficult to detect treatment differences. The decision was made to run a second tomato trial on plots that had received no preplant fertilization.

A second trial for tomatoes was started March 2015. The trial was conducted at an agricultural research farm near Escalon, California, on Sunseed 6366 variety of processing tomato. The experimental design was simplified by using only nine treatments. The treatments included controls receiving 0%, 40%, 70%, and 100% fertilization. The microbial treatment was a product called Bontera. This product was tested since the Inogro and Sentinel products were no longer available. The Bontera liquid microbial product was encapsulated into the starch/gypsum matrix. The matrix was tested at three levels of fertilization (0%, 40%, and 70%) while the liquid material was tested at two levels of fertilization (40% and 70%). The tomato seedlings were first treated in the greenhouse to inoculate the soil that would be placed into the field along with the tomato transplants. The seedlings were transplanted into the field on April 10, 2015. At the time of transplanting the seedlings, the matrix treatment was first applied into each transplant hole of the appropriate treatment and mixed well before adding the seedling. Liquid Bontera was added to the transplant hole at the time of transplanting only for the liquid treated plots. Additional Bontera liquid applications were made to just the plots with the liquid treatment. The liquid treatment was applied through the drip system at three and six weeks after transplanting the tomato seedlings. The application rate was according to the supplier's recommendation. No phytotoxicity was observed in any of the plots at any time during the trial. Irrigation was by drip irrigation and the different fertilizer regimes were applied through the drip system. Individual drip lines were provided for each of the fertilizer levels for the respective replicates in each fertilizer regime. Also, separate drip lines were established to administer the Bontera Liquid at the three and six weeks post plant applications. All drip applications were conducted using a Dosatron drip injector.

There were various parameters measured for the plants but the parameter of most interest in all of the trials was the total yield. The data for total yield were analyzed for the second tomato trial. The variability was very high again but there were two treatments (Matrix with 70% fertilization and the Control with 100% fertilization) that were significantly greater than the unfertilized control. Some may interpret this result and erroneously conclude that the matrix treatment with 70% fertilization is able to reduce the fertilizer requirement by 30% based on the fact that there was no significant difference between the yield of the control with 100% fertilization and the yield of the matrix material with 70% fertilization. The only valid statistical

conclusion from the second tomato trial was that the matrix treatment with 70% fertilization and the control with 100% fertilization had significantly higher yield than the unfertilized control. This is probably indicative of a fertilizer effect. The plots that had the matrix treatments were generally higher than the controls with similar amounts of fertilization. The one exception was that the control with 40% fertilization was higher than the matrix treatment with 40% fertilization.

For the first onion trial, a yellow onion variety was planted by seed March 2015. The soil analysis was performed before the onion seed was sowed. The field plots received no pre-plant fertilizer in 2015. This was done to try to deplete the soil nutrient levels somewhat and help accentuate the treatment effects. The matrix was broadcast on the soil surface at the time the onion seed was sown. This experiment was designed such that the effects of fertilization on crop yield could be observed. The same treatments used in the second tomato trial were used for the onions. The controls had 0%, 40%, 70%, and 100% of the normal fertilization applied during the growing season. The matrix treatments were applied along with different amounts of fertilization (0%, 40%, and 70%). Two liquid treatments of liquid microbial product were included in the study at 40% and 70% fertilization. The liquid Bontera product was sprayed on the soil surface followed by sprinkler irrigation to ensure the liquid product percolated down through the soil profile.

Soil analyses was performed before, during, and after crop growing season. The project team found in field trials in 2014 that the matrix treatment and liquid treatments had no discernible effect on soil nutrient levels. Tissue analysis was also performed in 2014 to determine whether the treatments increased the level of Nitrogen (N), Phosphorous (P), and Potassium (K) in the plant tissues. However, the data was variable and no significant effect was observed. Consequently, the extensive amount of soil testing was curtailed from what was originally planned. Soil analyses were taken only before planting to determine the initial soil nutrient levels. The pre-plant soil nutrient levels were important to know since it had direct bearing on whether the crop would respond to additional fertilizer applied during the growing season. The main focus was to determine whether the treatments affected the crop yields which, was of most interest to growers.

Since the onions were a later variety and were planted later in the year, the onions were harvested near the end of September 2015. The onions received no pesticide treatment during the growing season. The onion yield was recorded for each treatment. The onion root structure and condition was observed. There were no infections observed in any of the treatments or controls. The yield data for each treatment was analyzed. The results showed that there were no treatment differences. The variability in the data appeared to be excessive. The coefficient of variation (CV) should be less than 15% for field trials. When the CV is much higher than that, there is a risk that real differences will not be detected. The CV for the onion yield data ranged from 9.8% to 66.3%. The data of only two of the treatments had a CV of 15% or below. The results indicate that neither fertilizer nor the matrix treatments significantly affected onion yields.

Conclusions for this trial were that the effect of the matrix treatment on disease and bulb rot was not apparent from the data because there was no disease or rot in any of the treatments including the controls that did not receive the matrix treatment. The data variability for the onion was higher than that of the tomato trials. This is probably due to the fact that the tomato trials were planted with seedling transplants from the greenhouse. The onion trials were seeded in the field which inherently introduces more variability. The onion data indicated that neither fertilizer nor the matrix treatment affect yield. The poor yield response to fertilization could be due to the high level of soil nutrition when the study began. The pre-plant soil analysis indicated very high levels of P, medium to high levels of K, and medium levels of N. A greater fertilizer and matrix

response could be expected in trials performed on nutrient-poor soils. The matrix or any other microbial product will not be as effective on nutrient rich soils.

A second onion (Walla Walla) trial was conducted to try to reduce the variability of the data and better detect treatment differences. The onion trial included six replicates instead of four and onion transplants were used instead of sowing seed in the field. These two changes in approach were designed to improve the ability to detect treatment effects. The trial started March 2016 on a research farm in Guadalupe, California. The products tested were the Bontera product and a new product from L.H. Organics. Both products were encapsulated in the starch/gypsum matrix. Also, a control that consisted of the starch/gypsum matrix alone (no microbes) was tested. In addition, the Bontera liquid was tested. The matrix granules were broadcast onto the plots and worked into the soil as would be expected for commercial applications of this product. The liquid product was initially applied by a sprayer and soaked into the soil with sprinkler irrigation. The sprinkler irrigation was used for the first ten days after transplanting onion seedlings to ensure the seedlings were established. Subsequently, the onions were irrigated by drip irrigation. Liquid treatments of Bontera liquid were made through the drip irrigation at four and eight weeks after transplanting the onions. Fertilizer treatments were made through the drip system. There was no phytotoxicity observed in any of the treatments. The trial lasted 17 weeks and the onions were harvested July 2016. The onions were sized and weighed and the data were recorded. The effect of the fertilizer was very apparent. The trials with no fertilizer had higher amounts of small and medium-sized onions. The fertilized plots had higher amounts of L, XL, XXL onions. Based on the clear fertilizer response, it is readily apparent that adding fertilizer beyond 70% of the recommended rate will give only a small yield response if any. In this trial, only the BL treatment was consistent in giving an increase in onion yield. However, the effect was minor and not statistically different from the control. There was no increase in yield for plots receiving the matrix treatment compared to the controls.

There were two strawberry trials conducted at a research farm in Guadalupe, California. The first trial was conducted on soil with no chemical sterilant treatment. Strawberries are typically cultivated on soil that has been chemically sterilized with methyl bromide or another comparable product. This trial was conducted without the use of a sterilant to determine whether the microbial treatment would be able to protect the plants from soil-borne diseases and stimulate production on a non-sterile soil. The trial had treatments that included controls receiving 0%, 40%, 70%, and 100% fertilization. The microbial product was Bontera. The Bontera liquid microbial product was encapsulated into the starch/gypsum matrix. The matrix was tested at three levels of fertilization (0%, 40%, and 70%) while the liquid material was tested at two levels of fertilization (40% and 70%). The matrix was added in measured quantities into the transplant hole of the strawberries at the time of planting. The study was initiated on July 8, 2015 and completed on December 10, 2015. The strawberry trial coincidentally was conducted next to a trial from another research that had prepared the site by sterilizing the soil. The difference between the trials on non-sterile versus sterile soil was dramatic. Four weeks before terminating the strawberry trial, photographs were taken. There were many plants that had died in this first trial due to choosing not to sterilize the soil ahead of time.

The conclusion of this study indicated that the microbial treatments were virtually ineffective in controlling soil-borne diseases in strawberries grown on unsterilized soil. Due to the lack of plant vigor and growth, the data was variable and no significant treatment effects could be detected. Mean values for marketable yields were higher on the plots treated with either the liquid or matrix products and 40% of the normal level of

fertilizer. However, these differences were not significant. Farmers would not be recommended to use the microbial treatment without pre-plant soil sterilization treatments.

A second strawberry trial was contracted with a company conducted in Guadalupe, CA and services were contracted with Pacific Ag Research. The trial consisted of ten treatments with four replicates using plots that were 3.3 feet by 50 feet. A randomized complete block experimental design was used. The trial was initiated in November 2015 and terminated June 2016. The plot soil was 79% sand, 10% silt, and 11% clay, the pH was 7.3, cation exchange capacity was 6.9 meq/100g, and organic matter content was 0.6%. The soil was fumigated with PicChlor 60 EC at 30gal/acre three weeks before transplantation. The trial was planted with strawberry transplants (cv. Monterey) on November 30, 2015 on raised beds covered with polyethylene film as is typical for the industry. Plant spacing within rows was 14 inches and planting density was 22,500 plants per acre. The treatments consisted of fertilizer at rates of 0%, 40%, 70%, and 100%. Bontera and L.H. Organics microbial products were encapsulated in the starch/gypsum matrix. Both matrix products were tested at 0%, 40%, and 70% fertilization. No liquid products were tested in this trial. The granular matrix product was added (3 grams) to the transplant hole at the time of planting just before adding the transplant. The fertilizer treatments were added through the drip irrigation system at regular intervals throughout the growing season.

The experimental trial was well managed and the data are much better compared to trial #1. The results showed that fertilizer is a major factor in improving the crop yields. However, the matrix treatment had no significant effect on yields except for the L.H. Organics material at 70% fertilization that was significantly lower than the control with 70% fertilization.

Soil analyses were performed before various trials and then again at the end of the trials. Generally speaking, there was no correlation between the various treatments and the nutrient levels.

This project does not enhance the competitiveness of non-specialty crops. The bio-based matrix formulations was only applied to fields growing onion, strawberry, and tomato, which are specialty crops.

Beneficial soil microbe formulations were generously provided by Inogro, Flozyme Inc., Biogro, Sentinel Biologix, and L.H. Organics. All of the microbial products were encapsulated in the starch/gypsum matrix. These products comprised the granular material used in various onion, tomato, and strawberry trials.

## Goals and Outcomes Achieved

One of the proposed goals and outcomes was to reduce the amount of fertilizers and pesticides used by onion, strawberry, and tomato growers after their replacement with the novel bio-based matrix formulations. The first measurable outcome involved measuring how much the encapsulated beneficial soil microbes reduced the fertilizer and pesticide requirements. The best measurement to demonstrate this outcome was yield. Yield is ultimately the parameter that is important to farmers. Four different microbial products were tested during the course of the project. Trials were conducted on specialty crops including tomatoes, onions, and strawberries. There was no consistent positive effect of the microbial treatments on yield for tomatoes, onions, and strawberries. For onions, there was no significant loss due to disease in either the treatments or the controls.

Another one of the proposed goals and outcomes was to perform large-scale field trials using the matrix formulations. This work was to be performed in partnership with a company who had the microbial product to be evaluated and the relationship with farmers for conducting field trials. The project plan had to be modified due to the company's suspension of operations and production. Four different sources of microbes were tested on research field plots to determine their efficacy. No large-scale field trials were conducted in part due to the suspension of the company but also because farmers approached were unwilling to run replicates or evaluate more than one treatment. For these reasons, all new microbial products were tested only on research plots. Another of the proposed outcomes was to calculate from these trials, the total reduction in fertilizer and pesticide use. The results of the trials indicated that there was not enough difference in the yield among the different treatments to rule out that the differences were due to random variation. Therefore, based on the results of the study, the project team cannot recommend the use of microbial products that were tested as a viable means for reducing fertilizer or pesticide use. The second measurable outcome was to number the growers who were implementing the use of the matrix material on their crops. This measurable outcome is premature because none of the suppliers have product that is certified for use in the state of California. Flozyme Corporation is in the process of certifying their product but it may still take several months. However, due to the limited effectiveness of the microbes on the specialty crops tested, it is not recommended that growers use the products tested until more effective materials can be developed.

In addition to reducing fertilizer usage, the goal was to reduce pesticide use. The first strawberry trial was grown on soil without the use of a chemical soil sterilant. This trial was performed to see how effective the treatments were in control soil-borne diseases in strawberry.

The objectives of the project were to (1) further develop matrix formulations with encapsulated microbes for onion, tomato, and strawberry crops, (2) develop pilot scale capabilities to produce the matrix formulations, and (3) conduct field trials with onion, tomato, and strawberry growers. The matrix material was further improved by developing a granulation process for encapsulating microbes supplied by companies for specialty crops. The granulation process was scaled-up to produce sufficient matrix material of the appropriate granule diameter to conduct field trials. Field trials were conducted on tomato, onion, and strawberry using research farms. The trials were all repeated twice in an attempt to improve upon the first trial for each crop.

The outcome measures were not long term. The outcome measures were completed for six trials of tomato, onion and strawberry.

The accomplishments were that the matrix material was further improved by developing a granulation process for encapsulating microbes supplied by companies for specialty crops. The granulation process was scaled-up to produce sufficient matrix material of the appropriate granule diameter to conduct field trials. Field trials were conducted on tomato, onion, and strawberry using research farms. The trials were all repeated twice in an attempt to improve upon the first trial for each crop.

At the onset of this project, a grower meeting was held where frustration was expressed about whether microbial products were effective or not. Some growers were running their own trials with inconsistent results. During the course of this project, it was striking how many new companies are springing up with products they claim are effective for specialty crops. Unfortunately, the microbial products tested in this project were not effective in significantly increasing the production of tomatoes, onions, or strawberries at the

application rates and field conditions tested. More research is necessary to develop more effective microbial products or to better hone the application rates.

Regarding the starch/gypsum matrix, an agglomeration process was developed for mass production of the encapsulated product. The matrix was effective in encapsulation based on laboratory tests that showed microbial activity when the matrix was placed in contact with water. No conclusion can be made regarding the effectiveness of the starch/gypsum matrix material in the field because the encapsulated microbes were shown in the liquid treatments to be ineffective in significantly increasing crop production. A positive effect would only be expected if the microbes were shown to work. The matrix material may work fine with other microbes that are more effective.

## Beneficiaries

Growers of specialty crops, specifically onion, tomato, and strawberry farms in California were benefited by the project. Data was presented from the study to a group of university staff, and other stakeholders at an invited talk given at UC Davis. In addition, the results of the research were communicated to other stakeholders including suppliers of beneficial soil microbes.

The number of beneficiaries of the project include 380 onion, 1782 tomato, and 729 strawberry farms in California.

## Lessons Learned

The use of beneficial soil microbes in agriculture has tremendous potential and is already being exploited commercially for specific applications such as in disease control and for nitrogen fixation in legumes. Expanding the use of beneficial soil microbes to improve the production of California specialty crops is a relatively new area of interest and could benefit farmers by reducing the amount of chemical inputs. Concerns about chemicals in ground water and in irrigation runoff are among the issues driving research to reduce chemical usage in fields. The results of this study may appear underwhelming but there were lessons learned that could help future research. The original plan was to work with a California producer of beneficial soil microbes and scale-up production of the starch/gypsum encapsulation matrix so that treatments could be made on plots of tomato, onion, and strawberry in farmer's fields. The problem encountered with working closely with a single, small producer of microbes was that the company originally chosen halted their production even before the project got underway. In future research, the investigators are advised to source their microbes from a larger, established company, if possible, with data to support their recommendations for application rates and methods. Investigators may also choose to use their own blend of microbes provided they have isolated and characterized the benefit of said microbes to plant growth in greenhouse or field trials.

Another lesson learned was that experimental field trials are best conducted on research farms. One large grower offered to run a single treatment of the material. However, they were not able to run replicates or multiple treatments. The data from this study showed that field variability can be quite high making it very difficult to determine whether differences are real or simply due to random variability. The grower meeting held at the Western Regional Research Center at the beginning of this study was attended by farmers that reported the microbial products they tested in their fields worked some years and not others. Due to the natural variation in field data, it is imperative that trials be designed with replicates and controls to determine whether the differences are real or random. It was determined early on that field trials are best done on a

research farm that has the resources and support to properly conduct field trials. It was also observed that the amount of variability can be minimized by using transplants rather than sowing a crop directly to the plots.

Another lesson learned is the importance of narrowing the scope of the project. The proposal for this project was written to address a reduction in fertilizers as well as pesticides. These factors really need to be addressed separately. As project staff saw with the strawberry trial run on unsterilized soil, pest and disease intrusion can easily increase the data variability to the point that any treatment effect is masked.

Another lesson learned is that the study should focus on the most important parameter, yield. If there is a difference in yield, then there is a reason to measure other parameters such as shoot and root weight, plant vigor, plant height, etc. Once it becomes apparent that differences in yield will be difficult to detect, there should be an adjustment so that other valuable time and resources are not spent needlessly on measurements that would are no longer pertinent.

One of the unexpected results of the project was the fertilizer response of the crops. In some trials, the variability of the individual plots was such that there was no significant yield response to fertilizer. However, when the plots were well prepared and when seedling transplants were used rather than seed, the uniformity was better and variability was minimized. When a proper fertilizer response was observed, the response curve was not linear. There was a much higher response when increasing the fertilizer treatment from 0% to 40% compared to the lower response when increasing the rate from 70% to 100%. In virtually all cases, there was little or no significant difference in yield when increasing the fertilization rate from 70% to 100%. This finding brings into question whether farmers should be adding the recommended fertilizer rate. From a business standpoint, it may be profitable to add an excess of fertilizer to reach a maximum yield response. However, this practice can be especially hard on the environment since there is more of a chance that more of the excess fertilizer is lost in the environment. The question arises about whether the fertilizer recommendations should be lowered. The fertilizer yield response issue can also influence product claims in a negative way. For instance, a study that has a treatment with 70% of normal fertilization may likely get a statistically similar yield to a control with 100% fertilization. The company representatives may erroneously claim that the treatment has replaced the need for 30% of the fertilizer requirement. Rather than base claims on the fact there is no significant difference between a treatment at one fertilizer rate and a control at a higher fertilizer rate, the claims should be restricted to whether there is a significant difference between a treatment and a control at the same level of fertilization.

The second expected measurable outcome listed in this project had very little chance of being met in retrospect. The commercial microbe suppliers are still developing their products in many cases. Secondly, none of the products tested are actually certified in the state of California for commercial field use. This information came to attention after the project was underway. Future investigators need to be aware of this issue before expecting farmers to begin using these products.

## Additional Information

Sharon, J., Glenn, G.M., Lee, C., Isolation of highly efficient phosphate solubilizing bacteria capable of enhancing plant growth. Journal of Soil Science and Plant Nutrition . Log#321229 (accepted 6/23/2016)
Attachment 1 – Tomato Trial
Attachment 2 – Onion Trial
Attachment 3 – Strawberry Trial

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 52 | **Project Title:** Microcalorimetry for the Rapid Assessment of Specialty Crop Salinity Tolerance | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis | **Grant Agreement No.:** SCB13052 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Lorence R. Oki | **Telephone:** (530) 754-4135 | **Email:** lroki@ucdavis.edu |

## Project Summary

Salts in soils and irrigation water limits plant productivity. Salt tolerances are unknown for a majority of specialty crops representing a fundamental lack of information regarding best management practices. The project has the ability to rapidly identify salt tolerances by developing a novel methodology. The results will assist growers and decision makers seeking to increase water-use efficiencies by utilizing recycled water. Recycled water is typically higher in salts and currently is not deemed suitable for many specialty crops until salt tolerances are reported.

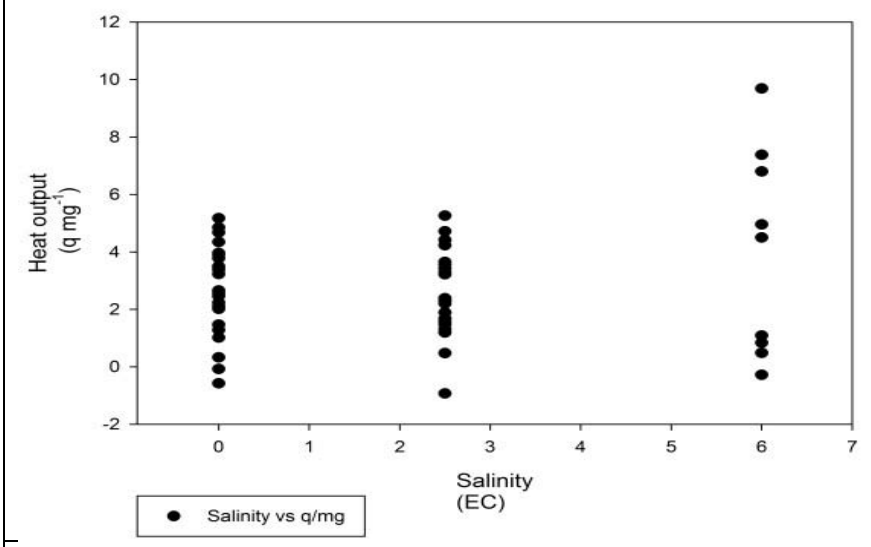
Currently, there is very little information regarding salt tolerances for a wide range of specialty crops. The main reason for the lack of information is that traditional methods for testing salt tolerances are resource and time intensive. Unlike traditional methods, staff have identified a new method for testing salt tolerances using isothermal microcalorimetry. Isothermal microcalorimetry is used to examine total metabolic rates of plant tissue samples and to study effects of a wide variety of naturally occurring or artificially added factors on those rates. The project developed a novel method of measuring respiration rates of plant tissues using microcalorimetry to rapidly (hours or days) assess the salinity tolerance of specialty crops species. The first two years were used to develop and validate the method; and during the nine months of the third year, staff established experimental field demonstrations as part of the wide outreach by the University of California (UC) Extension. Measureable benefits include pioneering a new scientific method, and identifying and disseminating salt tolerances previously unreported. Additionally, expanded knowledge of salinity tolerance improved sustainable production practices by allowing for increased use of recycled water for irrigation. By addressing a basic resource issues, salt tolerance, this project assisted decision makers in planning specialty crop agriculture by educating the public on growth limitations from salts.

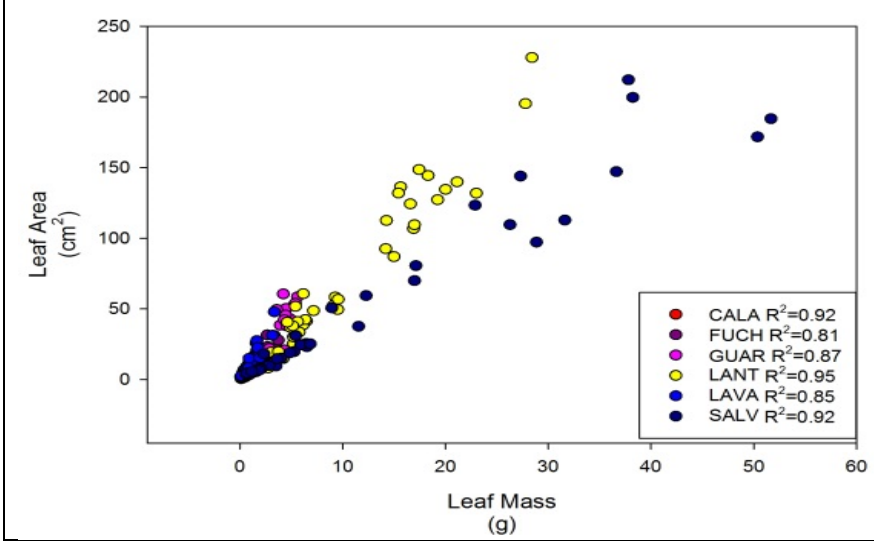
This project did not build on a previously funded Specialty Crop Block Grant Program project.

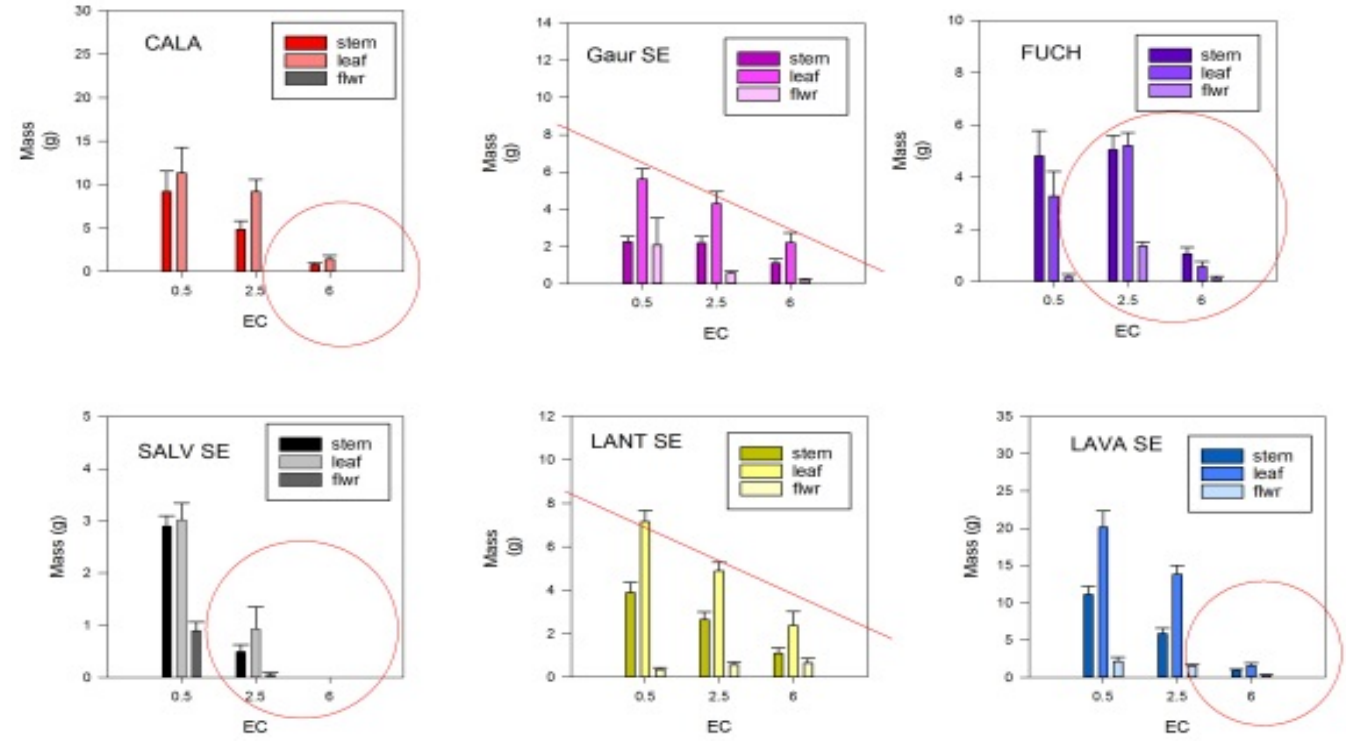
## Project Approach

The first task was to develop microcalorimetry methods for specialty crops. Unlike many grain crops, which are annual grasses, specialty crops are more diverse in growth forms and life histories. Accordingly, researchers needed to determine if the plant parts used from the grain crop calibration were appropriate for testing of perennial herbs or shrubs, and trees. The first year of experimentation focused largely on this task. Staff tested a variety of specialty crop life forms, including woody perennial crops, herbaceous perennials, and seed grown annuals. Staff dissected and tested root tips, leaf buds, flower buds, and whole seedlings, when appropriate. The testing revealed that root tips, generally have the greatest metabolism and thus are the best tissues for testing in the microcalorimeter. Seedlings were also deemed excellent sample materials because their size matched the ampule chamber size, and the seedlings could be generated quickly.

The second task was to validate the microcalorimetry results with traditional salinity methods. Staff expanded the study to landscape plants commonly used within the Irvine Ranch Water District (IRWD), which requires the use of recycled water for irrigation in public spaces. The twelve species were chosen because they represent a variety of life forms (i.e. grasses, herbaceous perennials, and woody perennials). These plants were grown at the South Coast Research and Extension Center (SCREC) in Irvine, and at UC Davis (UCD). At SCREC, plants were established in a paired experiment where they were watered with either recycled or potable water. The recycled water was obtained from IRWD and was the same as what was provided throughout the district, thus creating a 'real world' situation. At UCD, plants were irrigated with three levels of sodium chloride (NaCl). Plants were grown all summer and then harvested to determine biomass differences. Also during this period, three Kale varieties were grown at UCD to test their whole plant biomass responses to elevated salinity. Staff had excellent results from the traditional methods, showing a strong correlation between increasing salinity and decreasing growth metrics.

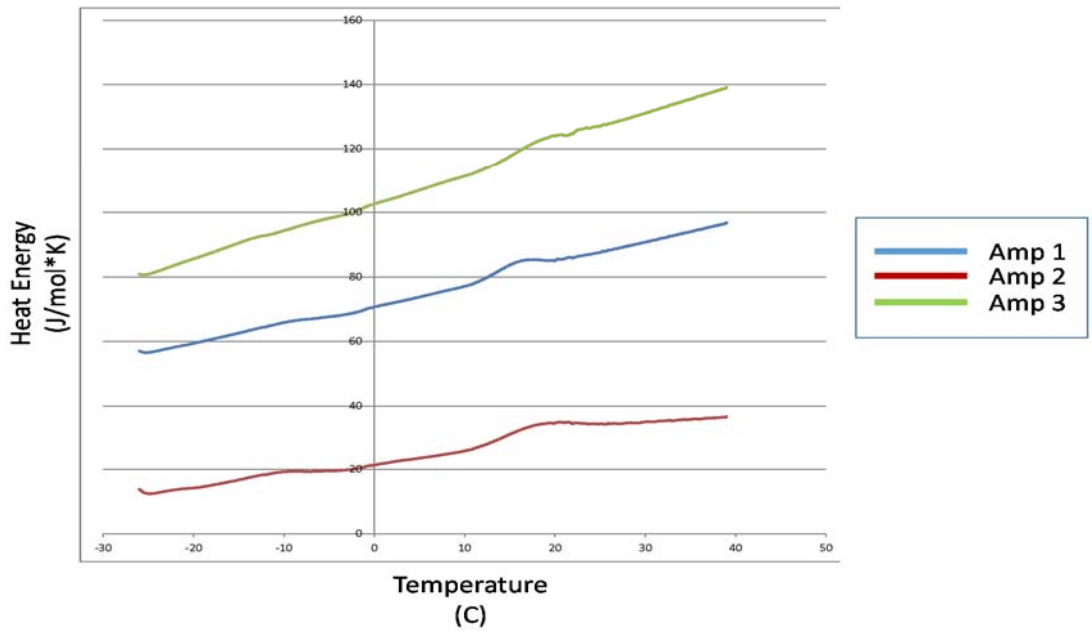


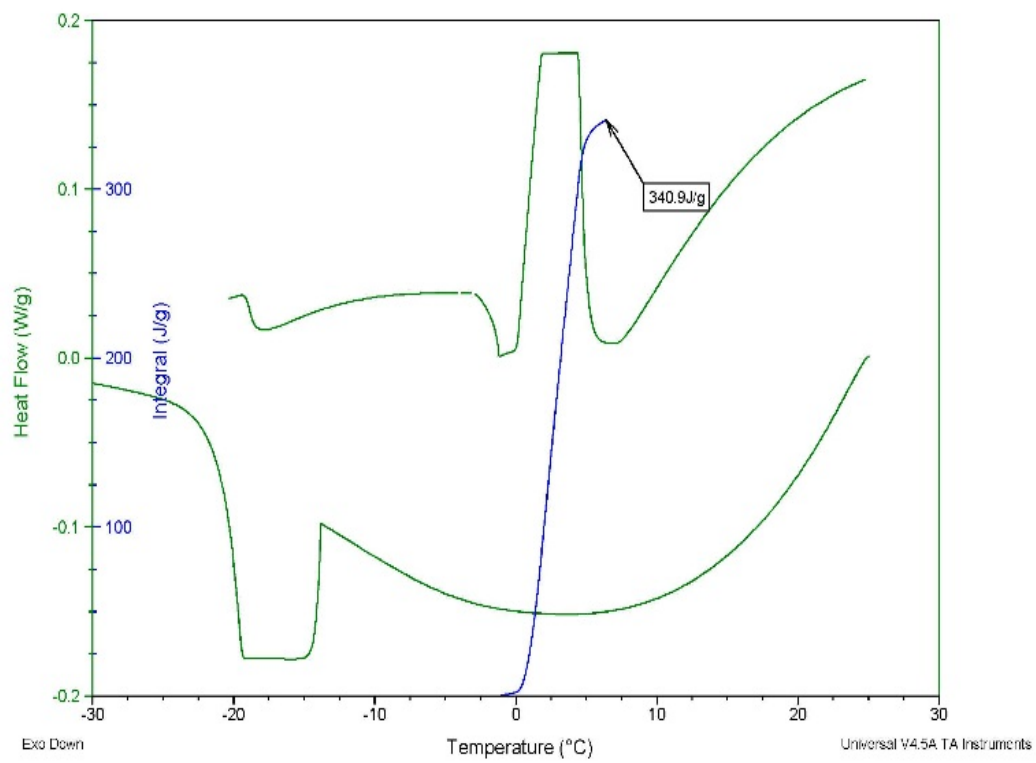






Three images of baseline data collected showing progress. The first image is heat rates of Kale cultivars response to increasing salinity. These values were collected from microcalorimetry. The second image is specific leaf area values for six species conducted in parallel growth trials at SCREC and UCD. The third image is decreasing biomass of same six species, in response to increasing salinity.

Interestingly, the validation procedure did not reveal clear correlation between calorimetry and whole plant methods. The mixed responses between calorimetry and whole-plant responses, as well as leaf-level measurements brought up questions about the reliability of the tools. Simply, staff wondered whether or not they could trust the results from the very different machines. Therefore, in year-two staff began an intensive calibration testing procedure. These tests revealed that three of the four calorimeters were inconsistent, and unreliable. Also during this time the leaf chlorophyll meter was lost for six months by the delivery service. These situations created an insurmountable experimental delay. Unfortunately, a new calorimeter costs rough $50,000-$100,000. Therefore, staff continued the rigorous testing of the remaining calorimeter, conducting comparisons of heat rates against a known substance ($Al_2O_3$), as well as against pure water (see pictures below).




Calibration results from tests of the remaining viable calorimeter. Top: Image of the heat energy rate output from the $Al_2O_3$ calibration. Bottom: Results from the heat of fusion tests with pure water.

Staff generated a new experimental timeline that was based on the ability of the one remaining, reliable, calorimeter and moved forward at one-fourth the pace. The third task was to rapidly assess important specialty crops. This process is currently on-going. Although the grant period ended at the end of June 2016, the rapid assessment period will continue. Since staff found that seedlings are the most suitable for the calorimeter, they are focusing on important annual plants, including lettuce, kale, zinnia, and other flowering species. Staff are meeting the goals for rapid assessment, completing tests for each cultivar/species within one week. Although, technical difficulties delayed the progress, staff are still very hopeful that the methodology developed with this grant will become a reliable and useful procedure.

The final task was to disseminate the information that was gathered. Because less information was generated than expected, staff have prioritized verbal dissemination rather than written. This has been accomplished by attending workshops on water-management and California agriculture. In particular, staff attended the United States Department of Agriculture's (USDA) Drought Management Workshop in Modesto, California. During breakout session, staff met with representatives from Almond commission, as well as UC Agriculture and Natural Resources (ANR) Farm Advisors to discuss the program and the application of microcalorimetry in their research programs. Staff also traveled to Watsonville area and met with local extension agents as well as three different large commercial growers in the area to discuss drought management options, including the microcalorimetry program. Furthermore, staff attended UC ANR Surface Renewal Method workshop to meet with other researchers from across the State who are also working on drought management strategies. Lastly, staff attended UCD's Evapotranspiration Remote Sensing Workshop, another gathering of experts in precision agriculture and drought management. These were all excellent, low cost, opportunities to meet with other researchers, farmers, extension agents, and industry representatives who are involved in water conservation and drought management.

Presentations were made to the California Associations of Nurseries and Garden Centers (CANGC) Research Committee at UC Riverside on Feb 4, 2015. There were about 20 people present. Staff also presented results from this project at the USDA, National Institute of Food and Agriculture groups (USDA NIFA NC1186 and NE1335) combined meeting in Long Island, NY with about 50 people attending. In Ventura Califoria, April 2016, staff presented results in a presentation to the UC ANR Environmental Horticulture working group, approximately 40 people attending. In addition to talks, staff also had the article in Greenhouse Production News: Oki, L., A. Filmer and L. Nackley. 2015. Environmental horticulture research at UCD. Greenhouse Product News. 25(12): 36-42. http://www.gpnmag.com/article/environmental-horticulture-research-uc-davis/ .

In addition to these meetings, staff are preparing the data from the experiments for publication in a peer-reviewed horticultural journal.

All work was performed specifically to benefit specialty crops by only testing and reporting salt tolerances of California specialty crops

The Post-doctoral research scholar was responsible for the primary work activities. The researcher managed the growth and data collection process for all plant species grown. The researcher was also responsible for the day-to-day management of the student and staff assistants.

The graduate student was responsible for the maintenance, care and testing of grape varieties in the microcalorimeter.

The Principal Investigator (PI) was responsible for quality assurance and quality control. The PI reviewed and commented on all of the tasks described above to ensure they were conducted in a manner of excellence, reflective of research at the UC.

## Goals and Outcomes Achieved

Staff were able to meet one of the major performance goals when they developed the new method for measuring salt tolerance. Staff failed to meet one of the other performance goals, which was to test 100+ species. The technical difficulties were too great to overcome. This was limited because of A) staff only have one machine and B) only have two operators. Staff have secured additional funding to continue the work. The current rate is one cultivar/species per week, and staff are planning to hire an additional employee to double the rate. Therefore, although the timeline was too brief, the overall goal is still reachable.

Outcome measures were short-term. The goal was to be able to rapidly assess specialty crop salt tolerances.

It is difficult to quantify the actual accomplishments with the goals established. On one hand, staff fell short of the goals because they were not able to test as many species as expected, and therefore did not have as much information to disseminate. However, since staff were able to develop a novel methodology the foundation has been laid for building up to full goals.

In total, 34 cultivars were tested:
2 strawberry varieties
3 grape varieties
2 coast redwood varieties
13 landscape ornamentals: shrubs and grasses
3 turf species: fescue and ryes
6 leafy greans: kale, lettuce
5 cut flowers: gerbera, lavender, petunia

Staff have a validated method that allows them to test for the salt tolerances of plant species four times faster than traditional methods. This is based on a one-week microcalorimetry testing period, compared to a one-month growth trial.

## Beneficiaries

This project benefited commercial growers or municipalities who are rapidly seeking to expand their use of recycled water for specialty crop irrigation.

According to the 2014-2015 Agriculture Statistics Review, the value for Nursery Products in 2014 was $3.22 billion and for Floral Products was $470 million for a combined total of $3.69 billion. This places the combined Nursery and Floral Crops as the number 5 agricultural crop commodity in the state. In addition, Nursery and Floricultural crops are in the top 10 agricultural commodities in 31 of California's 56 counties that reported agricultural production in the survey. With water becoming one of the most competitive natural resource in California, if the methodology is widely adopted and enables greater use of recycled water, the cost saving and beneficiaries are enumerable.

## Lessons Learned

Clearly, there needs to be some contingency plans written into the contract should there be catastrophic failure of capital investments. Staff never would have predicted that three of four of the calorimeters would fail. However, they were not new machines and in hindsight staff should have written in an option to purchase a new calorimeter. This is not a trivial cost as a new calorimeter would have equaled or exceeded the annual salary for any of the student or post-doctoral researchers. Providing an emergency clause is an important lesson learned. Other positive lessons learned, are the value of stakeholder engagement. Staff coordinated with a number of specialty crop seed growers, who were able to share important insights on cultivars/species that may be more relevant for the industry. Another positive lesson learned was a reinforcement of the value of good project management. Staff had much greater productivity when they decomposed larger quarterly goals into smaller, weekly, tasks that had to be reported and discussed the following week. It is nothing new, but was something that worked well for the team.

One surprise outcome was that for a number of species the preliminary data showed that the plants treated with saline water had greater metabolic heat rates than plants treated with low-salinity water. This is contrary to the traditional physiological response that salt diminishes metabolic activity. Again, these are preliminary results, and at this time staff cannot explain this unusual phenomenon. Staff are investigating further to see if the novel method has in fact revealed some novel physiological responses.

To reiterate, it is important to have a back-up plan. Develop an executable project, but then take a moment to imagine if critical aspects of the work-flow or process were to be delayed by an external force, how would the project continue in the time limited by the funding cycle.

## Additional Information

At this time, staff are preparing three separate manuscripts.
1) May be titled “Shriveled grapes are not always raisins: lessons learned from irrigating Vitus species with salinized water.” It will be produced from the dissertation of the graduate student. It will focus on the physiological responses of table grapes (Vitus spp.) to recycled water. Target journals include, *California Agriculture*, or *Plant, Cell, Environment*, or *Environmental and Experimental Botany.*
2) Will likely be titled “Microcalorimetry as a novel method for testing plant salt tolerance” It will be a methods paper describing the novel methodology and the target journal is *ThermoChemica Acta*.
3) Will be a paper likely titled “Microcalorimetry for rapid assessment of specialty crop salt tolerance.” Content will focus on the results from the rapid assessment of specialty crop seedlings, the target journals are *Scientifica Horticulturae*, or *HortScience*.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 53 | **Project Title:** Characterization of Resistance in Cantaloupe and Honeydew to Cucurbit Yellow Stunting Disorder Virus and Sweetpotato Whitefly | |
|---|---|---|
| **Grant Recipient:** United States Department of Agriculture, Agricultural Research Service | **Grant Agreement No.:** SCB13053 | **Date Submitted:** December 2016 |
| **Recipient Contact:** James D. McCreight | **Telephone:** (831) 755-2864 | **Email:** Jim.mccreight@ars.usda.gov |

## Project Summary

The fall melon crop in the low desert of California was eliminated in 2006 due to a combination of Cucurbit yellow stunting disorder virus (CYSDV), a newly introduced virus, and heavy feeding pressure by its insect vector, sweet potato whitefly biotype B (SPWF-B). The low desert of California (Imperial, Coachella and Palo Verde Valleys) has historically been an important spring and fall-season melon production area, with a 2010 gross value of $69.2 million for the spring; a fall crop could increase this to $104 million. The appearance of the aggressive SPWF-B in 1990 significantly reduced the fall crop through feeding damage; numbers of SPWF-B eggs and nymphs were 1500-fold greater than in Texas and Florida. CYSDV, spread by SPWF-B, appeared in California in fall 2006. Together, SPWF-B and CYSDV eliminated the fall melon crop in the low desert, and CYSDV threatens spring melon production when SPWF-B survives the winter in sufficient numbers.

There are no commercial melon cultivars with resistance to either SPWF or CYSDV anywhere in the world. Three non-sweet, vegetable type melons from Africa and India are resistant to CYSDV. Low-level resistance to SPWF-B expressed by two of these is inadequate for reducing the economic impact of whitefly feeding or virus transmission in California. Six new melons from India exhibited putative resistance to CYSDV in fall 2011 and 2012. Four produced large plants that finished the season in good condition, and appeared to exhibit resistance to feeding by SPWF-B in 2012; two had significantly fewer numbers of SPWF-B than the two accessions previously determined to have low-level resistance to SPWF. Fruit of the six accessions have some characteristics of sweet, dessert type melons and may be better sources of resistance for breeding CYSDV-resistant cantaloupe, honeydew and mixed melons adapted to California.

The project goals were to: 1) Determine the best source(s) of host plant resistance to CYSDV in melon from among the resistant candidates identified to date; 2) Characterize host plant resistance to SPWF-B identified in four accessions in 2012 and a fifth accession identified in 2014; 3) Cross candidate CYSDV and SPWF-B resistance sources with susceptible elite Western United States (US) shipping type melons (USWSM) for inheritance studies and introgression to USWSM; and 4) identify potential RNA interference (RNAi) targets in SPWF-B that will reduce whitefly fitness and block virus transmission.

Resistance to SPWF-B will result in fewer applications of insecticides to reduce direct damage from feeding and indirect damage from sooty mold that grows on the ‘honeydew’ excreted by SPWF-B onto leaves and fruit and results in reduced fruit yield and quality. Resistance to SPWF-B will reduce the adverse economic and environmental impacts of SPWF-B control. Resistance to CYSDV will reduce the adverse impact of the virus on plant growth, and consequently on fruit set (yield) and quality. Vector and whitefly resistance may restore the lucrative fall production season.

This project did not build upon previously funded Specialty Crop Block Grant Program project.

## Project Approach

Field tests for resistance to CYSDV and whitefly:
Four field tests were planted in Imperial Valley at the University of California Desert Research and Education Center, Holtville.

CYSDV tests were evaluated in the fall seasons of 2014 and 2015. CYSDV-resistant plants were selected from different progenies of crosses between eight sources of resistance to CYSDV: PI 313970 (reported to be resistant by the project team), TGR 1551 and TGR 1937 (reported by a lab in Spain to be resistant), and five putative new sources of resistance (PI 122847, PI 123496, PI 124550, PI 145594, and PI 614486). Selection was based on percent of leaf area expressing virus symptoms and overall plant and fruit appearance. Three vegetative cuttings were taken from each selected plant for establishment in a greenhouse, and subsequent self-pollination to develop lines with uniform reaction, and cross-pollination with a susceptible cultivar USWSM type cantaloupe (Top Mark, Impac) and Green Flesh Honeydew. The cross-pollinated progenies were then self-pollinated to produce segregating families for recombination CYSDV resistance with the horticultural qualities of the susceptible cultivars.

None of the five putative sources of resistance were more resistant to CYSDV than the three reported sources of resistance. The three resistance sources were members of *Cucumis melo* subspecies *agrestis* Acidulus Group, which produces small, non-sweet, bitter fruit that are used at the immature stage of fruit development in soups and stews. PI 123496 was, however, notable for its larger fruit with a lightly netted fruit pale white exterior (Figure 1). PI 145594 is likely also a member of the *Cucumis melo* subspecies *agrestis* Acidulus Group, but it combined well with the susceptible cultivar Impac and produced netted fruit in the $F_1$ (Figure 2) and segregated a high number of fruit that resembled USWSM type fruit in the $F_2$ (Figure 2).

Figure 1. Fruit of PI 123496 had some of the characteristics of climacteric, dessert type melon fruit. The subspecies and group have yet to be determined.

Figure 2. Fruit of PI 145595 and its $F_1$ with Impac (left), and $F_2$ (right).

Controlled inoculation greenhouse/laboratory tests for CYSDV resistance:
Limited numbers of controlled inoculation tests were done in the greenhouse/lab due to difficulties in establishing a pure CYSDV isolate in the greenhouse/growth chamber. PI 313970, TGR 1551 and TGR 1937 were resistant to CYSDV in three controlled inoculation tests in fall 2014 (PI 313970; mean ELISA absorbance value @ 405nm was 0.018 *vs.* susceptible cultivar Top Mark with a mean value of 0.318) and summer 2015 (TGR 1551 and TGR 1937 mean value was 0.008 *vs.* Top Mark with value of 0.156). Thus, the low virus content in these three reported sources of CYSDV resistance was confirmed. Four of the five putative new sources of CYSDV resistance were tested through fall 2015 and early winter 2016. CYSDV was not detectable in PI 122847 (0.000 *vs.* Top Mark with a value of 1.059) and PI 145594 (0.000 *vs.* Top Mark with a value of 0.568) in two separate tests. PI 124550 had a high level of virus (0.593 *vs.* Top Mark with a value of 0.568). PI 123496 was not consistent for virus content: 0.154 *vs.* Top Mark with a value of 1.059 in the first test, and a value of 0.453 *vs.* Top Mark with a value of 0.523 in the second test. The difference between the two tests for virus content may have been a reflection of genetic variation within the accession or test-to-test variability.

Field tests for resistance to whitefly were done in the spring seasons of 2015 and 2016:
Eleven putative whitefly resistant melon accessions were compared with the susceptible USWSM type cantaloupe cultivar Top Mark in spring field tests in 2015 and 2016. Several of the 11 accessions tested in the field were reported to exhibit whitefly resistance in greenhouse tests. The tests were done as split plot designs, where one plot of each entry was treated with insecticides and the other was untreated (no insecticide). Adult whiteflies were sampled at approximately two-week intervals from May 24 through July 19, 2015. Significant differences were detected among the 12 entries for numbers of adults (in ten-second vacuum samples of the plant canopies; data not shown) and numbers of immatures per $cm^{-2}$ of sampled leaf area. Numbers of immatures on the most susceptible and most resistant accession indicated different population dynamics under field conditions where whiteflies had a choice of host (Figure 3).

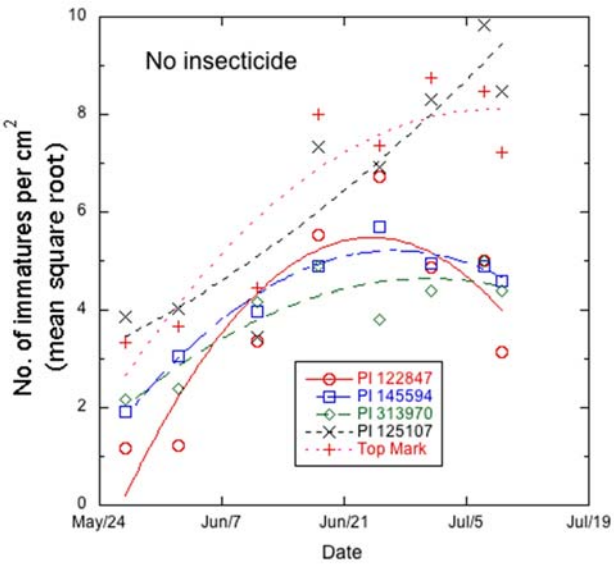



Figure 3. Number (mean square root) of immature whiteflies per $cm^2$ of sampled leaf area on four melon accessions and susceptible cultivar Top Mark.

Differences in numbers of adult and immature whiteflies were observed in both years. Samples were taken on eight dates in 2015 and one date in 2016. The five accessions with the lowest number of adults and the three with the highest number of adults in 2015 are presented in Figure 4. PI 122847 had the fewest adults through mid-June and was not different from the other "best" accessions through the final sampling date. 'Top Mark' and PI 125107 followed a similar pattern, while numbers of adults from PI 123689 continued to increase (Figure 4). The other four accessions were intermediate through the test (data not shown). Numbers of immatures followed a pattern of development through the test in 2015 that was similar to the adult numbers. PI 122847 had the fewest number of immatures initially, but was similar to PI 313970 and PI 145594 (Figure 3).

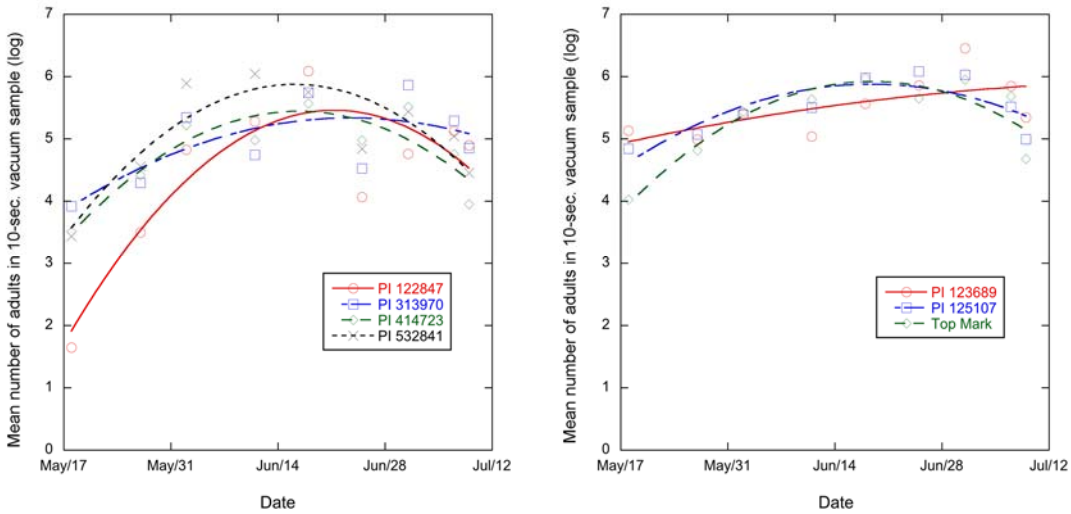



Figure 4. Mean numbers (log) of adults in ten-second vacuum samples of six melon accessions and 'Top Mark' at eight sampling dates from May 27 through July 9, 2015, highest (left) and lowest (right); DREC; no insecticide treatment.

In 2016, whitefly numbers were low through mid-June; the first samples were collected June 21 (Table 1). PI 313970 had the fewest number of adults, significantly fewer than 'Top Mark' and all of the other entries except PI 145594. PI 122847 had the fewest number of immatures but was not significantly lower than PI 313970 and PI 145594 (Table 1).

Table 1. Least square means of adults (log) in ten-second vacuum samples and immatures (square root) per 2-$cm^2$ area of single leaf samples taken from five plants in the center of each experimental plot (40 ft. in length), collected on June 21, 2016; means separation by Student'*st*-test (P= 0.05).

| Accession | Adults (log) | Immatures |
|---|---|---|
| PI 116482 | 4.0 c | 11.8 ab |
| PI 122847 | 4.3 bc | 6.1 d |
| PI 123689 | 5.1 a | 11.2 abc |
| PI 124107 | 4.0 c | 11.5 abc |
| PI 145594 | 3.0 de | 8.2 cd |
| PI 161375 | 5.4 a | 12.4 ab |
| PI 313970 | 2.6 e | 6.9 d |
| PI 414723 | 3.6 cd | 10.7 bc |
| PI 532841 | 3.6 cd | 11.0 bc |
| TGR 1551 | 4.8 ab | 11.1 abc |
| TGR 1937 | 3.8 c | 13.6 ab |
| Top Mark | 5.1 a | 14.6 a |

Greenhouse testing of whitefly resistance in melon:
Twelve melon accessions were compared with whitefly-susceptible Top Mark in a series of greenhouse tests from summer 2015 through June 30, 2016. The accessions included the 11 in the field test plus PI 123496. This was a no-choice test, whereby the whitefly adults were confined in small, clip-on leaf cages. The whitefly's were able to feed freely and oviposit (lay eggs) in a defined area of the test leaf.

The number of eggs was counted as a measure of oviposition resistance. Development of eggs through to emergence of the next generation of adults was monitored to estimate the mean survival from egg to adult; and the growth index, a measure of the rate of development from egg to adult, constituted two measures of antibiosis to whitefly. The three measures of resistance to whitefly were expressed as a percentage of the susceptible commercial USWSM type melon 'Top Mark'. These data were summarized as 95% confidence intervals (CI) for each of the three host plant estimates of resistance to whitefly. Whereby comparisons between accessions could be made using the 'rule of eye' method. Intervals that overlapped with a mean were not different, and CI that overlapped by half of one interval arm were significantly different at $P = 0.05$.

Oviposition expressed as a percentage of 'Top Mark' data varied among the tests for each accession (Figure 5). Comparisons of CI indicated TGR 1937, PI 161375, PI 122847 and PI 124107 to be potentially useful. PI 123496 showed a wide variation that may have been an indication of genetic heterogeneity in the accession, as many US melon introductions are known to be highly variable for many plant and fruit characters. TGR 1551 was used as a source of resistance to a different biotype of the whitefly (designated Q), in Spain and expressed useful variation, though like PI 122847, exceeded oviposition on 'Top Mark' in one test. Survival expressed as a percentage of 'Top Mark' data likewise varied among the tests, with many of the entries being comparable to 'Top Mark' (Figure 6). TGR 1551 and TGR 1937 were exceptional in this

regard; both were from Zimbabwe, whereas the other accessions were from Asia (India and Korea). Survival on the other 10 accessions was essentially the same as on 'Top Mark'. Survival was used as the criterion for genetic assessment of resistance to whitefly biotype Q in TGR 1551.

PI 123689 and TGR 1551were comparable for growth index (Figure 7). PI 414723 was potentially of interest, but was highly variable.

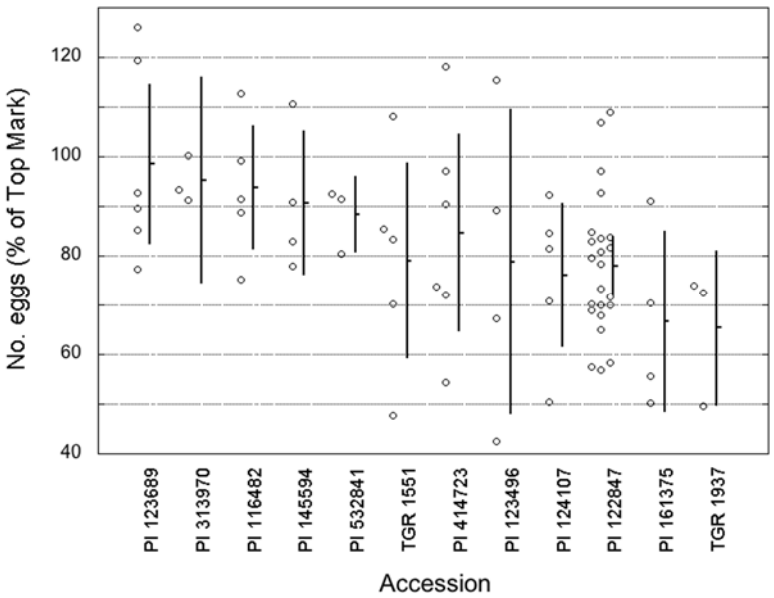



Figure 5. Confidence (95%) intervals and means for whitefly oviposition on 12 melon lines expressed as percent of susceptible commercial USWSM type melon 'Top Mark'.

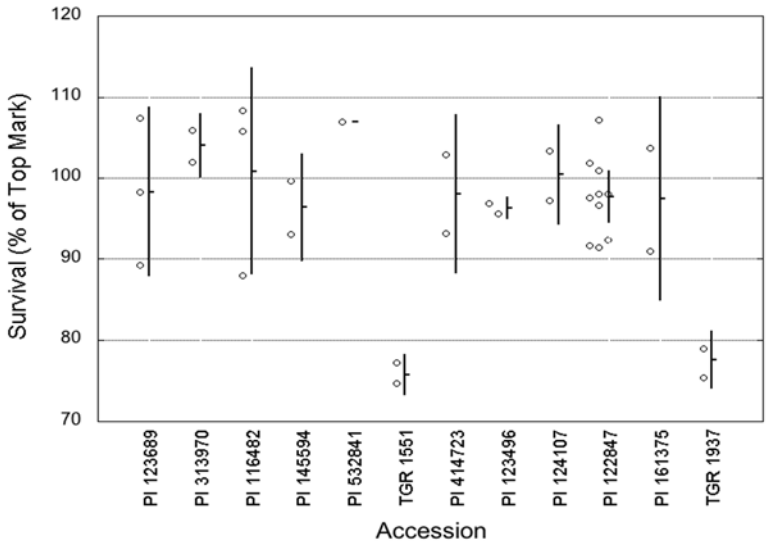



Figure 6. Confidence (95%) intervals and means for whitefly larval survival to adult on 12 melon lines in greenhouse tests expressed as percent of 'Top Mark' in each respective test; data points represented the means of different tests.

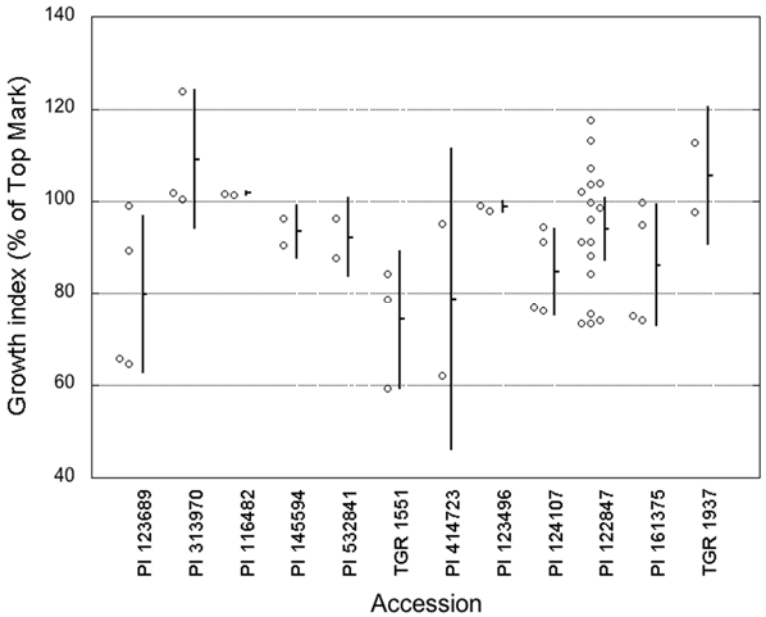



Figure 7. Confidence (95%) intervals and means for whitefly growth index on 12 melon lines expressed as percent of 'Top Mark'.

Identification of effective RNA targets that will reduce whitefly fitness and block virus transmission, and RNAi construct design and efficacy evaluation in melon:
A total of 262 genes were differentially expressed between whiteflies that fed for one, three, or seven days on either healthy (virus free) melon plants and melon plants infected with the whitefly-transmitted virus, CYSDV. Expressed genes were compared with those of previous studies on *Tomato chlorosis virus* (ToCV) a closely related virus from tomato in which over 1,000 genes were differentially expressed between whiteflies that fed on healthy tomato and tomato infected with ToCV at one and three days. This allowed the project team to identify genes differentially expressed between both healthy plants and plants infected with each virus, and should indicate genes and possibly pathways that are commonly altered in whiteflies in response to feeding on plants infected with this type of virus (genus *Crinivirus*, family *Closteroviridae*). Direct comparison of significantly differentially expressed genes identified 59 genes that were differentially expressed in whiteflies after feeding on either ToCV or CYSDV. This will lead to a better understanding of how whiteflies are influenced by the presence of the virus in the plant.

Another advantage of using transcriptome analysis on whiteflies in response to virus infection was that this provided information on the entire whitefly transcriptome. This information will be useful for design of RNAi approaches that can be evaluated as a possible strategy for whitefly control in cucurbits and other crops. Cucurbits are some of the most severely impacted crops in the US with losses resulting both from direct damage and plant collapse caused by whitefly feeding, as well as loss to production caused by whitefly transmitted viruses, including CYSDV and other viruses. RNAi holds a promise as a technique with tremendous potential to control sap sucking pests, such as the whitefly, *B. tabaci* on cucurbit production. To this end the project team used information gained from analysis of the whitefly transcriptome in response to feeding on CYSDV-infected melon plants to design and begin testing plants for evaluation of RNAi

constructs that caused high levels of mortality in adult whiteflies that may also reduce numbers of immature whiteflies (eggs and nymphs).
Double stranded RNA (dsRNA) was designed and ordered from a vendor. Two kinds of constructs were evaluated separately to determine efficacy for whitefly control:
Concatemers, which involved sections of more than one gene in tandem (Figure 8) and individual constructs (data not shown). For individual constructs, those that showed some promise individually were combined to determine if improved control could be obtained when used together (Figure 8). Constructs were suspended in a 20% sucrose solution at a concentration of 40 µg in 100 µl sucrose solution. Twenty whiteflies were placed into individual glass vials and the vials covered with a thin layer of Parafilm®. A second layer of Parafilm® was placed above the first and the 100 µl sucrose solution was added between the layers. Whiteflies were allowed to feed on the sucrose solution through the membrane for five-days, with daily monitoring of mortality compared with controls treated with either sucrose solution alone, or sucrose solution with a dsRNA construct from watermelon (WM) that did not correspond to anything in the whitefly genome (Figure 8).

RNAi construct design and efficacy evaluation:
Six concatemer constructs were developed for RNAi control of whiteflies based on information gained through transcriptome studies. Concatemer constructs were tested using the sucrose-based *in vitro* feeding assay method for seven days as described above, in which each construct was suspended in a sucrose solution and acquired by whiteflies in a vial feeding through a Parafilm® membrane (Figure 8).

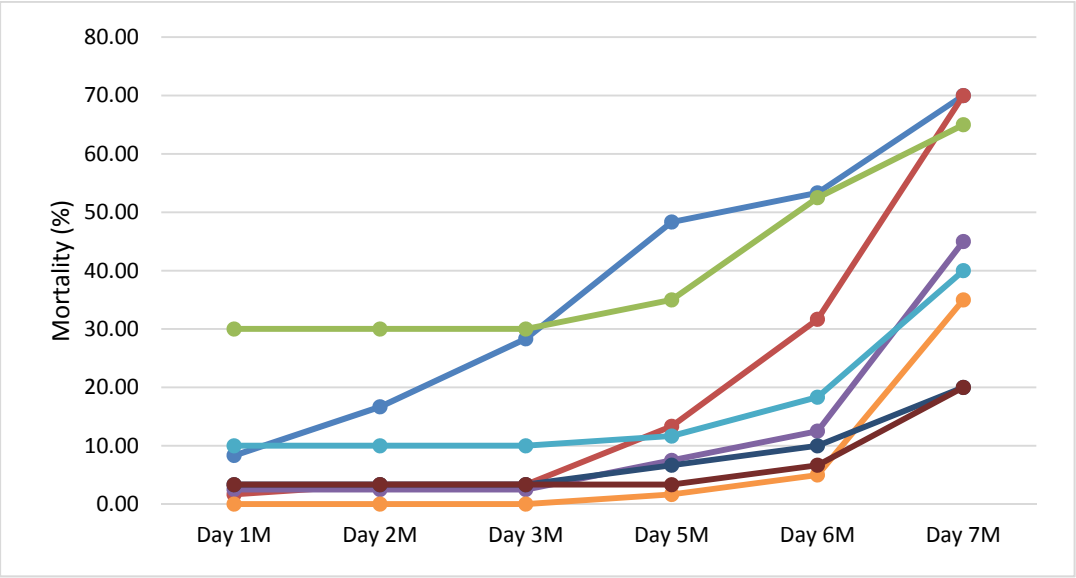



Figure 8. Whitefly mortality (%) in response to artificial feeding on seven concatemer constructs (see Table 1 for color codes), where 40ng of each construct in 100 µl of 20% sucrose solution used in each feeding experiment. Sucrose was a control without addition of dsRNA. WM is a watermelon gene dsRNA used as a negative control. Twenty whiteflies tested per vial; three replications.

Table 2. Percent mortality for six concatemers and controls shown in Figure 8.

| | Day | | | | | | Color |
|---|---|---|---|---|---|---|---|
| Construct | 1M | 2M | 3M | 5M | 6M | 7M | code |
| 1 | 8.33 | 16.67 | 28.33 | 48.33 | 53.33 | 70.00 | Lt. Blue |
| 2 | 1.67 | 3.33 | 3.33 | 13.33 | 31.67 | 70.00 | Orange |
| 3 | 30.00 | 30.00 | 30.00 | 35.00 | 52.50 | 65.00 | Gray |
| 4 | 2.50 | 2.50 | 2.50 | 7.50 | 12.50 | 45.00 | Yellow |
| 5 | 10.00 | 10.00 | 10.00 | 11.67 | 18.33 | 40.00 | Dk. Blue |
| 6 | 0.00 | 0.00 | 0.00 | 1.67 | 5.00 | 35.00 | Green |
| WM | 3.33 | 3.33 | 3.33 | 6.67 | 10.00 | 20.00 | Turquoise |
| Sucrose | 3.33 | 3.33 | 3.33 | 3.33 | 6.67 | 20.00 | Red |

In addition, 35 individual dsRNA constructs were evaluated using the same *in vitro* feeding assay described above. The most effective constructs out of the 35 were used in combinations of two for artificial feed method. Results are shown below with combination tests represented by codes (Figure 9).

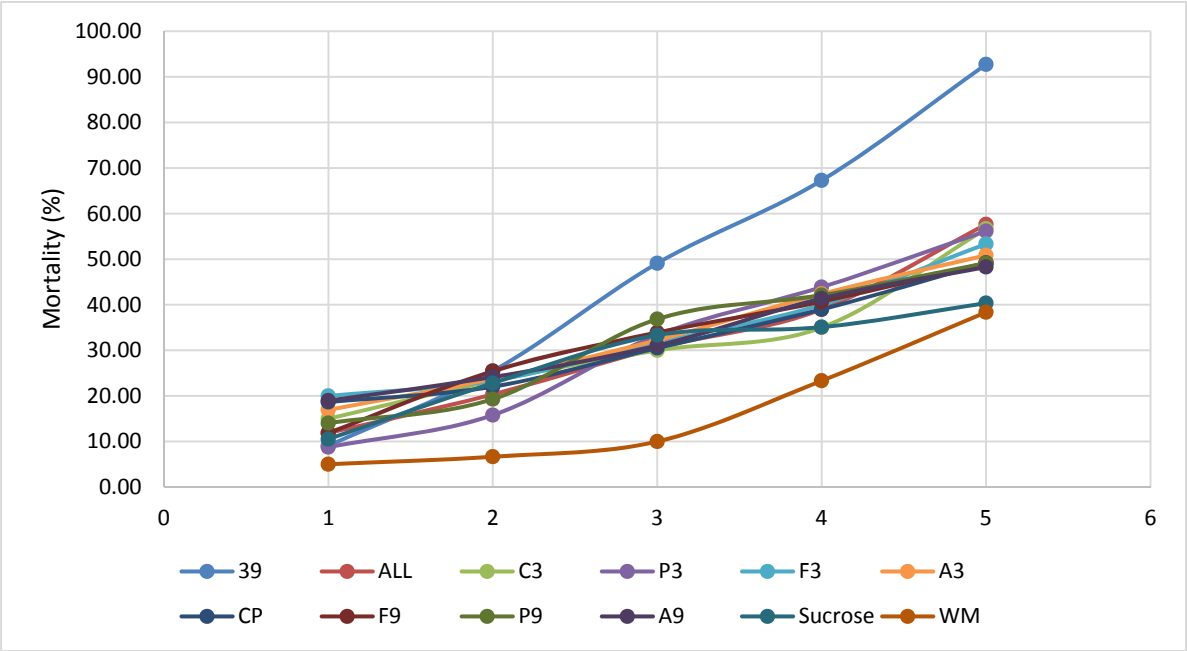



Figure 9. Whitefly mortality (%) in response to artificial feeding on ten paired RNAi constructs (Table 3), where 40ng of each of two constructs combined together in 100 µl of 20% sucrose solution in each feeding experiment. Sucrose is a control without addition of dsRNA. WM is a watermelon gene dsRNA used as a negative control. Twenty whiteflies tested per vial; three replications.

Table 3. Percent mortality for experiment involving combined constructs shown in Figure 6.

| | Day | | | | |
|---|---|---|---|---|---|
| Construct | 1M | 2M | 3M | 4M | 5M |
| 39 | 9.09 | 25.45 | 49.09 | 67.27 | 92.73 |
| ALL | 11.86 | 20.34 | 30.51 | 38.98 | 57.63 |
| C3 | 15.00 | 23.33 | 30.00 | 35.00 | 56.67 |
| P3 | 8.77 | 15.79 | 33.33 | 43.86 | 56.14 |
| F3 | 20.00 | 23.33 | 31.67 | 40.00 | 53.33 |
| A3 | 16.95 | 23.73 | 32.20 | 42.37 | 50.85 |
| CP | 18.64 | 22.03 | 30.51 | 38.98 | 49.15 |
| F9 | 11.86 | 25.42 | 33.90 | 40.68 | 49.15 |
| P9 | 14.04 | 19.30 | 36.84 | 42.11 | 49.12 |
| A9 | 18.97 | 24.14 | 31.03 | 41.38 | 48.28 |
| Sucrose | 10.53 | 22.81 | 33.33 | 35.09 | 40.35 |
| WM | 5.00 | 6.67 | 10.00 | 23.33 | 38.33 |

In summary, the ability to evaluate the transcriptome of whiteflies led to the identification of 262 whitefly (*B. tabaci*) genes that were specifically up- or down-regulated in response to feeding on CYSDV-infected melon. Fifty-nine of these genes were also identified as specifically up- or down-regulated from a previous study in response to feeding on tomato infected with a related virus. This suggested very specific responses by the whitefly to the presence of this type of whitefly-transmitted virus in plant sap and may have implications to block or interfere with the virus acquisition or transmission process. This information was also useful in identifying genes that may be useful targets to induce whitefly mortality through an RNAi system. This information will be used in preparation for additional studies to evaluate delivery methods that may facilitate RNAi-based control in melon and other crops.

All grant project expenditures were tracked and monitored to ensure that grant funds were used to solely benefit the competitiveness of specialty crops.

Project Partners:
The Principal Investigator, directed the project, organized, planted and evaluated the field plantings, evaluated for reactions to CYSDV, directed the greenhouse whitefly studies, and analyzed the data.

Co-Principal Investigator, assayed plants samples for virus content, carried-out the controlled CYSDV-inoculation studies, and directed the RNAi studies

Contractor, coordinated field activities, managed the chemical control of whitefly in the field tests, and sampled the whiteflies in the field tests.

## Goals and Outcomes Achieved

All proposed project activities were completed in order to achieve the performance goals and measurable outcomes. All project initiatives and objectives will be beneficial in the long run.

The project team was successful in achieving goals 1, 2 and 4 (Goal 4 was an additional goal added to further enhance the project. All four goals were identified in the Project Summary). Transfer of CYSDV resistance (introgression) to high quality shipping melons (Goal 3) will continue to progress slowly due to recessive genetic control of CYSDV resistance. Considerable work remains for whitefly resistance. Reported sources of resistance were compared with potential new sources of resistance that the project team identified in field and greenhouse tests, but it was not clear which was the best way to address this trait. Therefore, inheritance of resistance to whitefly remains to be determined.

1. CYSDV resistance: three sources of resistance were reported in the literature, including one reported by this project prior to the grant. Now additional sources have been identified, one with better fruit quality than the original three sources.
2. Whitefly resistance: a few sources of resistance were identified in the literature under different conditions. The team identified additional putative sources of resistance in response to whitefly feeding under high populations in the field. PI 313970 and PI 122847 appeared to provide some level of resistance in the field. Greenhouse studies indicated little difference among the lines for oviposition resistance. TGR 1551 and TGR 1937 were clearly superior for antibiosis to larval development (survival; Figure 6). TGR 1551 was one of the, perhaps, three accessions that exhibited a form of antibiosis that slowed larval development (lower growth index; Figure 7). These results suggest the possibility that the resistance in PI 313970 and PI 122847 may have been due to antixenosis (non-preference). When given a choice, the whiteflies would move to a more preferred host. TGR 1551 and TGR 1937 clearly exhibited antibiosis to larval development, with TGR 1551 also exhibiting a second form of antibiosis that reduced the growth index of whitefly larvae.
3. RNAi control of whitefly: this approach was a rapidly developing new means for insect control of virus vectors. Fifty-nine whitefly genes were identified up- or down-regulated by acquisition of the CYSDV that may be exploitable for control of whitefly.

Successful Outcomes:

1. Confirmed that putative new sources of resistance to CYSDV were not better than the first three sources reported in the literature, in terms of virus content and symptom expression. But the fruit and plant characteristics of one of the putative new sources of resistance produced fruit that had many characteristics of USWSM type melons that may prove helpful for combining CYSDV resistance with desired fruit quality (size, color, sweetness, etc.).
2. Confirmed whitefly resistance field and greenhouse studies of putative and reported sources of resistance, and gained insight about the mechanisms of resistance.
3. Identified the potential for control of whitefly through RNAi-based approach to whitefly control.

## Beneficiaries

1. The California melon industry will benefit from a clear understanding of the nature of CYSDV and whitefly resistance in melon, the breeding progress made, and the potential for RNAi-based approaches to whitefly control.
2. The California melon seed industry will benefit from the knowledge of additional sources of resistance to CYSDV. Many of these companies were international in scope and could apply this information to their other markets affected by CYSDV and whitefly.

Beneficiaries: The large groups that will benefit from this project are the California melon growers (circa 200) and shippers (circa 50), and melon breeding companies (circa 10). In addition, when CYSDV- and whitefly-resistant is deployed in elite melon cultivars, field workers will benefit from a renewed fall melon industry that, potentially, will be grown with reduced pesticides in Imperial, Coachella and Palo Verde Valleys. Successful development and application of the RNAi-based approach to whitefly control will also reduce pesticides usage and could, potentially, result in later and lower rates of CYSDV infection, thus, improving yield

## Lessons Learned

Development of RNAi techniques/technology enabled the project team to make significant evaluation of the potential for this approach to whitefly control. This is potentially an eco-friendly approach that has potential to greatly reduce insecticide applications.

## Additional Information

No additional information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 54 | **Project Title:** Biological Control of Brown Marmorated Stink Bug | |
|---|---|---|
| **Grant Recipient:** California Department of Food and Agriculture | **Grant Agreement No.:** SCB13054 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Charlie Pickett | **Telephone:** (916) 262-2053 | **Email:** charlie.pickett@cdfa.ca.gov |

## Project Summary

First introduced from Asia to the Mid-Atlantic States in the mid 90's, the Brown Marmorated Stink Bug (BMSB) is well established in Oregon and Washington, and at the time of this submission had been reported in seven cities in Southern California, and at one site in northern California. Due to its polyphagous appetite and ability to rapidly spread, most small fruits, fruit trees, nut trees, and field crops in California are threatened by this pest. The significant crops at risk are stone and pome fruits, tomatoes, peppers, grapes, nut trees, and citrus. BMSB has over 300 reported hosts including deciduous trees and weedy grasses, usually feeds on fruit, but can feed on all parts of plants. It can lay eggs on non-plant materials and seeks man-made structures where it overwinters, all which enable long distance travel. BMSB can be controlled using pyrethroids and carbamates, but heavy reliance on these products is not desirable since it will likely lead to chemical resistance and disruption of existing natural enemies. A survey will provide information on where BMSB is located, how fast it's spreading, and non-crop host plants. Providing a biological control alternative has the potential to greatly reduce pesticide costs to both the agricultural industry and in urban settings. Three species of *Trissolcus* have recently been found in China attacking BMSB eggs at high rates: 50-80%. Preliminary results show candidate parasitoids have a strong preference for BMSB. Native egg parasitoids in eastern U.S. typically attack less than 5% of their hosts. The California Department of Food and Agriculture (CDFA) intend to release these egg parasitoids after completing host range testing in California.

No information was available on the distribution of BMSB in California when this projected was funded. The BMSB had been reported in a number of locations in California, but there were no data on how rapidly it was spreading and building up in the state, as well as its proximity to centers of agricultural production. The pattern of infestation by this pest in eastern United States strongly suggested BMSB represents a serious threat to California specialty crop production. From the time BMSB was first reported in Pennsylvania in the mid 90's, about 15 years passed before the pest dispersed from urban centers and started causing serious damage to commercial agriculture. Economic damage had been recently reported for apples, peaches, cherries, tomatoes, pecans, and hazel nuts in eastern U.S. Maryland and West Virginia in 2009 reported serious economic loss to stone and pome fruits, as did Pennsylvania, New Jersey, and Virginia. BMSB, like other pentatomids, feed and cause economic damage primarily to the fruit of plants. They feed by piercing the tissue of plants and extracting their fluids. The bugs inject saliva into plant tissue to aid in digestion, causing browning and discoloration of fruit. Adults and all but the first instar nymphal stages also feed on leaves, stems, petioles, flowers, and seeds thus aiding in their survival and spread. Damage to fresh market fruit leaves them unmarketable and more sustained damage can cause rejection of fruit used in processing. Damage can be light to severe with complete crop loss. Fruit flesh may become soft and its surface concave. Severe damage causes fruit to abort. Secondary infections by pathogens are common. BMSB has been documented to change the flavor in some crops, which could prove important to the wine industry. However studies have yet to demonstrate that their associated odors will affect the final product. The anticipated damage caused by this

invasive pest will undoubtedly result in greater pesticide usage and thus additional production costs to many growers throughout California.

Although conventional pesticides can control BMSB in fruit trees and field crops, their cost and undesirable side effects create hardship to the agricultural industry. Newly discovered egg parasitoids commonly associated with BMSB in eastern Asia, its native home, showed much promise for use in the United States. One of the most sustainable, long term solutions for controlling invasive, exotic pests is the reuniting of coevolved natural enemies with their prey or hosts. Several species of *Trissolcus* had been recently discovered attacking BMSB in China and were undergoing testing by the United States Department of Agriculture (USDA) Agricultural Research Service. However, to obtain a field release permit, the same types of tests needed to be done on non-target resident stinkbugs in Western United States. The same parasitoids were available to California for testing at the time this proposal was submitted for review.

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

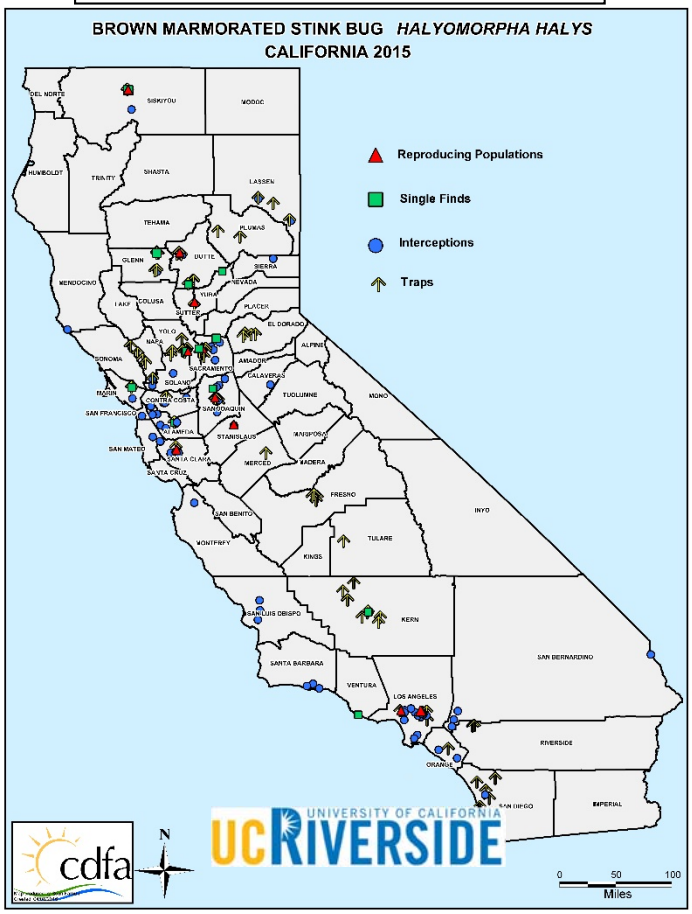
## Project Approach

Two of the three main objectives were addressed. The state was surveyed for BMSB and its resident natural enemies through use of pheromone baited traps, pest detection reports coming into CDFA, sentinel eggs, and field cameras. Secondly, the host specificity of the BMSB egg-parasitoid *Trissolcus japonicus* was evaluated for nine non-targets using a combination of 'no-choice' and 'choice' tests. *Trissolcus japonicus* was not released because host specificity testing was not completed and a petition for a field release permit was not pursued.

Each year the number of traps placed around the state increased as staff learned of new BMSB populations and their spread. During the last year of field work, 2015 (see Figure 1) 59 pheromone baited traps were placed in 19 counties (# traps) and serviced monthly replacing lures and collecting trapped arthropods: Alameda (1), Butte (6), Contra Costa (1), El Dorado (4), Fresno (3), Glenn (6), Kern (3), Lassen (4), Marin (2), Merced (1), Plumas (4), Sacramento (5), San Joaquin (3), Santa Clara (1), Siskiyou (1), Stanislaus (1), Sutter (1), Tulare (1), and Yolo (11). Most of these traps were located in urban settings though some (Butte, Glenn, and El Dorado counties) were placed near stone, pome, or other fruit tree orchards. In the southern half of the state a total of 45 monitoring traps were deployed and serviced monthly as above in 10 counties: Merced (5), Madera (1), Fresno (3), Tulare (3), Kern (8), San Luis Obispo (2), Ventura (2), Los Angeles (15), Riverside (2), San Diego (15). These traps are in the vicinity of various agricultural crops including citrus, pistachio, kiwi, peach, apple, avocado, grape, banana, and strawberry. BMSB life stages (egg masses, nymphs, and adults) have only been recovered from Los Angeles trap locations.

The number of counties with reproducing BMSB populations increased from 2 in 2013 to 9 as of spring 2016. All reports to date have come from traps or individuals in urban centers, or bordering commercial agriculture. There have been no reports of economic damage to agricultural commodities. Please see Figure 1 below.

Fig. 1. BMSB trap catches as of spring 2016.




Populations appear to be building fastest from Stanislaus County north to Butte County where there is a concentration of stone fruit and nut crops surrounding a string of small to large cities. The number of BMSB trapped per sample (averaged over year) in central and northern California shows most bugs were trapped in Sacramento and Stockton (San Joaquin County) (Fig. 2). Although Sacramento saw one of the highest populations recorded in 2013, it was almost entirely limited to one square block. Most of the drop in BMSB catches in the Sacramento area from 2013 to 2014 was due to the removal of several traps, and the addition of others by a cooperator (data not included), and the dispersal of the population to outlying areas. However, results from Stockton show a continuous increase in trap catch rates from 2013 to 2015, most likely reflecting a broader, longer established population of BMSB (Fig. 3). Significant populations have been found in Modesto, Stanislaus County and San Jose, Santa Clara County, and in Davis, Yolo County. High populations have also been found in Yuba City (Sutter County) and Chico, Butte County. BMSB has just been trapped for the first time in Napa County, and at a winery in Yolo County.

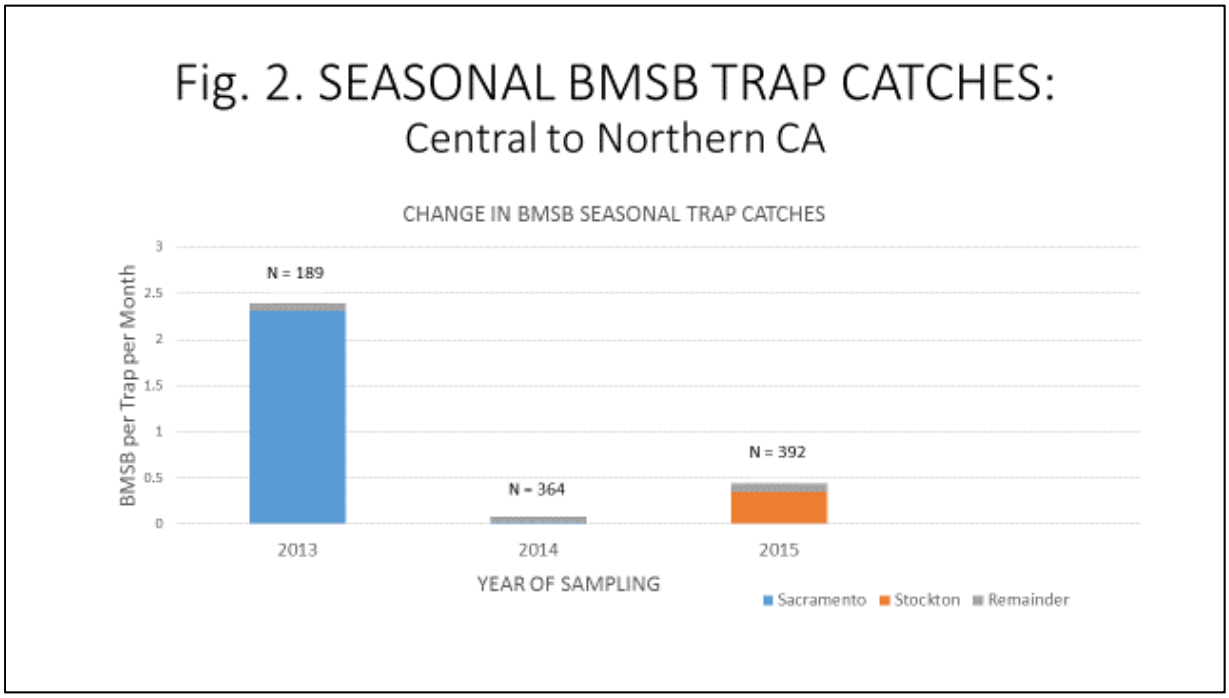


Fig. 2. SEASONAL BMSB TRAP CATCHES:
Central to Northern CA
CHANGE IN BMSB SEASONAL TRAP CATCHES
BMSB per Trap per Month
3
2.5
2
1.5
1
0.5
0
N = 189
N = 364
N = 392
2013
2014
2015
YEAR OF SAMPLING
Sacramento
Stockton
Remainder

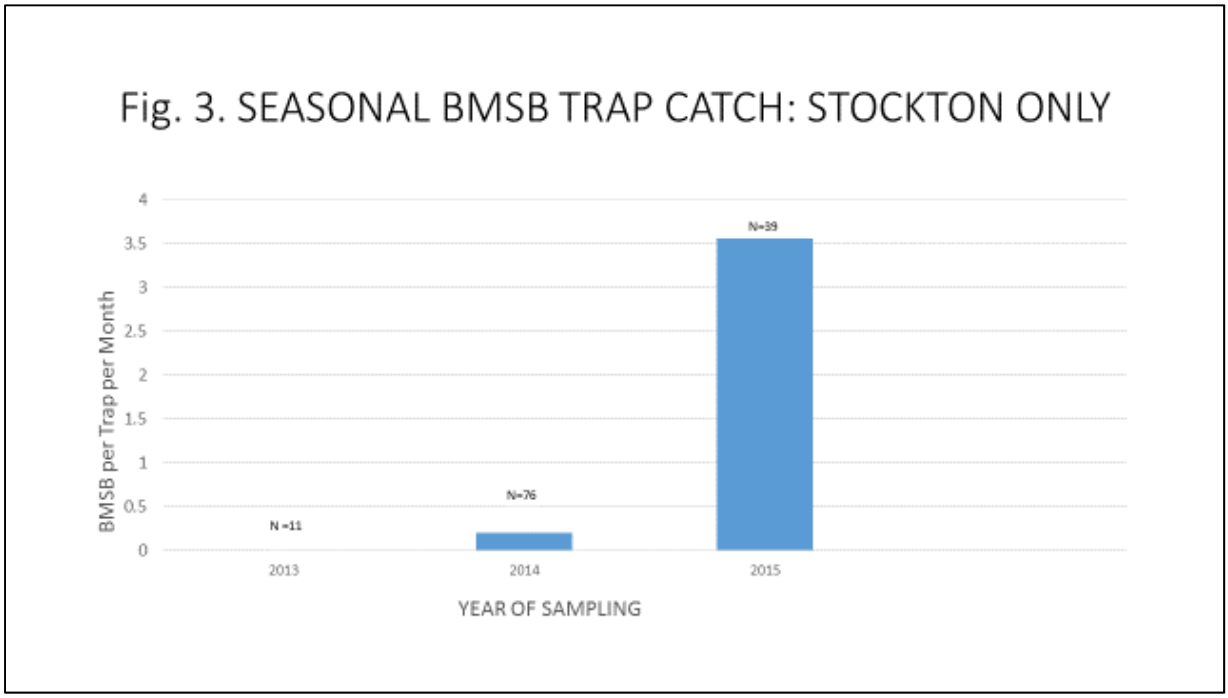


Fig. 3. SEASONAL BMSB TRAP CATCH: STOCKTON ONLY
BMSB per Trap per Month
4
3.5
3
2.5
2
1.5
1
0.5
0
N =11
N=76
N=39
2013
2014
2015
YEAR OF SAMPLING

Across most locations in central and northern California, the two most common natural enemies picked up in BMSB traps have been tachinid flies (*Euclytia flava*) and sphecid wasps (*Astata occidentalis*). From 2013 to 2015 and averaged over 11-21 counties, trap catches of *Astata* spp. varied from 0.27 to 0.8 per trap per season, while *Euclytia flava* varied from 0.18 to 0.64 per trap. One species of *Astata*, *A. unicolor*, was imaged dragging a BMSB nymph into its den in downtown Sacramento. This genus is known to specialize on stink bugs as prey.

Sentinel eggs were placed at 17 locations in northern California and 5 in southern California across 19 counties. In total, over 745 cards with sentinel eggs were placed in the field in 2015 and a similar number in 2014. In 2015, 15 were attacked by native parasitoids in the genera *Trissolcus*, *Anastatus*, and possibly other members of Scelionidae. Parasitoids emerging from sentinel eggs in northern California have been identified to species: *Trissolcus bracymenae* and *T. euschisti*, and *Anastatus pearsalli* (Eupelmidae) both common egg parasitoids of stink bugs in California. Two of 286 deployed cards (0.7%) from northern California were attacked and 13 of 282 (4.6%) in the southern part of the state. Imaging of sentinel cards was conducted at 6 of 17 sentinel card locations in northern California. The most common predator recorded feeding on eggs in the Sacramento regions was the carabid beetle, *Laemostenus complanatus*, followed by the earwig, *Eurborellia annulipes* (Labiduridae). A second earwig, *Forficula auricularia*, was recorded near Chico in an area bordering commercial orchards. On one occasion, a field cricket, most likely *Gammarotettix* sp., was imaged at the Chico site. Ants have been seen near sentinel cards but never eating or removing eggs. At one home site in Sacramento, a rat (most likely *Rattus norvegicus*) repeatedly removed all eggs from cards. This unusual 'predator' may have been drawn onto this property due to a chicken coop. On average 7% of eggs were removed through predation, excluding the rat's impact, and 11% including its impact.

Trees were surveyed in Sacramento once in the fall at peak BMSB populations in 2013, 2014 and 2015. The cities of Yuba City and San Jose were surveyed only once each because large populations of BMSB were not found precluding collection of data on bug – tree associations. Of 26 – 34 species examined over these years, twelves trees in Sacramento were found supporting populations of BMSB. These were ranked each year based on the percentage observed with BMSB on them then pooled over all three years: [(number of trees associated with BMSB/total recorded for that species)* 100]. Tree of heaven, Chinese pistache, and crepe myrtle were ranked highest, in descending order: 54%, 40%, and 20%, respectively. BMSB also had strong associations with sunshine elm (*Ulmus propinqua*) and trident maple (*Acer buergerianum*). All of these are Asian in origin.

Safety testing evaluations for *Trissolcus japonicus*, a BMSB egg-parasitoid sourced from China, were conducted from June 2014 to June 2016 at the UC Riverside Quarantine and Insectary Facility using a unique group of non-target stink bug species that is representative for the southwestern region of the U.S. These evaluations were part of the required environmental risk assessment that must be completed before *T. japonicus* can be released for BMSB control in California under a future permit issued by the USDA Animal and Plant Health Inspection Service. Selected non-target species included *Agonoscelis puberula, Antheminia remota, Bagrada hilaris, Banasa dimiata, Chlorochroa uhleri, Nezara viridula, Mecidea sp., Podisus maculiventris* and *Thyanta pallidovirens.* Among these, *A. remota, C. uhleri, B. dimidiata, Mecidea sp., P. maculiventris* and *T. pallidovirens* are native to the U.S., while *A. puberula, B. hilaris* and *N. viridula* are native to Africa. Adult stink bugs of these species were collected from several field sites in California under CDFA-approved permits and maintained in rearing cages for production of egg masses used for parasitoid exposure trials.

Safety testing evaluations were designed to follow an ecologically-meaningful, two-tier approach involving 'no-choice' and 'choice' tests. First, the purpose of 'no-choice' exposure was to unambiguously assess the inherent ability (yes/no) of the parasitoid to produce viable offspring (a measure of parasitism success) from non target hosts in the absence of the target pest, BMSB. Parasitism results collected from the first tier of testing help narrow down the list of non-target species that require further evaluation. For example, non-target stink bug species that were never parasitized successfully by *T. japonicus* in laboratory 'no-choice' trials (designed to inflate the risk of encounter with *T. japonicus* to 100%) are expected to face no significant threat (i.e., parasitism) from encounters with *T. japonicus* in the field, should they occur incidentally, on the basis that no viable parasitoid populations are expected to result from chance encounters between *T. japonicus* and these non-target host species from California. Consequently, the second tier level of safety testing focused only non-target species that were successfully parasitized by *T. japonicus* in 'no-choice' trials. 'Choice' exposure trials provided further information on the degree of preference and ability *T. japonicus* has for attacking BMSB host eggs in the presence of non-target species. An outline of the experimental setup for both safety tests is given below.

In no-choice trials, individual naïve female *T. japonicus* were first given direct access to a single non-target stink bug host egg mass in a dram vial, with no BMSB eggs. On the second day, as part of positive control treatment exposures, each female *T. japonicus* was transferred to another dram vial containing a single BMSB egg mass, i.e., the target pest species and coevolved reproductive host of this egg-parasitoid species. Control exposures with BMSB eggs confirmed that experimental female parasitoids were functionally healthy (i.e., able to parasitize eggs and produce viable offspring from BMSB eggs) during the experimental testing period and support the validity of conclusions drawn from collected parasitism data. In standardized 'choice' exposure trials, naïve female *T. japonicus* were given a binary choice of potential host eggs, i.e., a BMSB egg mass was paired with a non-target stink bug egg mass. The conclusions stemming from no-choice and choice test were made by comparing egg parasitism rates between BMSB and non-target species.

Under this experimental framework, 230 no-choice replicate sets (i.e., a total of 460 drams and roughly more than 12,000 eggs from BMSB and non-target stink bug species combined) were set up to evaluate the host range of *T. japonicus*. *T. japonicus* adults never eclosed from host eggs of *A. puberula*, *B. hilaris*, or *N. viridula* and this implies that *T. japonicus* poses no risk to these non-target stink bug species. In contrast, egg masses of *A. remota*, *B. dimiata*, *P. maculiventris*, *Mecidea* sp. and *T. pallidovirens* were, in some cases, successfully parasitized by female *T. japonicus* and produced both male and female offspring. Nevertheless, for these replicates, egg parasitism levels were consistently higher for *T. japonicus* on control BMSB eggs (i.e., >40% of all BMSB eggs were parasitized) even though these parasitoids had previous exposure to non-target host eggs and could have parasitized all of those non-target eggs. This result points to the underlying affinity *T. japonicus* has for BMSB as its coevolved natural enemy.

With one exception, preliminary choice trials (53 replicate sets; ~1,000 stink bug eggs) involving *T. pallidovirens*, *P. maculventris*, and *Mecidea* sp. also indicated that levels of parasitism were higher on BMSB than on these non-target hosts. In the case of *B. dimiata*, successful egg parasitism from *T. japonicus* reached ~30% (of all eggs used in these trials) and a similar level was detected for BMSB. However, choice testing is not complete for *B. dimiata* and these results simply indicate that the potential interaction *T. japonicus* may have with this non-target species will require future study to estimate the likelihood of these encounters (risk) under field conditions.

Activities of this project only benefited specialty crops. To ensure this project solely benefited California specialty crops, CDFA's surveys focused on counties with specialty crops at risk. Traps were placed in the vicinity of various specialty crops including citrus, pistachio, kiwi, peach, apple, avocado, grape, banana, and strawberry.

Project partner Post-Doctoral from UC Riverside and his research staff conducted the host specificity testing for *T. japonicus* and surveillance of BMSB populations from Los Angeles County as part this grant.

## Goals and Outcomes Achieved

The primary goal of this project was to introduce into California a novel, highly specific, biocontrol agent of the BMSB. Two of the three objectives are discussed below: (1) mapping the distribution of BMSB in California, and surveying for resident natural enemies, and (2) host specificity testing. No activities associated with the third objective concerning release of the candidate biocontrol agent were conducted.

The mapping of BMSB throughout California was achieved. With the help of the University of California Cooperative Extension, and using CDFA's Pest Detection Reporting database, the areas in the state knowingly affected by BMSB were tracked. By mapping these results over three years, one can see a clear expansion in the distribution of BMSB. The most concentrated populations appear to be along the eastern side of the Sacramento Valley, north into Butte County. BMSB is predicted to spread to the foothill regions of northern California based on climatic factors in common with its natural distribution in China (Zhu et al. 2012). Shown in Figure 4 is the predicted distribution for BMSB in western United States. The black dots show established populations as of 2012 and the red triangles are results from our survey showing established populations as of late 2015. This stink bug is naturally associated with trees, thus the large numbers of trees planted in the urban centers of this region, along with the high acreage of orchards provides a natural setting for the spread and expansion of this pest.

Through trapping and use of sentinel egg cards an initial survey has been completed on the types of natural enemies attacking BMSB in Sacramento and near Chico. All of these data come from urban areas, or the interface between urban and agriculture. Three predators and three parasitoids have been identified as attacking and feeding on BMSB. A carabid beetle and two species of earwigs were imaged feeding on eggs, and a predacious wasp and parasitic fly were repeatedly caught in traps, indirect evidence they may play a role in reducing numbers of BMSB. However, less than 5% of egg masses were attacked by the resident parasitoids and less than 11 % of eggs were eaten by predators, leaving much of the population surviving to later instars. Parasitoids rarely attack nymphal or adult stages.

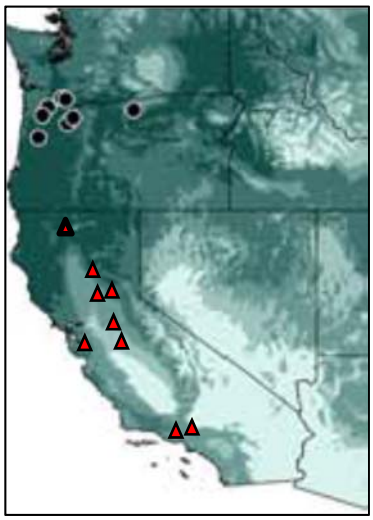


Fig. 4, from Zhu et. 2012. Red triangles show established BMSB based on this study and black dots from previous surveys.

Surveys of street trees were conducted each of the three years in mid-town Sacramento. The town of Yuba City and San Jose were surveyed once each, but large populations of BMSB were not present when this was done, precluding estimates of bug – tree associations.

Colonies of BMSB and nine non-target stink bugs were established and maintained at UC Riverside for host specificity testing of *T. japonicus.* California is one of several states conducting the risk-assessment of this prospective BMSB biological control agent which is intended for release in several areas across the U.S., including California, where the economic threat from growing BMSB populations is increasing and this pest is a significant concern for specialty crop industries. Therefore, active communication has been maintained with other U.S. BMSB research groups from OR, FL, DE and MN to ensure key non-target species and standardized testing methods have been included as part of the safety testing for *T. japonicus* in California. The majority of 'no-choice' trials were completed along with an initial portion of 'choice' trials. Completion of 'choice' tests will require an additional field season, after which a release permit can be secured. Current results from 'no-choice' and 'choice' testing have demonstrated that *T. japonicus* has a selective ability to attack BMSB eggs over those from non-target stink bug species. This favorable outcome is encouraging for implementing an effective BMSB classical biological control program to protect and enhance the competiveness of California's specialty crops.

The primary goal of measuring host specificity has taken longer than anticipated. This involves both no-choice and choice tests. The first part has been completed, but the second is required for a field release permit. The final goal is reduction of BMSB through releases of a permitted parasitoid, *T. japonicus*.

The goal of producing a map showing the distribution of BMSB has been completed. However, due to the continuous spread of BMSB, this map will become outdated shortly. Good progress was made in determining natural enemies with potential to attack BMSB. An estimate was made on how effective they were in reducing BMSB eggs. Host specificity testing was largely completed, but more work needs to be done. Without a field release permit, the last objective, release of *Trissolcus japonicus* is not possible.

Prior to this project, no maps existed on the distribution of BMSB in California or the rate of its expansion. Although information on locations of BMSB interceptions was available, no effort had been made to summarize it in a meaningful way. Well established, reproducing populations now occur in nine counties, up from two when this project started. This represents a 4.5 fold increase over nearly 3 years. To date, no agricultural commodities have reported economic damage from this pest. This could change soon, considering the rate of this pest's expansion. The types of resident natural enemies attacking BMSB have been documented in eastern United States, but not in California. The first records for native parasitoids have been recorded and these are similar to species on the east coast. No one had imaged predators feeding on sentinel egg masses at the beginning of our study. The predacious beetle and earwigs, plus the rat, feeding on these eggs is information new to science and the agricultural community

The rate of expansion of the BMSB population was measured over the course of this project. At the outset, only two counties were known to have established, reproducing populations and now there are nine, a 4.5 fold increase in number of counties in less than three years. In Stockton BMSB trap catch rate per month went from 0 to 3.5 from 2013 to 2016. At least one new predator was imaged feeding on BMSB eggs, *Laemostenus complanatus*, most likely a new record for North America. This species is usually found in urban centers which could prove beneficial for control of BMSB since this stinkbug enjoys overwintering in human domiciles. These predators appear to be correlated with populations of BMSB in Sacramento, based on trap catches (Ingels, unpubl. data).

In addition, more than 400 safety testing evaluations (replicates) were conducted for *T. japonicus* and this effort generated a greater understanding of the potential risk this candidate biological control agent represents for non-target species. *A. remota*, *B. dimiata*, *P. maculiventris*, *Mecidea* sp. and *T. pallidovirens* were parasitized by *T. japonicus*, but rates of successful parasitism were higher on BMSB and frequently reached 100% (of all eggs from an eggs mass). These results were anticipated because BMSB is the coevolved host of *T. japonicus.* These documented findings will form the basis of a science-based risk assessment report that will accompany the permit request for release of *T. japonicus* in California.

## Beneficiaries

The agricultural community should find the map of BMSB in California and host trees helpful in both developing pest management strategies and justifying funding or action towards developing control strategies. Results from the host specificity testing will ultimately help in the national effort to obtain field release permits for *Trissolcus japonicus*.

Homeowners throughout the state, especially the northern third, will benefit from information gained on natural enemies. It's clear there are some predators capable of feeding on eggs of BMSB and should be conserved.

There are over 55,000 growers of specialty crop trees that will benefit from the map produced during this project. All can now make more informed decisions on how to to deal with BMSB as it begins to move out from urban centers bordering these commodities. Also, everyone will benefit from this projects goals once the parasitoid *T. japonicus* is eventually released and widely established.

## Lessons Learned

The time required to conduct the specificity testing was greater than anticipated. Much of that was consumed by finding, then establishing numerous stink bug cultures needed for choice tests.

The one objective not achieved was obtaining a field release permit. This can only be done once both no-choice, then choice tests are completed. The latter wasn't. However, the project team made a great deal of progress towards this end and are positioned to quickly complete these tests and submit a petition for a field release permit.

## Additional Information

A review paper on our project's accomplishments was published in California Agriculture: http://calag.ucanr.edu/Archive/?issue=70_1 Biological control program is being developed for brown marmorated stink bug. California Agriculture volume 70 (1).

Literature Cited:

Zhu, G., W. Bu, Y Gao, and G. Liu. 2012. Potential geographic distribution of brown marmorated stink bug invasion (Halyomorpha halys). Plos One: volume 7 issue 2, 10 pp.

**Selected Presentations (e.g., commodity boards, professional meetings, pesticide applicator workshops):**

Hoddle M.S. What is biocontrol and how do we use it in the urban landscape? CAPCA LA Meeting, LA Arboretum 301 N. Baldwin Ave., Arcadia CA. 16 Nov. 2016.

Hoddle, M.S. What's bugging California?: Invasive pests in the garden. Ameal Moore Nature Center, Sycamore Canyon, Riverside. 21 Jan. 2017 (this was a 3 hr extension session 11:00am to 2:00pm, powerpoint presentation and displays of pickled and pinned insects of new invasive pests in California)

Lara, J.R., C. Pickett and M.S. Hoddle. Biological control of brown marmorated stink bug in California: Status and prospects. International Congress of Entomology, symposium. Orlando, FL. September 26, 2016.

Lara, J.R., M. Kamiyama and M.S. Hoddle. Brown marmorated stink bug update (pistachios). Pistachio Working Group Meeting. July 13, 2016.

Lara, J.R., C. Pickett and M.S. Hoddle. 2015. California BMSB biocontrol research updates. BMSB NEIPM Working Group Meeting. Winchester, VA. December 2, 2015

Lara, J.R.,C. Pickett, and M. S. Hoddle. Progress of monitoring and biological control research of the brown marmorated stink bug, Halyomorpha halys, in southern California. ESA 63rd Annual Meeting. Minneapolis, MN. November 17, 2015.

Lara, J.R., and M.S. Hoddle. Brown marmorated stink bug (BMSB) biological control and invasion updates from southern California. California Association of Pest Control Advisers Meeting. Santa Paula, CA. September 9, 2015.

Lara, J.R., and M.S. Hoddle. Biological control of brown marmorated stink bug in California. Pesticide Applicators Professional Association Meeting. San Diego, CA. July 8, 2015.

Lara, J.R., M.S. Hoddle, and C. Pickett. Brown marmorated Stink Bug (BMSB): monitoring & biological control research progress in southern California. USDA Specialty Crop Research Initiative (SCRI) Planning Meeting for BMSB Research. Portland, OR. April 29, 2015.

Lawson, M. and C. H. Pickett, 2016. Brown Marmorated Stink Bug. Yolo County Outreach event.

Pickett, C. H. New invasive pests important to California Agriculture. UC Cooperative Extension, Merced, October 2013.

Pickett, C. 2013. Brown marmorated stink bug: potential damage in California. UC Cooperative Extension, Lake County Annual Laws & Regulations Grower Meeting, Lakeport, CA. December 2013.

Pickett, C. 2014. Two emerging pests of economic importance to California. PAPA meeting, Susanville, CA.

Pickett, C. 2014. Brown marmorated stink bug: potential for biological control. California Wine Commissioner meeting, Lodi, CA. May 2014.

Pickett, C. 2015, R. Lara-Ariga, M. Hoddle, K. Daane, and Sin-geng Wang. Brown marmorated stink bug and Olive fruit fly. Turlock grower fair. November 2015.

**Posters at Industry and Professional Meetings:**

Pickett, C. H. M. S. Hoddle, J. Lara-Artiga, and M. Stadtherr. 2014. Distribution of brown marmorated stink bug in California and its extant natural enemies. Entomological Society of America National Meeting. Portland, Oregon.

Ingels, C. J. Lara Artiga, C. Pickett, and M. Hoddle. 2015. Brown marmorated stink bug: serious threat but biological control shows promise.

**Blog** (University of California):

Pickett, C. H., C. Ingels, M. Hoddle, and J. Lara-Artiga. 2016. UC and CDFA researchers make progress in fight against exotic brown marmorated stink bugs.

http://calnat.ucanr.edu/green_blog/?blogtag=Brown%20marmorated%20stink%20bug&blogasset=18704

**Publications:**

Pickett, C. H. Potential for biological control of brown marmorated stinkbug in California. April 2014. LoCA: The Wines of Lodi, California Newsletter.

Lara-Artiga, J., C. Pickett, C. Ingels, D. R. Haviland, E. Grafton-Cardwell, D. Doll, J. Bethke, B Faber, S. K. Dara, and M. Hoddle. Biological control program is being developed for brown marmorated stink bug. 2016. California Agriculture. January-March, pp. 15-23.

**Webpage:**

http://www.stopbmsb.org/where-is-bmsb/state-by-state/ca/

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 55 | **Project Title:** Development and Implementation of a Strategy for Durable Resistance to Lettuce Downy Mildew in California | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis | **Grant Agreement No.:** SCB13055 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Richard Michelmore | **Telephone:** (530) 752-1729 | **Email:** rwmichelmore@ucdavis.edu |

## Project Summary

Lettuce is grown as extensive monocultures in California, often with several crops per year. Such intensive production makes the crop susceptible to major disease epidemics. Downy mildew, caused by the obligate oomycete pathogen, *Bremia lactucae (B. lactucae)*, is the most serious foliar disease of lettuce in California and worldwide. Resistant cultivars and chemical applications are currently used to combat this disease. However, the pathogen is highly variable and can rapidly change to overcome such crop protection measures. It is necessary to characterize and monitor the population of *B. lactucae* to determine which resistance genes and sources of wild germplasm will provide effective durable resistance against the pathogen population in California. This is especially important for the ever increasing number of organic growers who cannot supplement resistant cultivars with chemical applications.

Lettuce (Lactuca sativa L.) is one of the top ten most valuable crops in the United States with an annual farm-gate value of over $2.9 billion. Over 80% of lettuce production occurs in California and Arizona. A large component of the economies in the lettuce production areas, such as the Salinas, California and Yuma, Arizona valleys, directly or indirectly depend on the production and processing of lettuce. Disease resistance is a major factor in determining profitability of lettuce production. Therefore it affects the farm supply industry and related industries where workers spend their income. Consequently, the deployment of more disease resistant cultivars as the result of this project will have direct, indirect, and induced economic benefits.

When genetic sources of disease resistance are available, breeding is the cheapest, cleanest, safest, and most dependable method of crop protection available. However, since *B. lactucae* is continually changing genetically in response to the deployment of resistant cultivars, constant monitoring of the pathogen and incorporation of new resistance genes into breeding programs are essential.

The project was eminently feasible and timely. The protocols for manipulating and characterizing this obligate biotrophic pathogen was a routine in the University of California (UC) Davis lab. Project staff have been monitoring *B. lactucae* in California since 1982; however, due to the labor resources required this had been done on an opportunistic basis and usually less than 50 isolates could be analyzed per year resulting in an incomplete picture of what was happening. It was apparent, however, that seemed to be increasing amounts of novel variation in virulence phenotype. New technologies are now available for rapid, inexpensive DNA sequencing and high-resolution genotyping of isolates. Project staff have sequenced the genome of *B. lactucae* and the understanding of the molecular determinants of pathogenicity is advancing rapidly. It is now possible to characterize isolates for candidate genes determining virulence. This provides the opportunity to establish a pipeline of resistant lettuce cultivars based on knowledge of pathogen variability that will increase the

evolutionary required of the pathogen to become virulent; therefore this project results will enhance the durability of resistance and consequently reduce reliance on chemicals.

Plant breeding is a long-term endeavor that relies on inputs of wild germplasm with useful characteristics such as disease resistance and well-adapted cultivars as recipient material. It is increasingly data and technology driven. This project provided comprehensive data on variability of *B. lactucae* in California. This informs and will be the foundation for the on-going lettuce breeding efforts that are funded by the California Leafy Greens Research Program (CLGRP).

This project did not build upon a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Collection of isolates from all growing areas of California: During the project period, the project staff made monthly collecting trips covering all of the major lettuce production areas of California that were coordinated with Cooperative Extension Agents and Pest Control Advisors (PCAs). They also developed a network of collaborating PCAs, seed company personnel, and pesticide company personnel who supplied additional isolates. From October 2013 to June 2016, a total of 484 isolates were collected and analyzed at UC Davis. In addition, collaborators, Enza Zaden USA, Monsanto Vegetable Seeds, Mission Ranches, Rijk Zwaan, and Syngenta, characterized 141 isolates and contributed their phenotypic data to this project. The total number of isolates characterized phenotypically during the project period was 627.

Phenotyping of isolates for virulence phenotype, mating type, and fungicide sensitivity: The virulence phenotype for all 484 isolates and the mating type of 457 isolates have been completed. Sensitivity to the fungicide, metalaxyl, began to be tested on isolates collected at the end of 2014 due to availability of the product. Fungicide sensitivity for the 296 isolates collected has been completed.

Of the eight designated Pathotypes of *B. lactucae*, only Pathotypes VII and VIII were detected from multiple locations. Pathotypes V and VI were only found in the desert areas of California. Pathotypes I to IV were not detected.

From 2013 to 2015, about 60% of isolates had novel virulence phenotypes that did not match the known Pathotypes. In 2016, 87% of isolates had novel virulence phenotypes and Pathotypes V and VI were not detected. Both mating types were detected at an approximately 1 to 7 ratio of $B_1$ to $B_2$ isolates, sometimes from the same field, indicating the potential for sexual reproduction and increased variability. Sexual reproduction therefore seems to be playing a larger role in changing the virulence spectrum than it has in the past. Isolates of opposite mating type, collected in 2014 from the same field near King City in Salinas Valley, were crossed in the lab to investigate the potential of sexual reproduction to generate novel phenotypes. Results from this cross demonstrated that fit progeny can arise from sexual mating. The 15 progeny isolates analyzed had a wide range of virulence phenotypes; some were similar to the designated Pathotypes, but most were novel. Both $B_1$ and $B_2$ mating types were observed in the progeny as were isolates with high levels of mefenoxam insensitivity.

Analysis of field isolates for mefenoxam sensitivity demonstrated that there are both sensitive and insensitive isolates distributed across the production areas of California at about a 1 to 2 ratio. Comparisons between field isolates with similar phenotypes to the progeny isolates showed that there is higher similarity between the

progeny isolates and field isolates collected in 2016 than to those collected in other years. This was consistent with sexual reproduction generating new novel phenotypes. The current *B. lactucae* population is very different than what it has been in the past, and steps to denominate new Pathotypes to reflect these changes are underway.

Genetic analysis of isolates by sequencing: Fifty-nine California isolates (41 historic isolates and 18 representative contemporary isolates) have been sequenced to gain an understanding of past and current variation at the DNA level. In addition, 47 archival isolates from the world-wide collection at UC Davis were sequenced to understand variation of Californian isolates in a global context. These DNA sequences were shared with United States Department of Agriculture (USDA), Agricultural Research Service located in Salinas, California to analyze variation in mitochondrial genome sequences and develop diagnostic molecular markers for lettuce downy mildew. These data revealed two distinct lineages of California isolates that were separate from the majority of European and other isolates. However, the mitochondrial genotypes did not align with the known Californian Pathotypes indicating convergence of nuclear-encoded virulence phenotypes.

Screening of lettuce germplasm: Project staff received 110 new accessions of Lactuca germplasm that were grown in the greenhouse to increase their seed and then screened for resistance to *B. lactucae*. Thirty-four germplasm accessions from Kyrghystan, Georgia, and Uzbekistan were screened with three isolates: an archival and contemporary Pathotype VIII and a novel contemporary isolate. This second isolate represented the most predominant virulence phenotype occurring this year. Ten of these 34 accessions were identified as being potential new sources of resistance. All 34 lines plus 67 additional accessions from Azerbajain were screened. UC Davis has completed the initial round of screening for 59 of the 67 lines collected in Azerbajain; 14 of these were resistant to the three isolates tested. In the coming months UC Davis will re-test the resistant lines against these and two additional isolates, one of which represents the most predominant $B_1$ isolate that we detected. Those that remain resistant to the five isolates will be used to screen for resistance in UC Davis introgression program.

Initiation of introgression of new resistance: Currently, ten of the new sources of resistance identified during this project are being introgressed into romaine, butterhead, red leaf, iceberg, and green leaf lettuce types. This will continue to go on past this project duration and supported with outside funding. Resistance from different sources are being introgressed into the different lettuce types in order to diversify the selection pressure on the pathogen population and prevent a variant developing on one type being virulent on all types. Seven are in the third back-cross generation, while the remaining three are in the second back cross generation. In addition to the four isolates used to screen the germplasm, two more contemporary isolates are being used to screen progeny of each cross.

All data collected from this project, including the germplasm accessions with new sources of resistance, have been deposited into the web-accessible database that the project team continues to develop (http://bremia.ucdavis.edu/). Virulence phenotypes have been displayed as they were generated allowing stakeholders to access the data expediently. Results were included as part of the annual reports to the CLGRB and presented at the biannual CLGRB board meetings.

Since March 2014, the project team participated in the biannual meetings of the International Bremia Evaluation Board, US branch (formally ABEB, now IBEB-US), which is an organization coordinated by

lettuce breeding companies to utilize the information generated by the project to officially denominate Pathotypes of *B. lactucae*; these will then be used to characterize commercial lettuce cultivars as being resistant or susceptible to predominant strains of downy mildew. The results were also discussed at the first meeting of the IBEB in Murcia, Spain, in April 2015 so as to coordinate nomination of predominant strains of the pathogen worldwide.

This project does not benefit commodities other than specialty crops.

## Goals and Outcomes Achieved

Goal 1): To develop a comprehensive knowledge of the variability of the pathogen, *B. lactucae*, that causes downy mildew in California. Performance measure: Collection, phenotyping, and genotyping of approximately 25 isolates sampled from throughout California on a monthly basis for 2.75 years. Benchmark: A detailed understanding of pathogen variation in terms of candidate genes responsible for virulence and avirulence. Target: Identification of 10 representative isolates of *B. lactucae* for use in screening germplasm for resistance.

Project staff made monthly collections of lettuce infected with downy mildew in the major production areas throughout California. All isolates were phenotyped using standardized protocols for virulence phenotype, mating type, and mefenoxam sensitivity. Representative isolates were identified and sequenced by UC Davis DNA Technologies Core. Sequence data have been and are currently being analyzed by the project team and the USDA-Agricultural Research Service in Salinas, California.

Goal 2): To generate knowledge as to which wild germplasm accessions of Lactuca spp. will be donors of effective resistance genes for breeding programs. Performance measure: Identification of at least 100 accessions that are resistant to the 10 representative isolates of *B. lactucae*. Benchmark: Completion of screening of germplasm for resistance to all 10 isolates. Target: Inputs for a pipeline for generating advanced breeding lines with new resistance genes.

Five isolates were identified as representative of the most predominant and virulent isolates collected during the project's duration and were inoculated onto new germplasm accessions. Collectively, they were virulent on all the previously known resistance genes. Individual accessions were chosen as sources for introgression of resistance into genotypes adapted for California.

Goal 3): To implement a new resistance breeding paradigm that is driven by pathogen population and lettuce germplasm data to provide more durable disease resistance. Performance measure: Initiation of at least five parallel backcross programs to introgress and combine new resistance genes into each of the four major types of lettuce (over 20 total). Benchmark: Release of resistant germplasm accessions within the timeframe of the project and advanced breeding lines with multiple new resistance genes within five years of the end of the project. Target: Durable resistance of lettuce to downy mildew and reduced fungicide use.

Ten resistant accessions have been crossed with California cultivars of butterhead, iceberg, red leaf, green leaf, and romaine lettuce types. Progeny of each back cross were screened with the same representative isolates used to initially screen the germplasm. Each generation takes approximately six to nine months and will therefore continue after the conclusion of this project. The outcome measures for goals 2 and 3 will continue beyond the duration of this project funded with other sources. So far, 34 germplasm accessions have

been screened and ten new sources have been identified (Goal 2). These new sources have been incorporated in UC Davis's lab's CGLRB-funded breeding program and advanced breeding lines are scheduled to be released in the next three to five years (Goal 3).

Goal 1): The proposed number of isolates to be collected and analyzed per month was 25; therefore the total after 2.75 years would be 825 isolates.

The actual number of isolates collected was 484 and seed company collaborators characterized an additional 141 isolates and contributed their phenotyping data to the project; therefore the total number of isolates for this project was 627. This number was lower than the target mainly due to low amounts of disease in the summer and fall months each year because of the abnormally dry conditions in the coastal production areas.

Goal 2): The expected number of representative isolates for use in screening germplasm was ten. The actual number used was six. Six isolates representing the major virulence phenotypes could be used that were collectively virulent on all of the known resistance for germplasm screening. The number for new sources of resistance was projected to be over 100.

Ten were actually identified. Less than 200 new germplasm accessions were acquired during this project. Consequently, not many new sources of resistance could be found.

Goal 3): The initiation of the introgression of ten new sources of resistance exceeded the proposed goal. Project staff have successfully completed objective in conducting monthly surveys over the 2.75-year long project resulting in the characterization of 627 isolates. Project staff have gained a detailed understanding of variation in the current population of *B. lactucae* in California that indicated which resistance genes will be effective and when fungicide applications would be useful. Both mating types were found in a $B_1$ : $B_2$ ratio of approximately 1:7, indicating the increasing importance of sexual reproduction in generating variation in the *B. lactucae* population in California. The frequency of novel virulence phenotypes that differed from a designated Pathotype increased from 2013 to 2016 (39%, 45%, 47%, and 87%, respectively). New Pathotypes are currently undergoing the denomination process in order to address this change. Ten new sources of resistance that provide resistance to all tested isolates have been identified and are currently being introgressed into cultivars of five different lettuce types.

## Beneficiaries

The seed companies have a clearer picture of which resistance genes are currently effective as well as several new resistance genes to incorporate in their breeding programs. Advanced breeding lines resistant to the current pathogen population in California are being generated, which will assist the smaller seed companies that do not have long term breeding programs that access wild accessions. It will also increase the diversity of lettuce varieties that developed for California and made available to growers and consumers. The growers, particularly organic ones, have information as to which cultivars are likely to be resistant. Conventional growers will have disease resistant crops that are more economical to grow because they will not require applications of expensive chemical protectants. Also, growers are less likely to experience yield losses due to their disease resistance being rendered ineffective by changes in the pathogen population. Consumers will benefit from reduced applications of chemical protectants and higher quality lettuce.

The project facilitated the formation of the American Bremia Evaluation Board (ABEB) in 2014 by breeding companies and UC Davis. This is a breeding company coordinated group that will nominate official Pathotypes for *B. lactucae* in the western United States using a similar protocol to that used in Europe by the IBEB. In May 2015, there was a joint meeting of ABEB and IBEB and it was decided to coordinate the activities of both groups under a single IBEB umbrella with two sub-groups IBEB-EU and IBEB–US responsible for activities in Europe and the US, respectively. Both groups will use the same core differential set of resistant cultivars so that data can be compared. When isolates of the same virulence phenotype are observed in multiple years and locations in California that overcome important Dm genes, they will be nominated for designation as a new Pathotype. A reference isolate will be distributed to the companies to confirm the phenotype and its stability; if confirmed it will be designated as an official Pathotype and used in cultivar resistance descriptions.

There are three beneficiaries of this project: 18 seed companies, numerous growers, and a broad cross section of society as consumers that access the website.

## Lessons Learned

Project team was able to shorten the time necessary to phenotype an isolate by half (from 3 months to 1.5) by streamlining culturing processes. However, phenotyping 25 isolates per month proved not to be feasible. Consequently, the project team aimed at 15 to 20 isolates per month; this seemed to provide an informative picture of variation present. Over the whole project period, the average was 15 isolates per month; due to the recent increase in novel phenotypes, it may be necessary in the future to increase this to 20 isolates per month.

At the beginning of the project the $B_1$ mating type was thought to be rare and sexual reproductive inconsequential in generating variation in California. However, this project clearly demonstrated the presence of the $B_1$ mating type and the potential for sexual reproduction. It also documented the recent big increase in pathogen variation. Sexual reproduction also results in the production of oospores that can survive in the soil for multiple years. This will tend to alter the epidemiology of the disease, increasing the potential for earlier and more widespread epidemics.

It was previously thought that infections within single fields were genetically uniform resulting from single initial infections. However, the project found multiple instances where more than one virulence phenotype was identified from individual fields indicating several infections and complex epidemiology within lettuce production areas.

The goal of understanding the extent of variation of *B. lactucae* was achieved. However, the total number of isolates collected and analyzed was a little below that originally proposed. This was partly due to the drier than usual conditions as well as intensive use of fungicides making it harder to find isolates. In addition, analyzing the large number of isolates proved to be more labor intensive than anticipated and maxed out the labor and space resources. Future monitoring should aim to phenotypically characterize 15 to 20 rather than 25 isolates per month. In addition, the development of Polymerase Chain Reaction (PCR) based molecular markers would allow the more processing of numerous isolates and allow selective phenotyping of novel genotypes.

The number of new germplasm accessions screened was less than proposed. This was due to the difficulties in acquiring new accessions due the increasingly restrictive constraints of conventions regulating international

germplasm movement. Project staff have screened all of the new accessions that were acquired; this resulted in the identification several new sources of resistance. Acquisition of new germplasm is a slow process that should continue to be pursued through official channels.

## Additional Information

Additional information about Bremia database can be accessed through the website http://bremia.ucdavis.edu/.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 56 | **Project Title:** Release of a Promising Natural Enemy for Biocontrol of Olive Fruit Fly | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Berkeley | **Grant Agreement No.:** SCB13056 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Kent M. Daane | **Telephone:** (559) 284-5931 | **Email:** kdaane@ucanr.edu |

## Project Summary

Table and oil olives are unique California specialty crops threatened by the olive fruit fly (OLF), which invaded California around 1998. Table olives have a near zero tolerance for the OLF and are primarily located in the Central Valley, where the summer heat helps to suppress the OLF populations. Over the past decade, oil olive acreage has increased tremendously, with many orchards located in the cooler coastal regions where fly populations have grown to excessive numbers. Current management strategies have relied on frequent applications of insecticide bait (spinosad) sprays, which has resulted in the development of the fly's resistance to spinosad, increased control costs and non-target impacts. Moreover, the effectiveness of insecticide-based programs has been hindered by abandoned and residential olive trees that act as reservoirs for fly populations. In order to develop sustainable management strategies, classical bio-control programs were initiated in 2003 to introduce effective natural enemies for the control of this invasive pest. Several agents were evaluated and screened at the University of California, Berkeley's (UC Berkeley) quarantine facility. The project team, identified one of the most promising natural enemies, a parasitic wasp *Psyttalia lounsburyi* (*P. lounsburyi*) that could specifically attack and kill OLF maggots.

Through the course of this project, the project team continued efforts to mass-produce, release and evaluate the establishment and spread of *P. lounsburyi* in coastal olive growing regions where the olives were usually heavily infested and where the parasitoid was most likely to impact OLF populations. The project objectives were to 1) determine factors needed for parasitoid establishment (e.g., landscape, climate, olive varieties) and develop optimal release strategies (e.g., numbers of parasitoids released, seasonal release periods); 2) quantify field dispersal patterns and seasonal dynamics; and 3) release, monitor the establishment, and record the impact of *P. lounsburyi* in released areas.

The olive industry in California had been almost pest free prior to the introduction of OLF. Major olive insect pests such as the olive scale, *Parlatoria oleae* Colvée, and the black scale, *Saissetia oleae* (Olivier) had been substantially suppressed by introduced parasitoids. OLF had successfully spread throughout all parts of California where olives were grown, and was capable of infesting 100% of the fruit on a tree, rendering the harvest unmarketable. At the time of this project, management recommendations included application of GF-120 once weekly or twice monthly from two weeks prior to olive pit hardening (early June) until fruit was harvested in the fall (for table olives) or winter (for oil production). California's olive industry also faced fierce competition from the European markets. The added expense to control OLF was a hardship for growers and had forced some individuals out of olive production entirely.

The project's goal was to introduce and establish specialized natural enemies of OLF in California. Existing insecticide-based programs targeted only the adult fly and could be limited by the fact that many ornamental olive trees in non-crop habitats provided the pest a large reservoir. This highlighted a need for an area-wide control approach. Biological control had the potential to play an important role in Integrated Pest Management

(IPM) by reducing larval fly populations in natural reservoir habitats, even if not in cultivated crops. Significant levels of natural enemy activity in any of the key habitats could reduce numbers of flies that migrated into crop habitats, making it easier and more economical to manage the fly with a combination of other IPM methods.

A previously funded 2010 Specialty Crop Block Grant Program Project 2: *Olive Fruit Fly: Managing an Ancient Pest in Modern Times*, imported and screened in quarantine seven parasitoid species. Approval for the release of two species was granted by the United States Department of Agriculture: Animal and Plant Health Inspection Service's (USDA APHIS). *Psyttalia humilis* and *P. lounsburyi* were released and evaluated. *P. lounsburyi* was established near San Luis Obispo and San Mateo California, and shown to be the most promising parasitoid following only a limited release. The previous project's findings suggested that *P. lounsburyi* should establish in California regions with mild climates (e.g., coastal olive regions), where larger and more damaging OLF populations were found.

The current project built upon the previous work and aimed to rapidly expand the geographical range of *P. lounsburyi* in California. In fact, extensive field surveys showed that this parasitoid has permanently established in at least ten (previously two) coastal counties from Marin to Ventura and has widely spread from the two earliest release sites in San Mateo and San Luis Obispo. Parasitism had also increased over the years in the two earliest released sites.

## Project Approach

In years 1-3: extensive field releases of *P. lounsburyi* were conducted in eight coastal (Sonoma, Marin, San Mateo, Santa Cruz, San Luis Obispo, Ventura, Riverside and San Diego) and two northern interior (Napa and Yolo) California counties. Release sites were selected based on identified field attributes that contributed to successful establishment. At each site, rigorous pre-release sampling and post-release monitoring on parasitism and OLF populations was conducted to determine the establishment and spread as well as the impact of the parasitoid.

In year 3: extensive post-release surveys were conducted at different times and distances from the two earliest released sites in San Mateo and San Luis Obispo to quantify the field dispersal patterns and seasonal parasitism dynamics. Lastly, all field-collected data was analyzed to determine the factors influencing parasitoid establishment.

The project's major activities and tasks included the rearing and shipment of the parasitoid *P. lounsburyi*, field release, and monitoring of the establishment, dispersal patterns and impact of released parasitoids.

(1) Parasitoid rearing and shipment: the parasitoid was mass-reared at the United States Department of Agriculture, Agricultural Research Service (USDA-ARS), European Biological Control Laboratory (EBCL) in France, and then received and processed at the UC Berkeley's Insectary & Quarantine Facility for field release in California. In total, 206,283 individual wasps (136,707 males and 69,576 females) were produced and 39,638 individual wasps (9,531 males and 30,107 females) were shipped to California for field release (Table 1). Rearing methods of this parasitoid were greatly improved in 2014 and as a result, more parasitoids were produced and shipped to California for field release in 2014 and 2015 than in 2013. About 30.8% of shipped parasitoids died either on route or shortly after arrival at the UC Berkeley Insectary Facility. Five shipments were received each year, once per month from August to December (Table 1).

(2) Field release: the parasitoid was released at 40 different sites in 10 different counties, including Yolo, Napa, Sonoma, Marin, San Mateo, Santa Cruz, San Luis Obispo, Ventura, Riverside and San Diego (Figure 1, Table 2). Upon arrival, all live wasps were released within 1-2 days and a total of 22,809 female wasps were released. Releases began in August when adequate numbers of infested fruit became available in California, and ended in December after most commercial fruit had been harvested (Table 2). Ideal release sites included clusters of ornamental trees (e.g., roadsides, parks and residential areas), organic commercial olive groves, or abandoned olive groves (trees in these sites were often heavily infested by the OLF but were treated with insecticides). Therefore, the majority of releases were made in those sites, but releases were also made in several managed olive groves in Riverside, Sonoma, Marin and Napa (Table 2).

Table 1. Parasitoid (*P. lounsburyi*) mass-reared at EBCL and shipped to California for field release

| Year | Shipment | Day | Produced | | | Shipped | | |
|---|---|---|---|---|---|---|---|---|
| | | | Males | Females | Total | Males | Females | Total |
| 2013 | 1 | 8/22 | 3,041 | 1,719 | 4,760 | 342 | 354 | 696 |
| | 2 | 9/17 | 8,298 | 3,882 | 12,180 | 518 | 832 | 1,350 |
| | 3 | 10/16 | 3,437 | 2,115 | 5,552 | 514 | 736 | 1,250 |
| | 4 | 11/13 | 3,767 | 2,446 | 6,213 | 228 | 719 | 947 |
| | 5 | 12/10 | 4,811 | 3,572 | 8,383 | 1,014 | 1,233 | 2,247 |
| 2014 | 1 | 8/12 | 9,209 | 5,754 | 14,963 | 1,275 | 3,000 | 4,275 |
| | 2 | 9/2 | 10,214 | 3,725 | 13,939 | 1,079 | 2,149 | 3,228 |
| | 3 | 10/7 | 13,195 | 5,435 | 18,630 | 346 | 2,511 | 2,857 |
| | 4 | 11/12 | 13,352 | 7,716 | 21,068 | 85 | 762 | 847 |
| | 5 | 12/1 | 14,058 | 5,606 | 19,664 | 1,272 | 4,274 | 5,546 |
| 2015 | 1 | 8/4 | 5,775 | 3,133 | 8,908 | 336 | 1,560 | 1,896 |
| | 2 | 9/1 | 10,885 | 6,144 | 17,029 | 554 | 2,926 | 3,480 |
| | 3 | 9/29 | 11,193 | 5,953 | 17,146 | 735 | 3,173 | 3,908 |
| | 4 | 10/27 | 12,624 | 5,102 | 17,726 | 597 | 2,456 | 3,053 |
| | 5 | 12/1 | 12,848 | 7,274 | 20,122 | 636 | 3,422 | 4,058 |
| **Total** | | | **136,707** | **69576** | **206,283** | **9,531** | **30,107** | **39,638** |

Table 2. Numbers of the parasitoid (*P. Lounsburyi*) adults released in California during 2013 -2015

| Year | Date | Number released | Release site | Habitat | County |
|---|---|---|---|---|---|
| 2013 | 22 Aug. | 315♀, 100♂ | Cañada College | Ornamental trees | San Mateo |
| | 20 Sept. | 60♀, 15♂ | Avila Beach 1 | Ornamental trees | San Luis Obispo |
| | | 60♀, 15♂ | Avila Beach 2 | Ornamental trees | San Luis Obispo |
| | | 25♀, 10♂ | David Farm 1 | Ornamental trees | San Luis Obispo |
| | | 100♀, 43♂ | David Farm 2 | Ornamental trees | San Luis Obispo |
| | | 245♀, 113♂ | San Anselmo | Ornamental trees | Marin |
| | 18 Oct. | 120♀, 30♂ | David Farm 1 | Ornamental trees | San Luis Obispo |
| | | 143♀, 43♂ | David Farm 2 | Ornamental trees | San Luis Obispo |
| | 20 Oct. | 242♀, 50♂ | San Anselmo | Ornamental trees | Marin |
| | 14 Nov. | 140♀, 20♂ | Avila Beach 2 | Ornamental trees | San Luis Obispo |
| | | 100♀, 15♂ | David Farm 1 | Ornamental trees | San Luis Obispo |

| Year | Date | Number released | Release site | Habitat | County |
|---|---|---|---|---|---|
| | | 60♀, 15♂ | David Farm 3 | Ornamental trees | San Luis Obispo |
| | | 25♀, 10♂ | Cal Poly 2 | Ornamental trees | San Luis Obispo |
| | | 20♀, 10♂ | Cal Poly 3 | Ornamental trees | San Luis Obispo |
| | 11 Dec. | 120♀, 35♂ | Avila Beach 2 | Ornamental trees | San Luis Obispo |
| | | 280♀, 75♂ | David Farm 1 | Ornamental trees | San Luis Obispo |
| | | 350♀, 304♂ | David Farm 2 | Ornamental trees | San Luis Obispo |
| | | 350♀, 300♂ | David Farm 3 | Ornamental trees | San Luis Obispo |
| 2014 | 12 Aug. | 900♀, 544♂ | San Anselmo | Ornamental trees | Marin |
| | | 945♀, 116♂ | San Diego | Ornamental trees | San Diego |
| | 8 Sept. | 616♀, 75♂ | Rossi Estate | Commercial grove | Sonoma |
| | | 703♀, 78♂ | Stone Edge Estate | Commercial grove | Sonoma |
| | 7 Oct. | 741♀, 55♂ | Kamen Estate | Commercial grove | Sonoma |
| | | 138♀, 10♂ | Coturri Estate | Commercial grove | Sonoma |
| | | 417♀, 30♂ | Moon Mountain | Commercial grove | Sonoma |
| | | 700♀, 130♂ | Davis Sci. Center | Commercial olives | Yolo |
| | 11 Nov. | 550♀, 50♂ | San Anselmo | Ornamental trees | Marin |
| | | 1,135♀, 255♂ | Davis Sci. Center | Commercial olives | Yolo |
| | 6 Dec. | 700♀, 100♂ | 389 4th St. East | Ornamental trees | Sonoma |
| | | 1,249♀, 208♂ | Napa City | Ornamental trees | Napa |
| | | 250♀, 50♂ | Albany Village | Ornamental trees | Alameda |
| | | 400♀, 100♂ | College of Marin | Ornamental trees | Marin |
| 2015 | 4 Aug. | 460♀ 52♂ | Rincon Vista | Abandoned olives | Ventura |
| | | 500♀ 87♂ | Olivewood Gard. | Ornamental trees | San Diego |
| | | 431♀ 43♂ | Temecula Olives | Organic olives | Riverside |
| | 1 Sept. | 500♀ 58♂ | 389 4th St. East | Ornamental trees | Sonoma |
| | | 300♀ 54♂ | College of Marin | Ornamental trees | Marin |
| | | 230♀ 35♂ | Woodland market | Ornamental trees | Marin |
| | | 500♀ 50♂ | 458 Ingalls St. | Ornamental trees | Santa Cruz |
| | | 830♀ 110♂ | Stubbs Ranch | Commercial olives | Marin |
| | 28 Sept. | 300♀ 30♂ | 2216 Las Amigas | Commercial olives | Napa |
| | | 500♀ 50♂ | 389 4th St. East | Ornamental trees | Sonoma |
| | | 500♀ 50♂ | Berkeley campus | Ornamental trees | Alameda |
| | | 300♀ 60♂ | Davis Sci. Center | Commercial olives | Yolo |
| | | 890♀ 100♂ | Atascadero | Ornamental trees | San Luis Obispo |
| | 27 Oct. | 726♀ 67♂ | Cliff Family Farm | Commercial olives | Napa |
| | | 500♀ 13♂ | Stubbs Ranch | Commercial olives | Marin |
| | | 500♀ 13♂ | Davis Sci. Center | Commercial olives | Yolo |
| | 1 Dec. | 250♀ 30♂ | Summit Lake 1 | Commercial olives | Napa |
| | | 550♀ 60♂ | Summit Lake 2 | Commercial olives | Napa |
| | | 250♀ 30♂ | Gott's Property | Ornamental trees | Napa |
| | | 550♀ 60♂ | Charter Oak Ave. | Ornamental trees | Napa |
| | | 550♀ 60♂ | Franciscan Estate | Ornamental trees | Napa |
| | | 574♀ 70♂ | E. Spain St. | Ornamental trees | Sonoma |

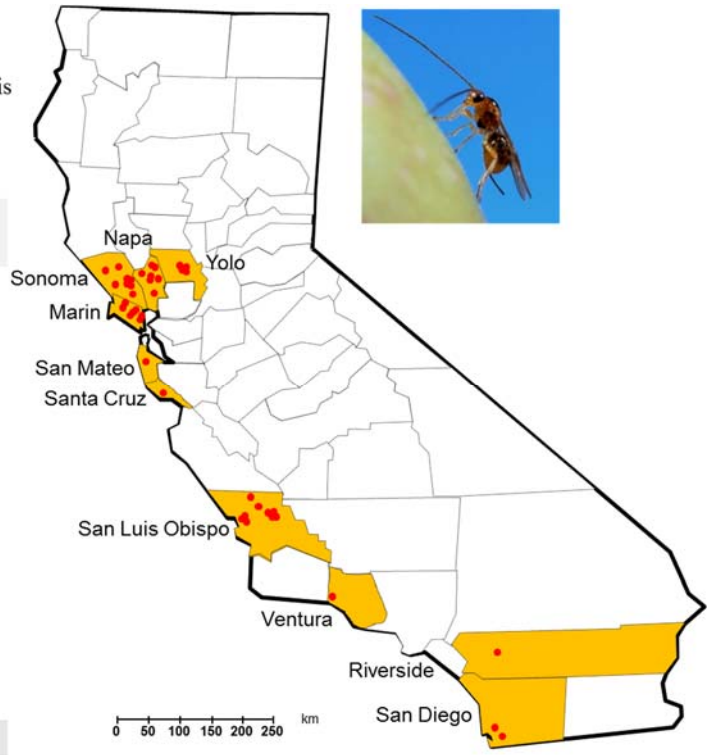
(3) Monitoring the establishment, dispersal and parasitism: Extensive surveys of infested olives were conducted in previously released sites prior to each year's release and after each new release. Surveying began in July when infested fruit became available in California. Prior to the 2013 release, pre-release samplings were conducted at two previous release sites in San Luis Obispo and San Mateo. *P. lounsburyi* was recovered at the California Polytechnic State University (Cal Poly) site 1, on August 8, 2013 in San Luis Obispo and at the Cañada Community College campus in San Mateo. This marked the two earliest established sites.

Following the 2013 release, the parasitoid was also recovered from two other sites located approximately 1,500 and 1,700 m away from the Cal Poly 1 site in San Luis Obispo, and at several sites close (< 1 miles) to the Cañada Community College campus site in San Mateo. These results showed that this parasitoid had dispersed from these two original release sites.

Figure 1. Numbers of adult female *P. lounsburyi* released in different sites and counties from 2013 to 2015. Red dots indicate release sites in each county.

Number of adult female *P. lounsburyi* released in different counties during this project (2013-2016)

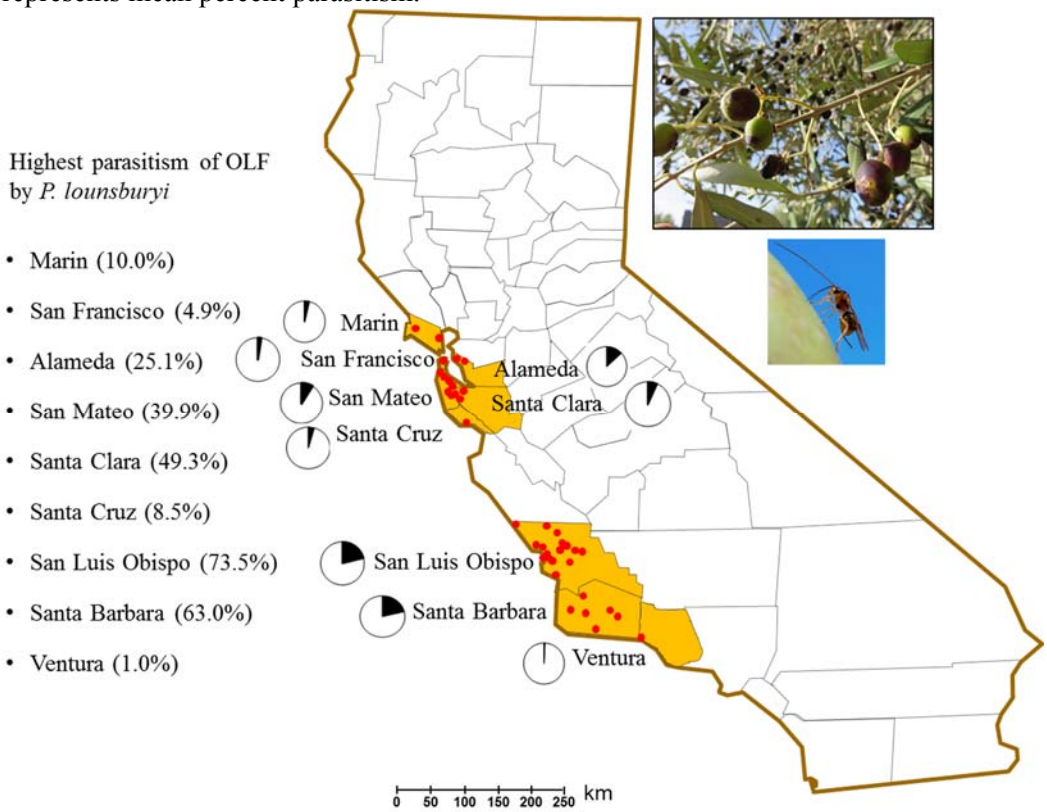
| County | Number (sites) |
|---|---|
| Yolo | 2635 (4) |
| Napa | 4425 (7) |
| Sonoma | 4858 (7) |
| Marin | 3952 (7) |
| San Mateo | 315 (1) |
| Santa Cruz | 500 (1) |
| San Luis Obispo | 3008 (9) |
| Ventura | 460 (1) |
| Riverside | 431 (1) |
| San Diego | 1445 (2) |
| **Total** | **22809** |





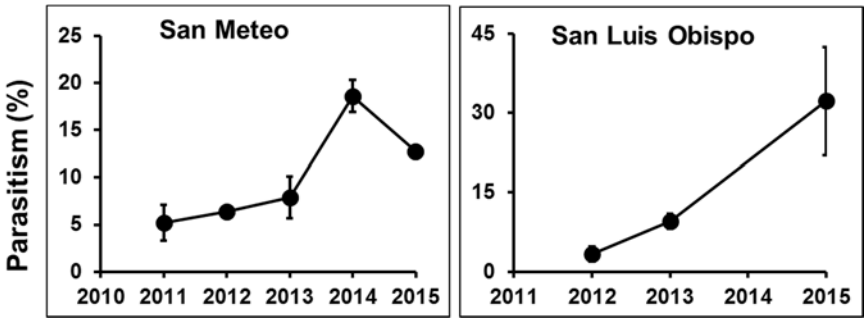

In 2014, *P. lounsburyi* was first recovered from San Anselmo, in Marin County in August before additional releases were made in 2014 and after parasitoids were first released at this location in August 2013. This marked a third location where the parasitoid had successfully overwintered and recovered the following fruiting season. *P. lounsburyi* was continually monitored at the one previously established site in San Mateo (due to low number of fruit in San Luis Obispo, this site was not sampled). Parasitism by *P. lounsburyi* significantly increased over the 2014 fruiting season, reaching a peak of 40% by end of season, and then dropped in early spring as host infested fruit dropped from trees and dried up.

Figure 2. Highest and mean parasitism of OLF by *P. lounsburyi* in different counties (based on 2015 data). Red dots indicate the release sites and dark area inside each circle represents mean percent parasitism.




In 2015, a total of 95 sites in 14 counties were surveyed and over 60,000 fruit was collected and processed in the laboratory. The project team continually recovered this parasitoid in the three early release sites in San Luis Obispo, San Mateo and Marin counties, and made the first ever recovery of this parasitoid in Alameda, San Francisco, Santa Clara, Santa Cruz, Santa Barbara and Ventura counties. It was found in all 15 sampled sites in San Luis Obispo area, 23 out of 25 randomly sampled sites from San Francisco to Santa Clara area and 30 out of 31 randomly sites in Ventura, Santa Barbara and San Luis Obispo counties. The high parasitism of OLF by *P. lounsburyi* was up to 39.9% in San Mateo, 49.3% in Santa Clara, 63.0% in Santa Barbara and 73.5% in San Luis Obispo (Figure 2). Parasitism of OLF larvae by *P. lounsburyi* increased over the years at both early release sites in San Mateo or San Luis Obispo (Figure 3). This marked a continuous, persisting population of this parasitoid following the previous releases in these earliest locations. These results demonstrated that this parasitoid had also permanently established, expanded, and had the potential to impact the population dynamics of the OLF in the coastal regions. However, *P. lounsburyi* had not been recovered in Sonoma, Napa, Yolo, Riverside and San Diego counties. The lack of recovery at these locations may have been due to either low numbers of released parasitoids or small pre and post sample sizes.

Figure 3. Mean (± SE) parasitism of OLF larvae by *P. lounsburyi* in two early release sites




All funds from this project were used to solely enhance the competitiveness of Californian table and oil olives. The accounting department also assisted in ensuring that all receipts and documents were recorded according to the project's budget narrative.

This project represented a true collaboration between various research agencies and the public sector. The Project Director (UC Berkeley) coordinated the Quarantine activities and field release and monitoring in California. The Research Specialist (UC Berkeley) conducted most of the research and report writing; several technicians at the project's laboratory assisted with the field surveys and releases; the co-PI with the California Department of Food and Agriculture helped to coordinate shipments of parasitoids from the USDA EBCL in Montferrier, France and also conducted release efforts in Marin and Yolo counties. A cooperator with Cañada Community College helped to coordinate release and recovery efforts near Santa Cruz and San Mateo, they also had a class of 20-30 students help with the release and recovery efforts. The Quarantine Manager handled shipments of the parasitoids that had arrived from France and helped move the imported material through Quarantine at UC Berkeley.

Field releases were accomplished only with the cooperation of individual olive farmers and landscape managers that allowed releases of parasitoids on their property and accepted a no-spray policy in order for the pest and natural enemy populations to be studied. These included many University of California Cooperative Extension (UCCE) farm advisors (eg., the area IPM Advisor and Acting Director, UC Statewide IPM Program; Farm Advisors in Napa, Ventura, and Santa Barbara), commercial olive growers (e.g., Enterprise Vineyards, Sonoma; Mesa Vineyard, San Luis Obispo; Temecula Olive Oil, Riverside), and numerous olive growers (San Diego, San Luis Obispo, Napa and Ventura counties).

Outreach activities:
The Project Director gave numerous talks to olive growers throughout the duration of the project. During the state-wide surveys and releases of the parasitoids, the project team also reached out to the UCCE farmer advisors (e.g., UC Statewide IPM Program, Napa, Ventura and Santa Barbara advisors), commercial olive growers (e.g., Enterprise Vineyards, Sonoma; Mesa Vineyard, San Luis Obispo; Temecula Olive Oil, Riverside), as well as individual olive growers in San Diego, San Luis Obispo, Napa and Ventura, and used these opportunities to disseminate information and research results from this project.

## Goals and Outcomes Achieved

As described previously, the project team conducted wide release and extensive monitoring of the released parasitoid and quantified field establishment and dispersal patterns, seasonal population dynamics as well as the impact of the parasitoid in released areas. The collected field data was then analyzed to determine factors that could have had an affect on the establishment of the parasitoid (e.g., landscape, climate, olive varieties). This information will be useful for developing optimal release strategies (e.g., numbers of parasitoids released, seasonal release periods) for future release of *P. lounsburyi* or other parasitoids.

The short term goal accomplished by the project team was to establish *P. lounsburyi* as widely as possible in all major olive growing regions in California in a relatively short period of time. Currently, the parasitoid has permanently established in most released sites along the coastal regions from Ventura County to Marin County.

*P. lounsburyi* was not recovered in interior (e.g., Butte, Solano and Yolo), northern (Sonoma and Napa), and southern (e.g., Riverside and San Diego) olive growing regions. The lack of recovery in these regions may have been due to the lack of samples or due to the small number of wasps previously released. The project team continued to monitor the establishment and spread of this parasitoid and conducted more releases in late 2016 in attempt to further expand the range of the parasitoid.

The long term goal was to establish specialized parasitoids in a majority of olive growing regions in California. It was suspected that the lack of recovery of *P. lounsburyi* in some previously released regions may have been due to the fact that the tropical African parasitoid, *P. lounsburyi* appeared not to diapause during the winter. *P. lounsburyi* established only in the weather-mild olive growing regions in California. In order to achieve the long term goal of reducing the overall need to treat for OLF the project team would recommend the introduction of a more cold tolerant parasitoid such as the temperate *Psyttalia ponerophaga* (*P. ponerophaga*) from Pakistan. This parasitoid appeared to diapause at low temperatures such as those found in the states interior. This characteristic may make *P. ponerophaga* more capable of surviving the winter especially in colder olive growing regions and would be an important addition to the long term management of OLF.

All of the stated activities were accomplished within the program period.

At the beginning of the project, the parasitoid *P. lounsburyi* was found permanently established only in two counties. Through the course of the project, the parasitoid was found permanently established in at least 10 coastal counties and parasitism of OLF by the parasitoid increased steadily. Thus, *P. lounsburyi* was successfully disseminated throughout California.

After a three-year effort, both the geographical range of this parasitoid and the parasitism of OLF by the parasitoid had increased. It is expected the parasitoid will continue to play a key role in controlling this pest fly in its established regions.

## Beneficiaries

California coastal olive oil producers were the primary beneficiaries. Interior Valley table and oil olive growers also benefited, but primarily through the increase knowledge of OLF biology. Landscape systems (home-owners, commercial properties, etc.) with olive trees also benefited.

There were approximately 27,000 acres of olives grown in California. In 2014-2015 fiscal year there was approximately $72,904,000 in revenue from olive orchards. In 2015, 4.0 million gallons of California extra virgin olive oil was produced. With continued work, achievement of the long term goals would reduce the need to treat for OLF, especially in coastal areas. This outcome would greatly reduce pesticide use and its impacts.

## Lessons Learned

*P. lounsburyi* permanently established in most released sites along the coastal regions from Ventura County to Marin County. The *P. lounsburyi* continued to expand and increase its impact on OLF population dynamics. This successful experience will help in future releases of other biological control agents of OLF or other pests. However, *P. lounsburyi* has not yet been recovered in interior (e.g., Butte, Solano and Yolo) and southern (e.g., Riverside and San Diego) olive growing regions. This suggested a need for the introduction of a more cold tolerant parasitoid.

An original petition to remove *P. ponerophaga* from quarantine was submitted to USDA APHIS in 2005 (USDA APHIS PPQ 526). It was recommended that release of *P. ponerophaga* be approved after: 1) submission of a more detailed petition that included a comprehensive post-release monitoring plan; and 2) deposition of voucher specimens of the released population of *P. ponerophaga* in the national entomological collections in North America (including Canada and Mexico). In 2009, the project team resubmitted the revised North American Plant Protection Organization (NAPPO) Petition and Draft Environmental Assessment. The Committee recommended to (1) provide more information regarding the agent and the agents' host use in its native range in Pakistan; (2) discuss the establishment potential of the agent in California, with a concern that it may not diapause and be difficult to survive the seasons when host availability is likely scarce; (3) describe specific post-release monitoring plan; and (4) if possible, add more non-target test results. To date, the project team had conducted (1) more biological studies on this parasitoid's temperature range, especially its tolerance to low temperature; (2) field survey and laboratory tests of the parasitoid's host use in Pakistan; and (3) more non-target test in California. These new results showed that *P. ponerophaga* was more cold-tolerant than other released OLF parasitoids and appeared to diapause at low temperatures. All surveys in Pakistan showed that this parasitoid used only OLF as a host and did not attack other common tephritid species there. A revised petition for the release of *P. ponerophaga* was submitted in order to achieve the projects long term goal of establishing specialized parasitoids in the majority of California's olive growing regions.

The costs and difficulties in rearing the parasitoid *P. lounsburyi* limited the numbers that could be released. Five shipments of wasps were received during each fruit season, once per month from August to December. The project team discovered that release in southern California should be started in July when OLF fruit have begun to mature and become infested by OLF. The team also realized that the release in December was a little too late as the parasitoids would not be very active when field temperatures dropped below 10-15°C. It is recommended that future releases in southern California begin in July and end in November.

All goals and outcome measures of the project were considered to have been achieved.

## Additional Information

Publications:

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Daane KM, Wang XG, Nieto DJ, Pickett CH, Hoelmer KA, Blanchet A, Johnson MW. 2015. Classical biological control of olive fruit fly in California, USA: release and recovery of introduced parasitoids. BioControl 60:317-330.

Bon M-C, Hoelmer KA, Pickett CH, Kirk AA, He Y, Mahmood R, Daane KM. 2016. Populations of *Bactrocera oleae* (Diptera: Tephritidae) and its parasitoids in Himalayan Asia. Ann. Entomol. Soc. Am. 114:81-91.
Wang XG, Daane KM, Nieto DJ, Pickett CH *et al*. Establishment and spread of an introduced parasitoid for the control of olive fruit fly in California (in preparation).

Presentations at national and international conferences:
Daane KM. Olive fruit fly and Marshall Johnson: Controlling ancient pests in modern times. ESA's 61st Annual Meeting, Austin, TX, November 4-9, 2013.

Daane KM, Wang XG, Nieto DJ, Pickett CH, Hoelmer KA, Johnson MW. Field release and establishment of introduced olive fruit fly parasitoids in California and predication of geographical range of the parasitoids. ESA's 62nd Annual Meeting, Portland, OR, November 16-19, 2014.

La Spina M, Daane KM, Blanchet A, Hoelmer K, Pickett C, Williams L. Improvement of mass-rearing procedures for an olive fruit fly parasitoid – duration of exposure to hosts affects production of *Psyttalia lounsburyi*. 4th International Entomophagous Insects Conference, Málaga, Spain, October 4-9, 2015.

La Spina M, Daane KM, Wang XG, Kirk A, Blanchet A, Hoelmer KA, Pickett CH, Williams L. Recent developments in the classical biological control program for olive fruit fly in California. 9th Conference of Spanish Society of Applied Entomology, València, Spain, October 19-23, 2015.

Wang XG, Daane KM, Nieto DJ, Pickett CH, Blachet A, La Spina M, Williams L, Smith L, Biondi A, Hoelmer KA, Johnson MW. Establishment and spread of an introduced parasitoid for the control of olive fruit fly in California. ESA Pacific Brach Annual Meeting, Honolulu, HI, April 3-6, 2016 (invited talk for the symposium “Achievements in Recent Biological Control”).

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 57 | **Project Title:** Mechanisms, Distribution, and Invasion Potential of Glyphosate-Resistant Junglerice and other Summer Grass Weeds in California Tree and Vine Cropping Systems | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis | **Grant Agreement No.:** SCB13057 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Brad Hanson | **Telephone:** (530) 752-8115 | **Email:** bhanson@ucdavis.edu |

## Project Summary

This project was designed to address California specialty crop tree and vine industry concerns about rapidly evolving weed management issues related to known or suspected glyphosate-resistant (GR) summer grass weeds. The research team, which included University faculty, a Cooperative Extension Specialist, University of California Cooperative Extension (UCCE) Farm Advisors, and supporting scientists, was well-equipped to address fundamental and applied questions related to understanding and managing herbicide-resistant weeds. This project largely focused on GR junglerice (*Echinocloa colona*) although many aspects are also applicable to other summer grass weeds. The research team used multiple scientific approaches ranging from the lab to the field to develop new information on the distribution, biology, physiology, mechanisms of resistance, and invasion potential of emerging GR summer grass weeds. The overarching goal of this project was to develop knowledge that could lead practical weed management practices that enhance the productivity and sustainability of California specialty crop orchard and vineyard cropping systems.

Management of herbicide-resistant weeds, especially GR biotypes, has been the most important, and the most rapidly changing, weed control issue affecting California orchard and vineyard specialty cropping systems over the past decade. While GR winter-annual weeds, including ryegrass (*Lolium multiflorum*), horseweed (*Conyza canadensis*) and hairy fleabane (*Conyza bonariensis*), are widespread in and around perennial crops, summer-annual grasses, such as junglerice, have recently emerged as the newest challenge facing orchard and vineyard specialty crop producers. Winter-annual weeds differ, substantially, from summer species with respect to growth and phenology patterns, and as a consequence, must be managed using substantially different control strategies. Hence the need to broaden understanding of how environmental and crop production practices specifically affect summer-germinating weeds.

The principal goal of this project was to develop an understanding of GR grass weed biology, phenology, and physiology. This knowledge and associated technology transfer efforts by the collaborators, support scientists, and several student trainees are contributing to the development of more effective, economical and environmentally sustainable weed management practices for orchards and vineyards, which, in turn, will improve the competitiveness of perennial specialty crops in California. Although this research focused, primarily, on the distribution, mechanisms of resistance, and invasion potential of GR junglerice in California tree and vine crops, several other summer grasses (goosegrass, fingergrass, witchgrass, sprangletop, barnyardgrass), also suspected to be GR, were addressed by some aspects of the research and extension objectives.

This project did not build on a previously funded Specialty Crop Block Grant Program (SCBGP) project. This research project was developed in response to tree nut and grape industry concerns about the rapidly growing problems with GR weeds in orchards, vineyards and other specialty cropping systems in California.

## Project Approach

Multiple approaches were to be used to address the objectives of this project including: landscape-scale sampling to identify the distribution of resistance; field, greenhouse, and growth chamber evaluations to characterize growth and development; physiological and analytical laboratory and population genetics to describe the mechanism(s) of resistance.

The following are brief summaries of the activities and tasks performed; more details and data are available in Attachment 1.

1. Collect seed for screening to determine the distribution of GR junglerice in the Central Valley

   - As part of a separate weed screening project, 13 sampling regions were identified in the Central Valley for a stratified random weed survey (Moretti et al. 2016). These 13 regions encompassed a 720 km north-south area of inland California. In each region, 16 sampling sites were identified and visited by research personnel. Over two growing seasons, a total of 410 orchard and vineyard sites were visited and weed species presence documented and mature seed collected if possible. Seed from 28 junglerice populations was collected for resistance screening.

   - Populations were screened using whole plant dose-response experiments in the greenhouse. This work clearly confirmed GR junglerice in multiple locations around the Central Valley with resistance levels ranging from about 1.5 to 4x. This was later confirmed in greenhouse lines subjected to more whole plant dose-responses as well as *in vivo* shikimate assays to specifically measure glyphosate inhibition of the EPSPS enzyme.

2. Evaluate coexistence of GR junglerice and barnyardgrass in California orchards

   - Barnyardgrass presence in commercial orchards was documented as part of the junglerice screening. It was noted that junglerice was much more prevalent than barnyardgrass, although there were a few orchards where they coexisted, particularly in the Sacramento Valley. While barnyardgrass has been, historically, a significant weed for growers in California, junglerice has become a much larger concern over the past five to ten years.

3. Evaluate the risk of GR trait moving from junglerice to barnyardgrass using uni-direction forced outcrossing studies

   - The project team attempted to evaluate sexual crossing of junglerice and barnyardgrass in the greenhouse with little success in either direction (junglerice as male or female parent). Similarly, the team briefly attempted to cross junglerice with other weedy Echinochloa species common in the Sacramento Valley but also were not successful.

   - This approach did not include forcing crosses through emasculation and hand pollination, so lack of

crossing does not preclude the possibility that outcrossing can happen. However, it suggests that it is not highly likely. Depending on future research directions, this question may be addressed further; the possibility of glyphosate resistance moving from *E. colona* to other weedy *Echinocloa* species or from herbicide resistant *Echinocloa* species of rice crops into orchards still presents a real risk to weed management.

- Because several target site mutations were identified and also uncovered evidence of a non-target site mechanism of resistance in junglerice, research was refocused to address intraspecific gene flow. Since junglerice is a tetraploid, it is very possible that multiple resistance alleles could accumulate in an individual and this may account for some of the variability in the level of glyphosate resistance observed in this species in various experimental and commercial settings.

4. Evaluate glyphosate uptake and translocation in GR and glyphosate-susceptible (GS) junglerice using 14C-labeled herbicide

   - The work to determine the fate of glyphosate in treated junglerice seedlings was not fully completed during the project period. Work conducted thus far indicates that there is no difference between GR and GS plants in the amount or rate of glyphosate absorption. The radioactive plant samples for the translocation work are currently in storage awaiting final processing. This part of the project was delayed by a maintenance issue with a critical piece of equipment, a reagent backorder, and a backlog of samples from other projects. This work is still progressing and will continue beyond this performance period in conjunction with a new research project.

5. Evaluate GR junglerice populations for target site (EPSPS enzyme) gene mutations known to confer glyphosate resistance

   - Whole plant response to glyphosate was evaluated in a screening of the initial 28 junglerice accessions, as well as several subsequently added populations, and was confirmed with later screenings of F2 and F3 junglerice lines. From these lines, several junglerice lines were subjected to partial sequencing of the genetic coding region for the EPSPS enzyme that is the target site for glyphosate. There are several single amino acid substitutions in this coding region for this enzyme that can result in target site resistance.

   - The normal, wildtype plants have a proline at position 106. This work identified three different mutations at position 106 resulting in some GR populations with a serine, a leucine, or a threonine. This confirms target site mediated resistance in California junglerice. However, there appears to be at least one GR population that does not have a target site mutation which raises the possibility of a non-target site mechanism also in this species.

6. Assess glyphosate metabolism in GR junglerice

   - The techniques for treating summer grass weeds with 14-C glyphosate, extracting the tissue, and monitoring for glyphosate and metabolites using HPLC coupled radiation detection has been optimized. However, progress was delayed by an instrument malfunction that has since been repaired. The metabolism work on jungle rice and two other grass species of orchards will continue in conjunction with an ongoing project.

7. Assess plasticity and phenotypic variability of GR junglerice from different regions of California in common garden experiments.

   - The work evaluating the plasticity and phenotypic variability was completed as planned. Studies were conducted in the field to evaluate junglerice response to various levels of shading at field locations in both Davis and Fresno.

   - Interestingly, there was an interaction among biotypes and shade response; some biotypes were morphologically similar under all environments while others presented vastly different architecture depending on the level of shade. This response was most notable in regards to degree of prostrateness or erectness, but also to some degree in total biomass prosecution and reproductive potential.

   - The phenological development of GR and GS junglerice was monitored to determine the effects of establishment date on the development and reproductive capacity of plants emerging early-to-late in the growing season. These experiments were conducted in 2016 and data are currently being collected and analyzed.

8. Determine effects of environmental factors on GR junglerice germination, growth, and response to glyphosate

   - Several data sets were developed to describe the growth rates and phenotypic response of GR and GS junglerice populations to different environmental factors. A series of experiments were conducted in growth chambers to compare germination rates, vegetative productivity, and reproductive output in response to a series of temperatures. This work generally showed similar temperature preferences for all of the junglerice populations tested regardless of their known response to glyphosate.

   - Representative GR and GS populations were subjected to salinity and osmotic stress at germination and salt stress was also imposed on whole plants in greenhouse studies. This work suggested that the GR population tested is slightly more robust than the GS population under challenging environmental conditions. However, due to the limited number of populations in this study, cautious interpretation is needed.

   - A study on the relative competitive ability of GR and GS junglerice was conducted using a replacement series experiment. This work did not show any clear differences in competitive ability of the two biotypes in the absence of glyphosate.

   - A laboratory experiment was conducted to compare nitrogen uptake by a GR and GS junglerice. This work did not find any differences in nitrogen uptake or nitrogen use efficiency that appeared to be biologically relevant.

   - The results from the aforementioned studies have suggested that the presence of the GR trait does not affect junglerice growth and development under a wide range of conditions. This is an important piece of information: while the GR trait may not be associated with elevated tolerances to abiotic stresses, neither does it confer any fitness penalty. In the absence of glyphosate, GR and GS biotypes appear to be equally suited to grow and develop in perennial cropping systems.

- Two studies were conducted to evaluate potential interactions between environment and herbicidal efficacy. In the first study, junglerice plants were treated with sethoxydim, glufosinate, or glyphosate and grown under conditions of shade or sun and various levels of moisture stress. In a second study, GR and GS plants were treated with glyphosate and subject to three different temperature regimes. These trials both indicated interesting and potentially meaningful interactions between environmental conditions and herbicide efficacy – even for the GR biotypes.

9. Evaluate susceptibility of GR junglerice to alternate Mode of Action (MOA) herbicides in field and greenhouse (GH) experiments

   - Over three growing seasons, members of the research team conducted several field research and demonstration trials to evaluate alternative herbicide strategies for management of junglerice in commercial vineyards and orchards in the Central Valley. These provided important information and context for the laboratory and greenhouse work and also formed the backbone of the extension programming aspects of the project. Additionally, greenhouse research was conducted to formally evaluate the performance of known GR and GS junglerice populations to other herbicides with other modes of action.

   - In general, this research did not find any evidence of cross-resistance among GR junglerice to other herbicide chemistries that control the GS populations. Additionally, the field work and extension programs strongly suggested that growers consider utilization of preemergence herbicide programs rather than rely solely on POST programs for management of summer grasses. In particular, a sequential approach to use of split or late applications of dinitroanaline herbicides was proposed as a management tactic to increase efficacy on summer annual grasses without significant increase in herbicide use.

10. Evaluate susceptibility of other summer annual grass weeds to glyphosate and alternate herbicide MOA in field and GH experiments

    - Over three growing seasons, several field research and demonstration trials were conducted in commercial orchards and vineyards infested with other summer grass weeds. Grass weeds evaluated in some of these trials included threespike goosegrass, Mexican sprangletop, feather fingergrass, and witchgrass. This work primarily supported the extension programming aspects of the project and, in some cases, suggested areas of future research for the collaborators

11. Disseminate biology and control information to California specialty crop stakeholders

    - Most of the project collaborators on this project have extension responsibilities and interests. Over the course of the project, project staff routinely participated in extension meetings and shared results via presentations, online outreach activities, and individual consultations with growers, pest control advisors, and others involved in specialty crop weed management via UCCE. Collectively, the investigators and members of their research programs delivered project-related information in at least 60 presentations, online articles, or grower-oriented media during the project period (see Attachment 1 for a partial listing).

12. Project reporting: Prepare final reports for the SCBGP; prepare journal manuscripts and extension materials

- The annual and final reports for the SCBGP were organized by the principal investigator with input on specific research and extension efforts from all collaborators. Because the majority of this research was just completed mid-2016 and some will continue after the project, no journal articles have been submitted at this time. It is anticipated at least three journal manuscripts will be submitted in January 2017. Extension materials in the form of PowerPoint presentations, online articles, and newsletter articles (see Attachment 1 for a list of extension presentations).

The benefits of the applied aspects of the research and the extension efforts apply specifically to orchard and vineyard perennial specialty crops in California, namely tree nuts, tree fruit and grapes. Some of the more fundamental aspects of the research such as molecular genetics of the GR junglerice biotypes are broadly applicable to the weed rather than to the cropping system. However, weed populations tested were specifically collected from orchard and vineyard production systems that are heavily reliant on glyphosate (including almond, walnut, pistachio and grape) but also benefit other specialty orchard crops (such as olive, prune and pomegranate, among others) that also depend on glyphosate for postemergence weed control which maintains the specialty crop focus. Importantly, all risk assessments and alternative control strategies developed apply solely to specialty crops and are not directly applicable to annual cropping systems or other non-specialty crops in California because of differences in growing seasons, tillage operations, cultural control methods and herbicide availability.

The project team members have collaborated for several years on herbicide resistant weed research. As in previous work, the team contributed to various research and extension objectives in their areas of expertise. In this project, UC Davis was the lead institution with the principal investigator responsible for project coordination and reporting.

## Goals and Outcomes Achieved

The activities in each of the major performance areas were previously summarized in the Project Approach section of this report (and also in Attachment 1) but are briefly described here as well.

- Junglerice populations collected from multiple tree and vine cropping systems in the Central Valley were surveyed and screened for resistance.
- The coexistence of junglerice and barnyardgrass in California orchards and vineyards was evaluated.
- The risk of GR trait movement from junglerice to barnyardgrass was explored but not pursued in depth based on the results of preliminary studies. This effort was refocused on intraspecific gene flow within junglerice populations after multiple mechanisms of resistance were identified and noted the variability in level of resistance among populations which suggested possible accumulation of multiple resistance mechanisms in this polyploidy species.
- Glyphosate absorption was evaluated using radiolabeled herbicide in several GR and GS junglerice populations and no differences were observed. The glyphosate translocation work was not completed during the performance period due to an equipment malfunction; however, this work will be continued and completed in the next few months.
- Several gene mutations leading to single amino acid substitutions in the gene coding for the EPSPS enzyme were identified. A Pro106Thr, Pro106Ser, and Pro106Leu were identified. Additionally, evidence of a non-target site resistance mechanism was also uncovered and being explored in ongoing research.
- Glyphosate metabolism work is complete and does not appear to be a contributing factor to

glyphosate resistance in junglerice from California. The data is currently being finalized and will be included in the principal investigator's (PI) journal manuscript early 2017, and posted on the UC Weed Science report database: http://ucanr.edu/sites/UCWeedReports/Weed_Science_Database/
- Common garden experiments were conducted to evaluate the effects of different levels of shade on junglerice grown in the San Joaquin and Sacramento Valleys.
- The plasticity and phenotypic variability of GR and GS junglerice was evaluated in multiple experiments during this project period. Research addressed the effects of temperature, salinity, and osmotic stress on junglerice seed germination. Whole plant research included evaluations of the effects of salinity, shade, temperature, nitrogen, and planting date on junglerice growth and phenology.
- The susceptibility of GR and GS junglerice to preemergence and other postemergence herbicide modes of action was evaluated and demonstrated in greenhouse trials at CSU Fresno and UC Davis, as well as in commercial orchards and vineyards throughout the Central Valley by UC Davis and UCCE collaborators.
- Several greenhouse and field studies included evaluations of other summer annual grasses including sprangletop, feather fingergrass, threespike goosegrass, and witchgrass. However, the more detailed genetic, physiology, and phenology research focused on junglerice due to the economic importance and rapid spread of this species during the project period.
- Information on the biology and control of junglerice and other summer grass weeds of orchard and vineyard cropping systems was disseminated to California specialty crop stakeholders through the extension programs of the project collaborators.

Most of the outcomes of this project are relatively long term in nature. A much greater depth of understanding has been developed of the biology and resistance mechanisms of GR junglerice. Alternative control strategies have also been evaluated and demonstrated that orchard and vineyard managers can use to manage current problems with GR junglerice and reduce selection of additional GR weed biotypes. Many of the impacts of this research cannot be measured in the short term because changes in an evolutionary process are only observed over generations.

The project staff largely accomplished the goals of this project. Project staff worked both together and separately to address basic and applied questions related to the distribution, genetics, physiology, phenology, and management of GR junglerice in orchard and vineyard production systems of California. Objectives related to gene flow from junglerice to barnyardgrass were not fully explored or in depth studies conducted on the genetics and physiology of the other summer grass species. However, the preliminary and exploratory studies conducted in these areas provide good context relative to the detailed junglerice research and also provide a useful starting points for future studies.

With this research project staff determined that: 1) GR junglerice is common in many areas of the Central Valley, 2) it co-occurs with other *Echinocloa* species and other weedy, summer grasses, 3) there are at least three target site mutations and probably a non-target site mechanism of resistance in the species, 4) differences in glyphosate absorption does not appear to be related to resistance in this species, 5) the species is broadly adapted to the environmental stresses found in orchard systems, 6) the species is plastic in phenology but there does not appear to be a competitive difference among populations that is specifically related to glyphosate resistance, 7) there does not appear to be any evidence of cross resistance to other herbicide modes of action conferred by glyphosate resistance in this species, and 8) there are alternative management strategies that growers can implement to reduce problems with GR junglerice will likely involve more complicated management and higher costs.

During the course of this project, project staff identified three new target site mutations conferring resistance to glyphosate in California populations of junglerice. The germination, growth and development of this species was characterized under a wide range of environmental conditions and found that it was adapted to a diversity of habitats. Through information dissemination efforts, orchard and vineyard manager awareness was increased of this weed and demonstrated alternative management strategies. Because of the research team's statewide extension programs that address weed problems in nearly all the tree and vine commodities in California, these efforts have the potential to impact growers, commodities, and pest control advisors who collectively manage weeds on nearly two million acres of irrigated California specialty crops.

## Beneficiaries

The research information developed is applicable to all of the orchard and vineyard projection systems of California's Central Valley that utilize herbicides for weed control. The extension programs of project collaborators routinely presented information on management of GR weeds to audiences of fruit and nut tree and grapevine commodity groups and weed management professionals from around California (see a partial list of extension outreach presentations elsewhere in this report).

Commodity groups that benefit from this work include: tree nuts (almond, walnut, pistachio, pecan), stone fruits (apricot, nectarine, plum, prune, cherry, peach), grape (wine, table, raisin), as well as crops such as apple, pear, avocado, fig, kiwi, olive, and pomegranate. Conventional growers in all of those crops rely primarily or, in some cases exclusively, on glyphosate for postemergence weed management.

In broad terms, the tree and vine acreage that currently utilizes glyphosate and where junglerice and other summer grasses are present or could become problematic is approximately two million acres. Since this research addressed current issues with GR weeds and also had an educational focus aimed and preventing future problems with resistant weeds, the economic impact of this research cannot be directly calculated. However, growers routinely indicate that weed management is one of the largest economic costs and management concerns in most tree and vine crops.

## Lessons Learned

Although the project largely proceeded as planned in most of the experimental objectives, two important lessons were noted.

First, in hindsight, the project had some misalignment between the very specific research proposed on the primary species of interest, junglerice, and the broad array of other summer annual grasses. The broad category of summer annual grasses are much more easily evaluated in field trials and extension programming than in the more detailed laboratory work where species-specific differences were more challenging. Because of this, less specific physiology and gene flow work on barnyardgrass and the other species should have been proposed and simply included them in the broader management and education objectives.

The second challenge was related to the proposed budget and spending. The notification of funding and the beginning of the project performance period were relatively close together. A large portion of the budget was research staff salaries but, in several cases, those staff members were either hired specifically for this project and were not available to start immediately. This resulted in slower than projected spending during the first year of the project and that carried through the remainder of the project period.

No significant unexpected outcomes or results were noted during the implementation of this project.

Project staff did not fully explore the objectives related to gene flow from junglerice to barnyardgrass or conduct in depth studies on the genetics and physiology of the other summer grass species. However, the preliminary and exploratory studies conducted in these areas provide good context relative to the detailed junglerice research and also provide a useful starting point for future research. The goals related to evaluating glyphosate translocation within GR and GS junglerice were not fully achieved due to an equipment malfunction, but this will continue as part of a related graduate student project and is expected to be achieved after this project performance period ends.

## Additional Information

Please refer to Attachment 1:

1. List of project-related presentations, publications, and outreach efforts during the project period (all project collaborators).
2. Junglerice sampling and initial greenhouse screening information (UC Davis).
3. Genetic and enzyme assays on GR and GS jungerice (UC Davis).
4. Junglerice phenology and productivity in response to shade in common garden experiments (UC Davis and CSU Frenso).
5. Junglerice germination and growth in response to temperature (UC Davis).
6. Comparisions of GR and GS junglerice response to temperature, salinity, nitrogen uptake, and osmotic stress (CSU Fresno).
7. Effects of shade or moisture conditions on herbicide on junglerice (CSU Fresno).
8. Herbicide performance evaluations and demonstration in commercial orchards and vineyards (UC Davis and UCCE).

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 58 | **Project Title:** Evaluation of Multiple Disinfection Methods to Mitigate the Risk of Produce Contamination by Irrigation Water | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis, Center for Produce Safety | **Grant Agreement No.:** SCB13058 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Bonnie Fernandez-Fenaroli | **Telephone:** (530) 554-9761 | **Email:** bonnie@centerforproducesafety.org |

## Project Summary

In the United States annually, contaminated produce is estimated to cause over 1.1 million illnesses, 7,125 hospitalizations, and 134 deaths, with associated costs of $1.4 billion. This data speaks to the staggering impact of foodborne pathogen contamination on produce and the resulting impact to public health. Produce continues to be linked to foodborne outbreaks since many fruits and vegetables are consumed raw without a processing step that could inactivate microorganisms, if present. Currently, the safety of produce relies on the implementation of Good Agricultural Practices (GAPs) to prevent microbial contamination during growing, harvesting, and processing. However, effective mitigation strategies for foodborne pathogens on fresh fruits and vegetables are still lacking. Over a 15-year period beginning in 1990, produce was linked to 713 outbreaks and 34,049 cases of foodborne illnesses. Most recently in the U.S., outbreaks related to *Escherichia coli (E. Coli)* O157:H7, O145, and O26, *Salmonella* serovars, and *Listeria monocytogenes* have been linked to baby spinach, Romaine lettuce, peppers, cantaloupe, mangoes, and sprouts.

One approach to reduce the risk of produce contamination is to use effective mitigation strategies in irrigation water application systems. This research evaluated disinfection systems in real-world scenarios to provide insight to inactivation of pathogens and indicator organisms in irrigation water as well as risk reduction with respect to pathogen transfer.

The Food Safety Modernization Act (FSMA) of 2011 emphasized prevention of foodborne illnesses rather than responding to outbreaks. In response to FSMA, the U.S. Food and Drug Administration (FDA) recently finalized 21 CFR Part 112: Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption (i.e., the Produce Safety Rule). Because irrigation water is a likely point of pathogen contamination during fruit and vegetable production, the Produce Safety Rule calls for in-depth initial water quality surveys, which will be amended with annual surveys for generic *E. coli* in any surface-source agricultural water that will contact the edible portion of the plant during growing, unless a water treatment method is used. The testing expenses will greatly impact U.S. fruit and vegetable growers since many utilize surface water as an irrigation source or in agricultural protective sprays, and, more importantly, quantifying generic *E. coli* does not always indicate a food safety risk.

This project focused on identifying effective mitigation strategies, specifically various in-line water disinfection treatments, which growers could utilize in irrigation water application systems to reduce the risk of produce contamination. It is important for growers to understand the benefits of these mitigation strategies in addition to their limitations.

This project did not build on a previously funded Specialty Crop Block Grant Program (SCBGP) project.

## Project Approach

The field work for this project was conducted at the University of Tennessee Plateau Research and Education Center (Crossville, TN). Laboratory work was conducted at the Food Science Lab and the Biosystems Engineering Water Quality Lab at the University of Tennessee, Institute of Agriculture, in Knoxville, TN.

Project Experimental Design, Preparation of Plots, and Plant Tissue Sampling
2014 Strawberry Trial: Four separate irrigation blocks were established—ultraviolet (UV) light, chlorine, peroxyacetic acid (PAA), and a non-disinfected control. Each block consisted of eight raised-bed plots: four of the plots were covered in plastic mulch (plasticulture) and four were bare soil. These eight plots were further divided between overhead irrigation and drip irrigation. All plots were installed with both overhead irrigation (for frost protection) and drip irrigation (for fertigation). A typical plot was 1 m (3 ft) wide by 6 m (20 ft) long. A "blank" row with a tarpaulin curtain was placed between irrigation blocks to minimize water drift between treatments. The water source was pond-1, a cattle-watering pond with high concentrations of generic *E. coli* and Shiga toxin–producing *E. coli* (STEC).

2014 Tomato, 2015 Strawberry, and 2015 Cabbage Trials: Because of the extreme environmental contamination found during the 2014 Strawberry trial, the team decided to move the research plots 850 m (2,800 ft) further away from the beef herd. The same four irrigation blocks (UV, chlorine, PAA and non-disinfected control plots) were re-established with both overhead and drip irrigation. In addition, a municipal water irrigation block was created to help minimize potential contaminant sources and serve as a negative control. The municipal block only had drip irrigation, and the water was supplied in a trailer-mounted 950-L (250-gallon) tank. Pond-2, which is contaminated with STEC, served as the water source for the remainder of this project. Cattle did not have direct access to pond-2, but were in the same drainage area. Tomatoes and cabbage are generally not overhead irrigated, thus overhead irrigation plots were not used during these trials. Initially the 2015 strawberry crop was terminated June 5, and cantaloupes were seeded back into the same plots on June 10. This location received 7.7 inches of rain in June and 11.75 inches of rain in July; in total, this was 11 inches over average. By early August, crop failure was obvious and the project team decided to switch to cabbage as a late-season model crop. The cabbage was transplanted into newly formed beds on August 21, and harvested in November 3, 2015.

Plant Tissue Sampling: Ripe strawberries (cv. Chandler) and tomatoes (cv. Florida 47) were picked from each plant using sterile gloves and placed into sterile Whirl-Pak bags. Strawberries undergoing the same experimental treatment were placed into the same bag; undamaged, marketable strawberries were chosen for sampling. Tomatoes undergoing the same experimental treatment were placed into the same bag; undamaged tomatoes larger than 3.5 cm in diameter were chosen for sampling. For cabbages, nine cabbage (cv. Grand Vantage) heads per plot were sampled. Outer leaves were removed to reveal the inner head, from which two exterior leaves were removed.

Design of Water Treatment Systems
A general purpose centrifugal pump was used to move pond water from the contaminated ponds (pond-1 and pond-2) to the irrigation plots. A sand filter (150-mesh equivalent) was located adjacent to the disinfection system and provided filtered water to the irrigation systems. After filtration, the water was divided across the four treatments.

UV Disinfection: A Sterilight Silver model SSM-37 (Viqua, Guelph, Ontario, Canada) closed-vessel UV light module was incorporated into the hydraulic network system serving the UV block. This device was operated at a UV dosage of approximately 35,000 $\mu W \cdot s/cm^2$ during frost protection and 47,000 $\mu W \cdot s/cm^2$ during drip irrigation. This configuration was used in both year one and year two.

Chlorine: For year one, calcium hypochlorite ($Ca(ClO)_2$) was the chlorine source. Chlorine was metered into the irrigation system using a diaphragm injection pump. Stock concentrates were produced using 454-g (1-lb) packs of 68% calcium hypochlorite (i.e., swimming pool shock) to get a stock solution of 12% available chlorine. At this concentration not all of the inert ingredients within the packs are soluble and thus form a significant precipitant; the precipitant was removed to prevent clogging of the metering pumps. A 12% concentration was chosen because the Peroxyacetic Acid (PAA) solution was also 12%, which allowed both metering pumps to be operated at the same setting. The concentrate was injected at a rate that created irrigation water with 20 ppm available chlorine. The hydraulic network was constructed to provide at least 2 minutes of water-chlorine contact time before water was applied to the crop. Chlorine concentrations were monitored with test strips (pHydrion, Micro Essential Laboratory, Brooklyn, NY).

During year two, chlorine dioxide was the chlorine source. A stock concentrate of 2% chlorine dioxide ($ClO_2$) was produced by dissolving a proprietary powdered-mixture containing sodium chlorite (ICA TriNova, Newnan, GA). This mixture was injected into the irrigation stream to achieve a final $ClO_2$ concentration of 10 ppm. $ClO_2$ concentrations were monitored with test strips (Insta-Test $ClO_2$, LaMotte Co., Chestertown, MD).

PAA: During year one, a 12% commercially-prepared PAA concentrate (SaniDate 12, BioSafe Systems, East Hartford, CT) was used as the PAA source. During year two, this concentrate was diluted by 50%, and the injection rate was doubled. For each year, the final PAA concentration in the irrigation water was 20 ppm, with a 2-minute contact prior to exiting the system. PAA concentrations were monitored with test strips (Insta-Test PAA, LaMotte Co.).

Irrigation Water Sample Collection and Analysis
Irrigation was scheduled on the basis of 50 mm (2 in) of water per week. Nutrients were applied by fertigation and followed the recommendations in the 2013 Southeastern U.S. Vegetable Crop Handbook. Once per week during irrigation/fertigation, three sets of water samples were taken from each treatment plus the source water. Following the protocols in Standard Methods for the Examination of Water and Wastewater (American Public Health Association, 2015), the following water quality parameters were determined: turbidity, total dissolved solids, total nitrogen, non-purgeable organic carbon, and pH. Total coliforms and generic *E. coli* were enumerated by the Quanti-Tray/2000 procedure (IDEXX Laboratories Inc., Westbrook, ME). STEC was enumerated using membrane filtration onto CHROMagar STEC (CHROMagar, Paris, France).

Objective 1– Evaluation of Irrigation Water Treatment Systems
Inactivation of indicator organisms (*E. coli* and fecal coliforms) and STEC was determined from a surface-water irrigation source after treatment by sand filtration followed by: 1) UV light dosage, 2) $ClO_2$ dosage, 3) PAA dosage, or 4) no further treatment (control).

Ultraviolet Light: The results of using the UV treatment are shown in Tables 1, 2, 3 and 4 (see Attachment). A particular advantage of using UV light is that a module can be installed on the irrigation pipeline to treat all the water. However, this is also a disadvantage because the pathogen kill-zone is limited to the volume within

the module – there is no downstream residual treatment. UV systems are designated by water flow rate and UV intensity. For point-of-use drinking water treatment, the U.S. Environmental Protection Agency (EPA) recommends a UV dosage of 40,000 $\mu W \cdot s/cm^2$. This value has a two-fold safety factor. Further, a certified UV system must be able to provide this exposure when about 50% of the transmitted radiation is blocked by a dirty quartz sleeve or by turbid water. Because the UV module has a fixed volume, as the flow rate changes, so does the UV dosage. As such, the user must size the UV device based on the greatest flow rate expected to be treated. As mentioned, UV is very sensitive to turbidity. This project was able to successfully remove pathogens from surface water with turbidities as high as 35 NTUs (nephelometric turbidity units). A notable difference in UV disinfection success was observed between Table 1 and Tables 3, 5 and 7. While UV provided successful treatment in all cases, when the source water was switched to pond-2 (less turbidity, see Table 5), pathogen reduction was more complete. Based on these findings, it is recommended that a UV device should be selected that can provide a minimum dosage 40,000 $\mu W \cdot s/cm^2$ at the required flow rate, and that the maximum turbidity should be limited to approximately 30 NTUs. The UV module should be placed for easy maintenance and include an intensity monitor to let the operator know when the UV transmission cannot provide the required dosage.

Calcium Hypochlorite: Overall, calcium hypochlorite performed very well. As shown in Tables 1 and 2, this product significantly inactivated generic *E. coli* and STEC organisms as compared with the non-treated control. Generic *E. coli* and STEC were not detected in 2014 strawberry and tomato crops irrigated with water treated with calcium hypochlorite. For this evaluation, the target available chlorine concentration was 20 ppm to ensure the satisfaction of the chlorine demand created by the organic matter in pond-1 and the short contact time; this dosage was higher than needed. It is recommended that producers have an injection system that can provide 10 to 20 ppm of available chlorine, and then the dosage can be lowered until 3 to 5 ppm chlorine residual remains in the water that is applied to plant surfaces.

Chlorine Dioxide: Chlorine dioxide was the chlorine source during 2015 and was injected at a rate to produce a 10 ppm concentration in the irrigation water. As shown in Tables 3 and 4, this product performed similarly to calcium hypochlorite and inactivated STEC below detection limits. Generic *E. coli* was detected twice, but populations were at or below 11 MPN/100 ml. Some plant damage on the chlorine dioxide plots was attributed to the sodium content of the disinfectant solution. This product must be manufactured on site; however, there are now vendors that will provide the chlorine dioxide precursors in smaller packets (as opposed to a shipping container) that produce final product volumes that are reasonable for producers to use for disinfection. It is recommended that producers have the capacity to inject chlorine dioxide at a rate that can produce a 5 to 10 ppm chlorine concentration in the irrigation water.

Peroxyacetic Acid: PAA performed very well as a disinfectant of raw surface water, even with a short contact time. For reasons not completely explained in the research literature, PAA seems to have a slightly greater affinity for oxidizing microbes than for the dissolved organic matter, which reduces the potential for dissolved organic matter to interfere with disinfection. PAA also readily decomposes to carbon dioxide and water in the environment. This product is commercially available in several concentrations. It is somewhat difficult to compare the various PAA formulations: this product is a mixture of peracetic acid, hydrogen peroxide, acetic acid and water. Peracetic acid is the primary active ingredient; however, hydrogen peroxide and acetic acid also have disinfectant properties. The solution used for this project was 12% peracetic acid, 18.5% hydrogen peroxide, and 20% acetic acid.

The PAA disinfectant performance was very good, but care must be taken when using this product. Initially, the 12% concentrate was used as the stock solution. However, the concentration produced sufficient volatilization that the metering pumps would frequently vapor-lock, allowing large water volumes to pass without treatment. As shown in Table 1, when injection was properly controlled, the compound performed moderately well. Tables 2, 3 and 4 show the improvement with PAA performance achieved with changes in management. This problem was alleviated by diluting this concentrate by 50% (thus doubling the injection rate), and by replacing the diaphragm metering pump with a peristaltic metering pump. A second potential issue with using PAA is the change in water pH; after treatment, the irrigation water dropped from approximately 6.8 to approximately 4.5. The pH change has the potential to acidify the soil and change the availability of nutrients. The issue of pH change needs further research to determine whether this concern is warranted.

Objective 2 – Transfer of Organisms onto Produce

The original intent of this objective was to evaluate the movement of pathogens from the irrigation water onto the model crops, with the anticipation that the plots irrigated with treated water would demonstrate less contamination than the non-treated control plots. To minimize cross-contamination, the plots were separated by curtains and there were blank rows between treatments to increase the separation. As seen in Table 7, STEC contamination was fairly well-distributed across all treatments in the 2014 strawberry trial (24–40%). The untreated control had slightly more contaminated samples (40%) than the treated irrigation blocks, but the result was not significant ($p > 0.05$). These plots were located 100 m (300 ft) downwind of a pasture containing beef cattle (stocking density approximately 1 cow per acre). It was assumed that other environmental pressures (insects, small mammals, birds, bioaerosols) played a significant role in crop contamination, such that any irrigation treatment effects were eliminated. No conclusions could be drawn from this trial. The research plots were reestablished 850 m (2,800 ft) away from this pasture, but still downwind for subsequent trials.

Tomatoes were transplanted into the new plots. The tomato trial resulted in only one positive sample, isolated from the control plot, but there was no significant difference found between treatment blocks (Table 8; $p > 0.05$). This crop was only drip irrigated, and the results indicate that drip irrigating tomatoes is a good agricultural practice. Strawberries were transplanted the fall of 2014 and grown out in 2015; as shown in Table 9, the 2015 strawberries were as contaminated as the 2014 crop. This crop did not receive frost protection, thus the drip irrigated plots were not overhead frost protected, and still there was equal contamination across all treatments (43–32%). The project team attempted to find more information about the contaminant sources beyond the irrigation water. Isolates collected from plant samples were submitted for molecular genetic analysis to provide more information as to the pathogen reservoir. As shown in Table 10, there was minimum contamination (4–7%) in cabbage, but it was found among all treatments, with the exception of municipal water. These plots received only drip irrigation, but were significantly closer to the soil than the tomato crop.

On the basis of the above results, no specific conclusions about pathogen transfer from irrigation water could be made. Other environmental factors are apparently a greater cause of contamination than the irrigation water. While the specific vectors are unknown at this time, it appears that their effect overwhelmed any potential treatment effect provided by disinfecting the irrigation water.

In June 2015, the PI presented a poster on the project's interim research results at the Center for Produce Safety (CPS) Research Symposium in Atlanta, Georgia.

The crops grown for this project are listed on the United States Department of Agriculture, Agricultural Marketing Service's list of specialty crops. The CPS staff is in constant communication with the industry and the scientists working on this project, and is unaware of any commodities that benefited from this project other than specialty crops.

The project partners were the CPS and the University of Tennessee, Institute of Agriculture. CPS managed the project and the University of Tennessee performed the work.

## Goals and Outcomes Achieved

Activities that were completed included (1) determining the inactivation of indicator organisms (*E. coli* and fecal coliforms) and STEC from a surface-water irrigation source after treatment by sand filtration followed by three disinfection methods, and (2) evaluating the transfer of STEC and indicator organisms from the irrigation water to model crops with the three mitigation strategies as compared to no treatment, utilizing overhead and drip irrigation delivery.

Some modifications to the project were approved, and these included using tomatoes and cabbage (instead of cantaloupes) as the late season crops, using calcium hypochlorite as the chlorine source in year one, and adding an additional irrigation water treatment (municipal water as a negative control).

As a background to the field activities, during the summer of 2013, funding from the U.S. FDA Western Center for Food Safety (secured by one Co-PI) was used to establish the strawberry plots that served as the model crop for frost protection and for irrigation. This crop overwintered well and began new growth in late March 2014. One night in April was the only frost protection event required that season; this night had greater than 12 hours of below freezing temperatures, with a low temperature of −3°C (27°F). For the remainder of the growing season, liquid nutrients were applied once per week, providing the equivalent of one-half inch of water. Supplemental water was added to maintain a weekly water application of approximately two inches. A routine was established with one-half of the ripe berries harvested on Monday mornings, overhead irrigation provided on Monday afternoons, and the remaining ripe berries harvested on Tuesday mornings. This was an attempt to provide before and after information about pathogen transfer. The third portion of the weekly harvest was on Thursdays. The last harvest was in late May 2014.

It was determined that 30% of the strawberry samples from the 2014 trial were contaminated with STEC independent of irrigation treatment (Table 7; $p > 0.05$). The team anticipated that other routes of contamination resulted in similar contamination levels amongst all produce although significantly lower populations of STEC were present in treated water (UV, PAA, chlorine) used for irrigation and frost protection than the untreated positive control (Table 1; $p < 0.05$). In retrospect, while the cattle were 100 m (300 ft) from the plots, it seems that the plots were too close to the STEC source. Flies, bioaerosols, and other vectors could have transferred pathogens to the research plots. In the hope of controlling the natural contaminant sources, this field location was abandoned and the experiment was relocated further away from the cattle, and a negative control (municipal water) irrigation block was added as a treatment. With the plots reestablished, a fall tomato crop was transplanted on August 14, 2014. Each treatment had four plots for a

total of 20 plots. These plots were drip irrigated only – no overhead irrigation. After an early frost, green tomatoes were harvested on October 6, 2014.

On September 18, 2014, 1,600 strawberry plugs were transplanted across 40 plots adjacent to the tomato plots. There were 8 plots per treatment and five treatments – chlorine dioxide, PAA, UV, municipal water (negative control), and untreated surface water (positive control). During January 2015, row covers were applied to the strawberry plots. During the spring of 2015, the strawberry crop was cultivated and harvested; there was no need to frost protect this season. Irrigation water (both overhead and drip) samples were collected throughout the growing season. Once ripening began, the plots were harvested using the following routine. On Mondays, half the ripe berries were gathered from all plots during the mornings. During those same afternoons, half of the plots received overhead irrigation and half of the plots received drip irrigation. On the next mornings (Tuesdays), the remaining ripe berries were picked. On Thursdays, a complete picking was conducted to prevent overripe berries from causing spoilage. The strawberry crop was terminated June 5, and cantaloupes were seeded back into the same plots on June 10. This location received 7.7 inches of rain in June and 11.75 inches of rain in July. In total, this was 11 inches over average. By August 8, 2015, crop failure was obvious and the project team decided to switch to cabbage as a late-season model crop. The cabbage was transplanted into newly formed beds on August 21 and harvested on November 3, 2015.

The project was carried out as per the work plan, and direct enumeration of STEC and indicator organisms of treated irrigation water was determined and compared with untreated water. The target criteria—to achieve specific log reductions of indicator organisms and no recoverable STEC per liter of irrigation water or on produce—were not as expected. As the project went forward it became obvious that there were other pathogen sources beyond the irrigation water; however, developing an understanding of other pathogen sources was not our original objective. This project was not able to clearly demonstrate pathogen-free crops when using treated irrigation water because of these additional pathogen sources. Any potential treatment effect provided by disinfecting the irrigation water was overwhelmed by these other (unknown) sources.

The water treatment data gathered were based on surface water samples taken before and after treatment with the selected disinfectants. The baseline data for *E. coli* and STEC in water are shown in Tables 1–4 as "before treatment." Reductions in pathogen concentration are shown for each of the treatment technologies.

For the irrigation water measurements during the various crop trials, calcium hypochlorite (at 12% available chlorine) significantly inactivated generic *E. coli* and STEC organisms in the irrigation pond water as compared with the non-treated control. Chlorine dioxide (10 ppm) performed similarly to calcium hypochlorite and inactivated STEC below detection limits; generic *E. coli* was detected twice, but populations were at or below 11 MPN/100 ml. While the UV light provided successful water treatment in all cases, pathogen reduction was more complete for pond-2 source water (less turbidity) than pond-1 source water. Peroxyacetic acid (20 ppm) performed very well as a disinfectant of raw surface water, even with a short contact time, but care must be taken with injection control and changes in water pH when using this product.

The project was not able to demonstrate the elimination of STEC on strawberry and cabbage crop trials that used treated irrigation water. The likely reason was that additional pathogen sources aside from the irrigation water were not accounted for in the development of the project.

The project demonstrated that the tested water disinfection treatments are promising mitigation strategies that can be applied by produce growers to reduce contamination risk to their crops. Overall, all disinfection treatments performed significantly ($p < 0.05$) better than the untreated positive control in reducing the populations of STEC in water sourced from the contaminated irrigation ponds, and water from all treatments was similar to municipal water (Table 6). These treatments should especially be considered when irrigation water will contact the edible portion of the crop.

## Beneficiaries

The primary beneficiaries of this project are specialty crop producers who use ponds as their source of irrigation water. The desire to produce safe fruits and vegetables goes beyond the requirements of FSMA. Producers need guidance on how to mitigate the risks associated with using surface water for irrigation. This project demonstrated that contaminated surface water can be treated with traditional water disinfection methods under less than ideal circumstances. All producers who grow crops that will likely be consumed raw or with minimal processing can benefit from this project.

The potential economic impact of this project is the development of mitigation methods that can reduce the potential for pathogens to be transferred from surface water to fresh fruits and vegetables. When consumers have confidence in the safety of fresh produce then the whole produce industry benefits from increased sales, and the consumer benefits from the consumption of fresh (not processed) food.

According to the most recent (2012) Census of Agriculture there are 42,729 farms that grow specialty crops (including tomatoes, leafy greens, and melons) in California, representing $23.9 billion in sales in the state (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/index.asp). More specifically, the beneficiaries of this project in California may include the 250 growers of fresh-market tomatoes.

Dr. Buchanan (PI), University of Tennessee, presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously in a poster session at the 2015 CPS Produce Research Symposium in Atlanta, GA (with approximately 245 attendees). The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results will be disseminated at industry meetings, and streamed through social media sources. Results also will be made available online as follows:

1. Final reports submitted to CPS (after the June 2016 symposium) will be posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php
2. CPS works with the scientists to publish results in scientific journals. Publication dates occur after the project is completed. Abstracts and awards can be found on the CPS website.
3. The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "2015 CPS Symposium Summary: Key Learnings and What They Mean for You" on the CPS website at the following link:

http://www.centerforproducesafety.org/amass/documents/document/325/2015%20CPS%20Symposium%20Key%20Learnings%20web.pdf.

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

## Lessons Learned

Overall, all disinfection treatments performed better than the untreated positive control and were found to be similar to municipal water, which demonstrates that these disinfection methods are promising mitigation strategies that can be applied by growers to reduce risk. The water treatments should especially be considered when water will contact the edible portion of the crop.

Based on the project results, the investigators cannot draw specific conclusions about pathogen transfer from irrigation water. Other environmental factors were apparently a greater cause of contamination than the irrigation water. While the specific vectors are unknown at this time, it appears that their effect overwhelmed any potential treatment effect provided by disinfecting the irrigation water.

The project team learned that it is important to consider irrigation system start-up when evaluating the efficacy of water treatment. At start-up, the pipelines are not under pressure and the pump will transfer water at a greater rate than during steady-state conditions. As discussed in this document, disinfectant injection rates and UV dosages have been based on steady-state conditions. Either the start-up water can be diverted until the water flow rate reaches steady-state, or additional disinfection capacity can be added to account for the increased flow rate. Also, when fertigation is used, then the fertigation system needs to be disinfected. Water used to dissolve the nutrients must be from a sanitary source and the injection equipment must be sanitized before use. An alternative is to place the fertigation system before the disinfection system.

The project team clearly showed that STEC contamination does not only come from concentrated feedlots, as a STEC source in this study was a pasture-fed herd that had a stocking density of approximately one cow per acre. Therefore it is important for a grower to determine if they are downwind or downstream of cattle herds in any field study evaluating produce contamination.

The unexpected outcome of this project was the inability to clearly show the reduction of pathogens on crops that used treated irrigation water. The likely reason was that additional pathogen sources aside from the irrigation water were not accounted for in the development of the project.

As mentioned above, the project team suggests that other researchers doing field studies of produce contamination clearly determine if fields are downwind or down stream of cattle herds. STEC contamination does not only come from concentrated feedlots, and a STEC source can be a pasture-fed herd with a stocking density of approximately one cow per acre.

The project team suggests taking swabs of leaves and other vegetation before establishing research plots, as the team was quite surprised (after the fact) to find STEC on tree leaves and grasses well away from the beef pasture.

## Additional Information

See Attachment for Tables 1–10.

Presentations:

Buchanan, J. R. 2016. Beyond chlorination: Other ways to keep your irrigation water safe. Pick TN Conference, Knoxville, TN, February 11-13.

Critzer, F. J. 2016. Produce Safety: Don't kill your customer. Pick TN Conference, Knoxville, TN, February 11-13.

Wszelaki, A. L., F. J. Critzer, J. R. Buchanan, and D. Lockwood. 2016. Western region fruit, vegetable, and food safety update. Tennessee Extension Agent In-Service, Lexington, TN, January 26-27.

Wszelaki, A. L., F. J. Critzer, J. R. Buchanan, and D. Lockwood. 2016. Central region fruit, vegetable, and food safety update. Tennessee Extension Agent In-Service, Murfreesboro, TN, February 2-3.

Buchanan, J. R., F. Critzer, A. Wszelaki and D. Lockwood. 2015. Evaluation of multiple disinfection methods to mitigate the risk of produce contamination by irrigation water - progress report [poster]. Center for Produce Safety Symposium, Atlanta, Georgia, June 24.

Gorman, S., L. Gann, A. L. Wszelaki, F. Critzer, and J. R. Buchanan. 2015. Disinfection methods to mitigate food safety risks associated with contaminated irrigation water on drip-irrigated tomatoes. [abstract] Journal of Food Protection, Supplement A, 78:280, Portland, OR, July 25-28.

Buchanan, J. R., F. Critzer, A. L. Wszelaki, and D. W. Lockwood. 2014. Irrigation water disinfection strategies. Center for Produce Safety Symposium, Long Beach, CA, June 24.

Buchanan, J. R. and A. L. Wszelaki. 2014. Mitigation of agricultural water. Plateau Research and Education Center, Steak and Potatoes Field Day, Crossville, TN, August 6.

Buchanan, J. R. and F. J. Critzer. 2013. New applications for old tools: Strategies for mitigating risks in agricultural irrigation. Steak & Potatoes Field Day, Plateau Research and Education Center, Crossville, TN, August 8.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 59 | **Project Title:** Assessing Postharvest Food Safety Risks and Identifying Mitigation Strategies for Foodborne Pathogens in Pistachios | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis, Center for Produce Safety | **Grant Agreement No.:** SCB13059 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Bonnie Fernandez-Fenaroli | **Telephone:** (530) 554-9761 | **Email:** bonnie@centerforproducesafety.org |

## Project Summary

In the past decade, outbreaks of salmonellosis and *Escherichia coli* (*E. coli*) O157:H7 gastroenteritis associated with consumption of a range of tree nuts, including pistachios, have been documented. Until recently, very little was known about the ecology of foodborne pathogens (*Salmonella*, (*E. coli*) O157:H7, and *Listeria monocytogenes* (*L. monocytogenes*)) in pistachio production and processing environments. This impeded the development of targeted pistachios-specific food safety programs. This project addressed the critical need for further information on identification of points during postharvest handling of pistachios where foodborne pathogens may be reduced, controlled or amplified.

The Preventative Controls for Human Food rule, finalized in August 2015, was implemented beginning in the fall 2016 to 2018. This rule mandated a formal hazard analysis and an introduction of practices that would control hazards that were identified. The hazard analysis and preventive controls must be supported with robust scientific data. Characterization of the heat resistance of foodborne pathogens and a potential surrogate organism in inoculated pistachios was needed to provide the scientific foundation for thermal process validation (one type of preventive control) used in the pistachio industry.

This project built on three previously funded Specialty Crop Block Grant Program (SCBGP) projects: 2009 SCBGP Project 54: *Assessing Postharvest Risks for Salmonella in Pistachios*, 2011 SCBGP Project 65: *Sources and Mechanisms of Transfer of Salmonella in the Production and Postharvest Tree Nut Environment*, and 2011 SCBGP Project 66: *Distribution of Salmonella in Pistachios and Development of Effective Sampling Strategies*. The previous research most relevant to this project demonstrated that there were differences in the prevalence and levels of *Salmonella* between floater and sinker pistachios. The current study sought to identify potential causes of the higher floater prevalence with the goal of determining appropriate mitigation practices.

## Project Approach

In 2014, methods for determining bacterial heat sensitivity in oil, hot water, and in a dry oven were evaluated for in-shell pistachios, kernels, and the shell. Significant differences in the reduction of the potential surrogate organism, *Enterococcus faecium* NRRL B-2354 (*E. faecium*), were noted among all three forms of pistachios. Reductions on the shell alone were orders of magnitude greater than either the in-shell pistachio or kernel. These differences were more evident in hot oil and hot water than in a dry oven.

Unusual weather led to a very short 2014 pistachio harvest. The number of collaborating pistachio processors was increased from one to four to ensure that adequate samples could be collected.

Growth curves were generated for a cocktail of *Salmonella* strains inoculated onto both "first shake" and "second shake" in-hull pistachios and "first shake" floaters and sinkers under postharvest conditions determined in previous studies.

Floater and sinker streams were characterized visually to determine the amount of adhering hull, foreign material and other defects. Proportions were determined by weight and documented with photos.

The Principal Investigator (PI) attended the June 2015 Center for Produce Safety (CPS) Symposium in Buckhead, GA and gave an oral presentation "Assessing Postharvest Food Safety Risks and Identifying Mitigation Strategies for Foodborne Pathogens in Pistachios".

On August 5, 2015 a meeting was held in Fresno, California at the office of the Administrative Committee for Pistachios. The PI and three laboratory staff from the Regents of the University of California, Davis (UC Davis) were present. The head of the Administrative Committee for Pistachios was in attendance, as were representatives from four pistachio processors. Results from the 2014 harvest were discussed, as were plans for the 2015 harvest. Industry members provided input and recommitted to assisting with sample collection during the 2015 harvest. Data pertaining to the use of *E. faecium* as a surrogate organism for *Salmonella* in pistachios was also discussed.

At the recommendation of the pistachio processors the 2015 data collection focused on Objectives 1a (evaluate growth or survival of foodborne pathogens on in-hull pistachios after harvest including the impact of pathogen type, temperature of exposure, harvest container (bins or trailers), time of harvest (first or second shake), and post huller stream (floaters and sinkers)) and 1b (evaluate growth or survival of foodborne pathogens on pre-dryer hulled pistachios including impact of pathogen type and post float tank stream (floater vs sinker)). The existing data on the reduction of *Salmonella*/*E. faecium* during drying, Objective 1c (evaluate the reduction of foodborne pathogens during drying under a range of drying times, temperatures and target moisture levels used by the pistachio industry) was considered sufficient to accomplish Objective 1d (develop a quantitative risk model to assess the parameters between the point where pistachios are shaken from the tree to the point that dehydration in the silo is complete).

The 2015 pistachio harvest lasted five weeks beginning August 31, 2015. Each week, through the week of September 28, 2015, pistachios were recovered from one or more of the project collaborators and the growth curves of inoculated pathogens was measured for: (a) a cocktail of *Salmonella* on early season (first shake) floater and sinker pistachios; (b) a cocktail of *Salmonella* on mid-season floater pistachios collected from three different hullers; (c) a cocktail of *Salmonella* on late season (second shake) floater and sinker pistachios; (d) a cocktail of *Salmonella* on separate components of late season floater pistachios; and (e) separate cocktails of *Salmonella* or *E. coli* O157:H7 or *L. monocytogenes* on mid-season floater pistachios.

Data collection was carried out for comparison of thermal tolerance of *Salmonella* and *E. faecium* as well as *E. coli* O157:H7 and *L. monocytogenes* (Objective 2). Specifically, the survival of *E. faecium*, *Salmonella* Enteritidis phage type (PT) 30 (control), and several *E. coli* O157:H7 strains inoculated onto in-shell pistachios on exposure to hot oil (dry heat), hot water (moist heat), and a hot oven was compared. Also, the survival of *E. faecium*, *Salmonella* Enteritidis PT 30, several *L. monocytogenes* strains inoculated onto in-shell pistachios on exposure to hot oil (dry heat), hot water (moist heat), and a hot oven were compared. Various survivor curves were generated, including: (a) a survivor curve over time of exposure to hot oil and

hot water for *E. faecium*, and three strains of *Salmonella* inoculated onto in-shell pistachios; (b) a survivor curve over time of exposure to hot oil and hot water for *Salmonella* Enteritidis PT 30 (control) and the more heat resistant *E. coli* O157:H7 and *L. monocytogenes* strains; and (c) a survivor curve over time of exposure to hot oil for *Salmonella* Enteritidis PT 30 and *E. faecium* on kernels stabilized at low and high moistures and for in-shell pistachios stabilized at high moisture.

The appropriate target pathogen for pistachios was confirmed to be *Salmonella* and thermal processes validated for this organism will reduce *E. coli* O157:H7 and *L. monocytogenes* by similar or greater levels; increasing pistachio moisture significantly increased reduction of *Salmonella* during thermal treatments. The data suggested that *E. faecium* NRRL 2354 was an appropriate surrogate organism for *Salmonella* on pistachios; the majority of current California pistachio processes have already used this organism to validate their processes, and thus, this was a particularly important finding.

California pistachios are a specialty crop and the research targeted this crop specifically. The CPS staff is in constant communication with the industry and the scientists working on this project, and is unaware of any commodities that benefited from this project other than specialty crops.

Collaborating industry partners were critical for access to facilities and for providing raw materials. The data described here were presented to the pistachio industry (coordinated by the Administrative Committee for Pistachios) on a regular basis, and feedback from pistachio processors lead to modifications in data collection and analysis that significantly increased the impact of the data collected. Processors were very open and willing to provide information on how their operations worked and provided valuable feedback on the study design and to key variables in the quantitative model. The team's documentation of "early" and "mid" season pistachios during and separation of float stream components in the generation of foodborne pathogen growth curves was added as a direct result of discussions with industry representatives.

## Goals and Outcomes Achieved

The project aims were: to understand the relative risks associated with *Salmonella*, *E. coli* O157:H7 and *L. monocytogenes* in pistachios; to elucidate the mechanisms by which floater pistachios were contaminated to a greater extent than in-shell pistachios; to develop a quantitative model that would assess parameters that influence growth or survival of foodborne pathogens between the point where pistachios were shaken from the tree to the time that dehydration in the silo was complete; and to determine the impact of pistachio moisture and nut form (kernel or in-shell) on the heat sensitivity of *Salmonella*, *E. coli* O157:H7, *L. monocytogenes*, and *E. faecium* inoculated pistachios.

The appropriate target pathogen for pistachios was confirmed to be *Salmonella* and thermal processes validated for this organism will reduce *E. coli* O157:H7 and *L. monocytogenes* by similar or greater levels. Increasing pistachio moisture significantly increased the reduction of *Salmonella* during thermal treatments. The data suggested that *E. faecium* NRRL 2354 was an appropriate surrogate organism for *Salmonella* on pistachios; the majority of current California pistachio processes have already used this organism to validate their processes, and thus, this was a particularly important finding.

There was no significant difference in the growth of *Salmonella* on first or second shake in-hull pistachios; in either case there was no significant growth of *Salmonella* in the first three hours of incubation. There was a shorter lag time, growth of *Salmonella* was more rapid, and final populations were higher on floater pistachios

compared with sinker pistachios. A quantitative model was developed to predict levels of *Salmonella* in floaters and sinkers from the time of shaking the trees to completion of drying. The model was based on data derived from this study as well as input from industry collaborators. The model predicted significantly greater levels of *Salmonella* in floaters than in sinkers, and the model sensitivity analysis suggested that delays in drying of hulled pistachios significantly influenced this outcome.

The outcome measures were not long term. Accomplishments very closely matched the goals of the project.

The project met the goal outlined in the initial grant proposal to compare the thermal tolerance of *Salmonella* to *E. coli* O157:H7, *L. monocytogenes*, and a surrogate (*E. faecium*) on pistachios. Over 1,000 samples were processed over the 2014 and 2015 harvests to generate 15 separate growth curves that were used in a quantitative model developed in this study. Over 1,500 samples were processed in screening pathogens for heat resistance and for generating survivor curves for pathogens and a surrogate organism inoculated onto pistachios. The appropriate target pathogen for pistachios was confirmed to be *Salmonella* and thermal processes validated for this organism will reduce *E. coli* O157:H7 and *L. monocytogenes* by similar or greater levels. In addition, *E. faecium* NRRL 2354 was shown to be an appropriate surrogate organism for *Salmonella* on pistachios. These data can be used by the pistachio industry to support practices that reduce potential levels of *Salmonella* in pistachios during harvest and to reliably reduce pathogens during thermal treatments.

The data generated in this study supported that the appropriate target pathogen for pistachios was *Salmonella* and provided solid evidence that thermal processes validated for this organism would reduce *E. coli* O157:H7 and *L. monocytogenes* by similar or greater levels. The data also supported the use of *E. faecium* NRRL 2354 as a surrogate organism for *Salmonella* on pistachios. A model developed with industry input and data generated in this study predicted that delays between hulling and drying pistachios could significantly impact levels of *Salmonella* in sinker and, especially, in floater pistachios. The model predicted significantly greater levels of *Salmonella* in floaters than in sinkers, and the model sensitivity analysis suggested that delays in drying of hulled pistachios significantly influenced this outcome.

## Beneficiaries

The primary beneficiaries of the results of this study were the pistachio processors and users of pistachio nuts, with growers as indirect beneficiaries.

There were more than 950 pistachio growers farming over 300,000 acres (bearing and nonbearing) in California. There were 24 pistachio processors in the United States, with the seven largest processors located in California, accounting for over 97% of the total volume produced. The total crop size increased from 1.5 million pounds in 1976 to an average of nearly 500 million pounds per year over the 2010–2015 crop years, with a value of over $1 billion annually. A large portion (60%) of the crop was exported, primarily to China and Europe.

The PI, with the UC Davis, presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, GA, to approximately 245 attendees. The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The

annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results were disseminated at industry meetings, and streamed through social media sources. Results are also available online as follows:

1. Final reports submitted to CPS were posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php\
2. CPS works with the scientists to publish results in scientific journals. Abstracts and awards can be found on the CPS website.
3. The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "2015 CPS Symposium Summary: Key Learnings and What They Mean for You" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/325/2015%20CPS%20Symposium%20Key%20Learnings%20web.pdf

The following websites provide additional resources on the final reports and symposium proceedings:

Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

## Lessons Learned

In a previously funded SCBGP study, one of the unexpected findings was that, in some years, higher levels of *Salmonella* were found in floater pistachios. In the current study the project team sought to identify potential causes of the higher floater prevalence. Floaters were shown to better support the growth of *Salmonella* than sinkers, in part due to the adherence of hull material to a significant portion of the floater stream. A quantitative model of *Salmonella* growth between shaking the trees and drying of the hulled pistachios predicted significantly greater levels of *Salmonella* on floaters than sinkers.

There were no truly unexpected outcomes or results. However, the data generated by this study provided the pistachio industry with significant actionable data that could be used to support food safety programs.

The goals and outcome measures were achieved.

Initially, the project had proposed to set up a temporary laboratory on site at one of the processing facilities in the Visalia, California area. However, because of the unexpectedly short 2014 harvest and the need to source pistachios from more than one facility, it was more efficient to collect samples and bring them back to the laboratory in Davis, California for processing.

## Additional Information

Presentation:
Harris, L.J. "Assessing postharvest food safety risks and identifying mitigation strategies for foodborne pathogens in pistachios," Center for Produce Safety Produce Research Symposium, Buckhead, GA; 23 June 2015.

Publications:

Moussavi, M., V. Lieberman, C. Theofel, and L.J. Harris. Behavior of foodborne pathogens in harvested pistachios. Target: Journal of Food Protection.

Barouei, J., M. Moussavi, C. Theofel, and L.J. Harris. Model to predict levels of Salmonella in postharvest pistachio streams. Target: Microbial Risk Analysis.

Moussavi, M., C. Theofel, and L. J. Harris. Reduction of foodborne pathogens and the surrogate *Enterococcus faecium* NRRL 2354 on inoculated pistachios exposed to hot oil and hot water. Target: Food Control.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 60 | **Project Title:** Effect of Physicochemical and Biological Parameters on Survival, Persistence and Transmission of Norovirus in Water and on Produce | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis, Center for Produce Safety | **Grant Agreement No.:** SCB13060 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Bonnie Fernandez-Fenaroli | **Telephone:** (530) 554-9761 | **Email:** bonnie@centerforproducesafety.org |

## Project Summary

Key knowledge on the factors that enhance or reduce norovirus survival in water and on produce is lacking. Collectively, there is strong evidence that human noroviruses (HuNoVs) can survive for prolonged periods of time (weeks to months) on produce as well as in water that can itself contaminate the produce. Human NoVs are responsible for a significant number of foodborne diarrheal cases each year, causing greater than 58% of California 9 million total cases (1). These viruses are estimated to cause nearly 15,000 hospitalizations and 150 deaths each year in the United States as a result of food and waterborne transmission alone (1, 2). Produce has been widely implicated in HuNoV outbreaks, particularly leafy greens (3–5) and soft red fruits (6–9). While some produce outbreaks have resulted from handler contamination at the food preparation level, HuNoVs have been detected on market-ready produce and shown to be infectious (10–12). Human NoVs can persist on strawberries and raspberries at common storage conditions well past the shelf-life of the fruits (13). Overall, HuNoVs are estimated to account for 40% of produce-related outbreaks (14).

Contamination of produce commonly occurs through the application of contaminated irrigation waters (6, 15, 16), and HuNoVs have been detected in water used for irrigation (17, 18). Contamination of ground and surface waters with enteric pathogens is a major problem in the U.S. and can occur in several ways, including discharge of treated and untreated wastewater, illegal dumping of human excrements (feces or vomit), and unintentional discharges due to urban, rural and agricultural run-off (19–21). Documented gastroenteritis outbreaks linked to contaminated surface and groundwater confirm the public health risk caused by the presence of enteric viruses in the environment (22). Moreover, once in the environment these viruses are able to persist for long periods of time. Human NoVs are stable in groundwater, river water, mineral water, and tap water for months (23–25). Remarkably, a recent study demonstrated that a HuNoV can persist in groundwater for years (23).

Noroviruses (NoV) are extremely hardy and resistant to desiccation, low pH, and common disinfectants, including dilute chlorine bleach (26–29). Relatively few environmental conditions (e.g., temperature, relative humidity) have been evaluated for their impact on NoV survival (26, 30, 31), and discrepancies between in vitro and epidemiological data suggest additional factors are also involved. Specifically, while laboratory experiments have demonstrated that high relative humidity and high temperatures lead to viral degradation (26, 30, 31), this is in stark contrast to epidemiological studies that reveal HuNoV disease is virtually endemic in tropical regions where humidity and temperatures are continually elevated (32, 33). Based on these conflicting observations, project staff predict that other as-yet undefined factors contribute to both the environmental stability of NoVs and their transmission to a host. These knowledge gaps prevent food safety experts from adequately addressing issues critical to development of virus removal/inactivation methods.

Such critical issues include (i) the ability to remove or inactivate virus below the threshold level of infectivity considering the extremely low infectious dose of NoVs; (ii) the relationship between NoVs and other environmental microorganisms; and (iii) the impact of environmental factors on the transmission of NoVs to a host. The effects of the food matrix and naturally occurring microorganisms on NoV transmission to a host are largely unknown.

Microbial risk analysis has indicated that even low levels of viral contamination in irrigation waters can result in a significant level of risk to consumers (34), but factors that contribute to virus survival on produce and ultimately transmission to a host are almost completely uncharacterized. While methods to reduce virus levels on contaminated produce have been discovered (35), the incidence of diarrheal disease upon consumption of virally contaminated produce is on the rise (36). Therefore, understanding agricultural and environmental properties that influence virus stability is necessary in order to prevent viral transmission and thus protect public health.

In this study, project staff investigated the ecology of virus, water and virus, produce interactions. These data are necessary to develop rational and effective strategies to prevent viral contamination of produce. Specifically, project staff proposed that NoV interaction with bacteria in the environment enhances persistence of NoVs in water and on produce, leading to enhanced transmission to a host. Biological parameters, such as enteric bacterial concentration, have been suggested to contribute to viral persistence but have not been investigated in detail (18). Moreover, bacteria have been shown to enhance infectivity of another enteric virus in vitro and in vivo and so may also aid in their persistence and stability (38). Also, conflicting data have shown that *P. aeruginosa* can negatively impact the viability of some viruses, presumably due to the secretion of specific bacterial enzymes (37), but this theory has not been investigated in detail or in relation to enteric viruses. A full investigation into the role of naturally occurring bacteria in the survival and transmission of noroviruses is necessary.

These studies provide foundational knowledge for the understanding of NoV ecology and its poly-microbial interaction with bacteria in irrigation waters and on tomatoes. This understanding provides the basis for development of pre and/or post-harvest intervention and/or mitigation efforts aimed directly at a common entry point into the food supply for many viral pathogens. The gathered data will be broadly applicable to a variety of foodborne viruses and so the information gained will help prevent the spread of other pathogens and reduce the overall burden of disease.

The epidemiology of global HuNoV outbreaks since 2002 is indicative of epochal evolution, typified by short bursts of high outbreak activity correlating with the emergence of a new pandemic strain interspersed with quiescent periods lasting 1–3 years (39, 40). In March 2012, the latest pandemic HuNoV strain, called GII.4 Sydney, was identified and has rapidly spread across the globe (41–43). To date, there has been a 58% increase in HuNoV outbreak activity in the United States since GII.4 Sydney emerged (41).

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

The impact of ammonium, phosphate and solar radiation (in the form of ultraviolet [UV] light) on the survival of norovirus were assessed during this project. Specifically, murine norovirus (MuNoV) was incubated at various temperatures (4, 22, 37 and 65°C) in a range of chemical (ammonium chloride or sodium phosphate)

concentrations. These mixtures were sampled periodically over the course of 45–60 days and viral loads quantified using both Real Time Polymerase Chain Reaction (qRT-PCR) and 50% Tissue Culture Infectious Dose ($TCID_{50}$) assays. For UV light treatment, two concentrations of MuNoV ($10^4$ and $10^7$ $TCID_{50}$/ml) were exposed to a range of UV doses. Two independent methods of analysis were used to discriminate between total viral RNA present (which is currently the only technique available for detection of HuNoVs and actual infectious virus).

Experiments evaluating the effect of UV light demonstrated that doses of 100,000 µJ/cm2 and higher completely inactivated MuNoV, while a dose as low as 10,000 µJ/cm2 did not reduce the levels of infectious virus compared to untreated samples. Results from initial experiments determining virus survival at the various temperatures revealed (as expected) that virus survival in the untreated control samples was increasingly stable with decreasing temperature. At 65°C, viral titers decreased rapidly and were undetectable by 3 days post infection (dpi). Surprisingly, at 37°C the virus remained detectable until 10 dpi, but concentrations did steadily decline over time, as expected. MuNoV was the most stable at 22 and 4°C, surviving past 10 and 60 days, respectively. Based on these control studies, 4°C provides and optimal condition for evaluating the ability of the aforementioned compounds to decrease viral stability, while 37 and 22°C provide an environment in which stability enhancement of MuNoV by these compounds can be assessed.

When evaluating the impact of chemical compounds at 4°C, higher concentrations (800 mg/ml) of ammonium chloride ($NH_4Cl$) resulted in a significant ($p < 0.05$) loss of infectious MuNoV after three days of incubation compared with untreated controls. By 7 dpi, both lower (80 mg/ml) and higher doses of the compound resulted in significantly ($p < 0.01$) lower concentrations of MuNoV and this trend continued out through 42 dpi. Exposure of MuNoV to sodium phosphate ($NaPO_4$) did not result in significant reductions in viral titers compared with untreated controls until 7 dpi, at which time the highest concentration of compound (5 mg/ml) resulted in a significant ($p < 0.001$) 1.3-log reduction in infectious viral particles. By 10 dpi, even low amounts (1 mg/ml) of $NaPO_4$ were able to significantly ($p < 0.001$) reduce viral titers, and this trend continued through 42 days for both compound concentrations.

Unlike the significant affects reported above, ammonium chloride had no effect on MuNoV concentrations at 22 or 37°C compared with untreated controls throughout the time when detectable virus was present. However, sodium phosphate negatively impacted survival of MuNoV at 22°C. By 3 dpi, the highest concentration of $NaPO_4$ had significantly ($p < 0.001$) lowered MuNoV concentrations compared with the untreated control; by 7 dpi, both concentrations of the compound resulted in significant ($p < 0.001$) virus reductions. At 37°C, $NaPO_4$ had little impact on virus survival through 3 dpi. By 7 dpi, the virus concentrations have decreased in all samples, but the virus concentration in both phosphate-treated samples were significantly ($p < 0.05$ and $p < 0.01$ for 1 and 5 mg/ml, respectively) higher compared with the untreated control. These results were complicated somewhat by the slightly lower input in the control samples; however, even taking this into consideration, the higher viral loads in the sample containing 5 mg/ml of $NaPO_4$ are still significant ($p < 0.05$). None of the treatments impacted virus survival positively or negatively at 65°C (data not shown).

This project also evaluated the survival of MuNoV on the surface of tomatoes. Green tomatoes were acquired from local growers immediately after harvest, prior to waxing. Tomato surfaces were spotted 10 times with 10-µl aliquots of MuNoV at a concentration of either $10^4$ or $10^7$ $TCID_{50}$/ml. The spots were allowed to dry

and tomatoes were incubated for 24, 48 or 72 h. After incubation the tomatoes were manually scrubbed in sterile bags containing 50 ml of phosphate buffered saline (PBS), and the concentration of virus in the wash was determined using qRT-PCR and $TCID_{50}$. These studies demonstrated the ability of MuNoV to remain stable and infectious on the surface of the tomato even after 72 hours of incubation, regardless of input concentration. Decreases in concentration were observed over time, but are consistent with the effect of room temperature incubation on viral stability. Interestingly, the concentration of virus removed from the tomatoes at every time point was similar to the amount applied to the tomatoes suggesting this virus does not form a strong attachment to the surface of tomatoes and can therefore be easily removed even after prolonged incubation. A second interesting observation revealed during data analysis of these samples was the comparison of infectious virus concentrations as determined by $TCID_{50}$ and viral concentrations as determined by qRT-PCR. For high amounts of virus, there was no difference in viral titer between these two types of analysis; however, for lower viral concentrations, the amount of virus determined by qPCR was always higher than the amount of infectious virus present.

Virus from chemical/UV treatments and tomato washes were used to infect mice in order to assess the ability of the virus to transmit to its natural host after exposure to the various conditions. C57BL/6 mice (n=3 for each strain/time point/condition) were infected orally with a maximum volume of virus containing sample from these conditions. After 24 hours, the mice were euthanized and pertinent organs (specifically, the distal ileum [small intestine], colon [large intestine] and mesenteric lymph nodes) in which MuNoV replicated were harvested. The tissues were homogenized and viral titers determined using plaque assay. Infection studies using UV-treated virus mirrored results from tissue culture infection where the highest levels of virus replication in the host occurred with samples that were untreated, and viral concentrations in the tissues were only slightly less in samples where virus had been treated with 10,000 µJ/cm2 prior to infection. These reductions in tissue titers are likely due to the slightly lower amount of infectious virus present after UV treatment. As with tissue culture, samples treated with 100,000 or 250,000 µJ/cm2 were not infectious to the host. Therefore, exposure to low amounts of UV light did not significantly reduce the transmissibility of the virus, however high doses of UV light did completely inactivate the virus and hinder transmission. For samples that were exposed to either ammonium chloride or sodium phosphate, a reduction in the ability of the virus to transmit to the host was observed after only three days of incubation prior to infection. However, this result was observed under all conditions, including the untreated virus samples, suggesting that the incubation alone, and exposure to the compounds, was responsible for the decreased ability of the virus to transmit. Infections in mice were also performed using the washes from tomato attachment studies described above. There was no detectable virus in the harvested tissues one day post infection, indicating that infection by the virus did not occur.

In addition to assessing the ability of physical and chemical factors to impact norovirus survival, the ability of bacteria and their secreted products to impact MuNoV survival were also assessed. For these experiments, high doses ($10^7$ $TCID_{50}$/ml) of MuNoV were incubated with either Psuedomonas aeruginosa (Pa), Escherichia coli (EC), Enterobacter cloacaie (ENT) or Citrobacter fruendii (Cf) or the cell free supernatants of these bacteria for 10 days, and the concentration of the virus monitored over time using RT-qPCR and $TCID_{50}$ assays. Results showed that MuNoV binds to bacteria at a high rate at various temperatures. At 4, 22 and 37°C, greater than 95% of the virus bound to bacteria. This attachment hindered the ability to analyze virus stability using tissue culture assays, but given the strong correlation demonstrated between tissue culture and molecular detection, qPCR was used for assessing the impact of bacteria on MuNoV survival. Results showed that incubation with live bacteria stabilized MuNoV during room temperature incubation. However, the

degree of stabilization was dependent on virus concentration. High virus inoculums demonstrated significant decline over the 10-day incubation while low virus inoculums were much more stable. This pattern was seen for all three bacteria (*E. coli*, *C. fruendii*, and *P. aeruginosa*), and while there was variability among the bacterial concentrations (low concentrations appeared to stabilize better than high concentrations for some samples) that were tested, those differences were not significantly different. These findings are particularly exciting in light of the known instability of MuNoV at room temperature. Room temperature incubation of MuNoV has been repeatedly demonstrated to be detrimental to virus stability leading to a total loss of detectable bacteria by 7–10 days. In addition, considering that environmental concentrations of both virus and bacteria are most similar to the lower concentrations used in these studies, these data may point to a strategy employed by the noroviruses to aid in their stability when outside the natural host.

The project staff also evaluated samples where MuNoV was incubated with the cell free supernatant (CFS) of the bacteria. Results from these studies demonstrated that both high and low concentrations of the virus can be stabilized by the factors secreted from Pseudomonas aeruginosa. When compared to incubation with the live bacterium, it appears stability is better when only the secreted factors are present.

In June 2015, the principal investigator (PI) gave an oral presentation on the project's interim research results at the Center for Produce Safety (CPS) Research Symposium in Atlanta, Georgia.

The CPS staff was in constant communication with the industry and the scientists working on this project and ensured that only California specialty crop commodities benefited from this project.

The project partners were CPS and the University of Florida. CPS managed the project and the project team at the University of Florida performed the research studies.

## Goals and Outcomes Achieved

For this project, MuNoV was exposed to physical (temperature and UV light), chemical (ammonium chloride and sodium phosphate) and biological (live bacteria and their cell free supernatants) parameters over extended periods of time (10–60 days). The virus levels in samples were then quantified using tissue culture and molecular detection assays and these quantities compared to virus levels in untreated samples. In addition, MuNoV was also applied to green, unwashed tomatoes and incubated for up to 72 hours. The tomatoes were then washed and the virus quantified, as mentioned above, to determine virus survival on this type of produce. Finally, virus exposed to physical, chemical or biological conditions or virus removed from tomatoes was inoculated into mice (the natural host) and the level of infection measured in order to assess the ability of the aforementioned conditions to impact transmission of this pathogen from food/water to the host.

Survival of MuNoV in response to physical stressors (i.e., temperature and UV light) was evaluated. Survival of MuNoV in chemically adjusted waters at 4, 22, 37 and 65°C using high and low doses of chemical compounds also was determined. Viral attachment and persistence on tomatoes were evaluated. The transmission of virus exposed to physical or chemical treatments to natural murine host was evaluated—infections from ammonium chloride–treated samples and UV-treated samples were completed, and plaque assay analysis for UV-treated samples was completed. The transmission of virus exposed to tomato surface to natural murine host was determined. The effect of tomato matrix on MuNoV infection of the host was assessed; however, the tomato matrix was found to be detrimental to cell culture assays and thus unusable for determining viral concentrations necessary to cause infection. The effect of bacteria on viral persistence was

assessed. Also, the effects of bacterial secreted factors on virus survival were evaluated through molecular detection. The effect of bacteria on viral attachment and persistence on tomatoes was evaluated; however, due to high levels of virus survival on tomatoes without bacteria, project staff could not determine if the presence of bacteria enhanced MuNoV survival on produce. Finally, the effect of biological parameters on MuNoV infection of a host was determined, but high levels of MuNoV attachment to live bacteria significantly reduced their concentrations so that virus levels in filtered inoculum were too low to cause host infection.

Two publications from the research results of this project are in progress and will be submitted at the end of 2016. The first, entitled "The effect of physical and chemical factor on norovirus survival" is under revision for subsequent re-submission. The second publication, "Bacterial enhancement of norovirus survival in vitro" is in preparation for first submission to the journal Applied and Environmental Microbiology.

The success of this project was to be determined by the identification of one or more factors that unequivocally impact norovirus survival in water and on tomatoes or disease in a host, and this outcome was achieved. Results from this project demonstrated that temperature (≥65°C), UV light (≥100,000 µJ/cm2), and ammonium chloride (only at 4°C) significantly reduce the viability of MuNoV over time. Sodium phosphate can also negatively impact virus survival at conditions (4 and 22°C) where MuNoV can persist for extended periods of time; however, this compound may also provide a protective effect at higher concentrations under conditions (37°C) that are normally detrimental to the virus. This project also demonstrated that the presence of bacteria provides protection and thus aids in survival of MuNoV.

## Beneficiaries

The most near-term beneficiaries of this research are produce growers who can implement the knowledge gained from these studies, particularly those who have control over their irrigation water supplies. This research also directly benefits research scientists and industry personnel involved in development of pathogen mitigation strategies. Furthermore, groups involved with the development of Good Agricultural Practices (GAPs) as they relate to reducing or preventing contamination by viral pathogens will benefit from a better understanding of chemical and biological factors that enhance virus survival. Results from this project will also benefit those involved in developing effective risk management techniques for noroviruses in foods and water, as the extensive comparison of infectious virus versus genome levels under a variety of conditions now provides a solid understanding of the relationship between molecular detection of viral genome and infectivity/disease potential of retained virus.

Produce growers are beneficiaries from this project. According to the most recent (2012) Census of Agriculture, there are 42,729 farms of produce crop growers representing $23.9 billion in sales in the state of California (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/index.asp).

A PI from the University of Florida presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, Washington, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, Georgia, to approximately 245 attendees. The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory

agencies. The annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results were disseminated at industry meetings, and streamed through social media sources. Results are available online as follows:

Final reports submitted to CPS (after the June 2016 symposium) are posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php

CPS will work with the scientists to publish results in scientific journals. Publication dates will occur after the project is completed. Abstracts and awards can be found on the CPS website.

The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "CPS 2016 Research Symposium Key Learnings" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/365/CPS%202016%20Key%20Learnings.pdf.

## Lessons Learned

This project confirmed that noroviruses are extremely stable and that factors that contribute to their stability can be multi-faceted. Only UV light and very high temperatures (65°C) were able to quickly eliminate infectious virus particles. All other treatments resulted in slower declines in virus stability. However, the decline in infectious virus can be accelerated by the addition of high concentrations of ammonium chloride or potassium phosphate. Thus, the addition of these compounds to irrigation water systems may prove useful in controlling and lowering norovirus in water when contamination events occur. Sodium phosphate also demonstrated a slight protective effect for MuNoV under certain conditions, but bacteria provided the biggest stabilizing force of all the conditions tested. Furthermore, it seems the presence of the bacteria themselves is not necessarily required for enhancing viral stability; enhanced viral stability can be achieved through products secreted by the bacterium. These observations may help explain the stability of norovirus in water sources and particularly in wastewater treatment systems. During this project period the team learned a great deal regarding the difficulty in working with poly-microbial systems and the challenges that arise when trying to analyze experiments and data. These complications extended to evaluating transmission of this virus which also proved to be difficult. However, through these challenges much was learned and techniques were modified or developed to aid follow-up studies.

Several unexpected results were obtained from this project. The first unexpected outcome encountered was the ability of sodium phosphate to stabilize MuNoV at 37°C when all other chemical and physical conditions reduced virus survival. A second unexpected outcome was the inability of MuNoV, which had been previously incubated on tomatoes, to infect its natural murine host. Infectious virus titers in the wash were determined by tissue culture analysis, and, while low, were within the range normally able to cause disease in mice. It is apparent that under these conditions, the ability to infect under tissue culture conditions does not correlate 100% to infectivity in a host. This phenomenon is not usually encountered in the research team's lab; therefore, it is possible that exposure to the tomato surface in some way inactivates the virus and prevents transmission to the host. The hypothesis is still untested, but remains an exciting possibility.

A third unexpected outcome was the high level of norovirus attachment to the bacteria. It is known that noroviruses interact with bacteria; however, under the conditions tested, approximately 90% of the virus attached to bacteria, regardless of bacterial concentration (which ranged from $10^3$ CFU/ml to $10^7$ CFU/ml) or if the bacterium was gram-positive or gram-negative. This association with bacteria may provide a means of protection for the virus in the environment. Unfortunately, this attachment prevented the performance of experiments as they were originally designed; however, we were able to find a method by which bacteria could be removed from the mixture while the majority of the norovirus remained. Samples that have undergone this treatment are in the process of being analyzed by the team to determine if bacteria (or the factors they secrete) stabilize norovirus in water.

An outcome not achieved was evaluating the impact of bacteria on norovirus transmission. Through trying to perform these studies, project staff learned that large numbers of MuNoV attach to bacteria, which eliminated filtration as a method for removing bacteria from mixtures prior to infection in mice. It was found that chloroform treatment of virus: bacteria mixtures was able to completely remove bacteria while resulting in only a nominal loss in virus. The discovery of this technique will allow for a more in-depth analysis of the results generated from this project thus far and will also aid in future studies aimed at determining the mechanism behind bacterial enhancement of MuNoV survival.

## Additional Information

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com (e.g., http://pma.com/content/articles/2016/09/2016-cps-research-key-learning)
Western Growers Association: http://www.wga.com/ (e.g., http://www.wga.com/magazine/2012/03/08/2016-cps-symposium-highlights)

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# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 61 | **Project Title:** Remediation and Recovery Measures to Expedite Plant or Replant of Vegetables Following Soil Contamination by Salmonella Enterica | |
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| **Grant Recipient:** The Regents of the University of California, Davis, Center for Produce Safety | **Grant Agreement No.:** SCB13061 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Bonnie Fernandez-Fenaroli | **Telephone:** (530) 554-9761 | **Email:** bonnie@centerforproducesafety.org |

## Project Summary

Pathogen testing programs conducted on diverse raw and minimally-processed specialty crops, especially since 2007, have demonstrated that contamination capable or known to have reached market channels is present on fruits and vegetables intended for fresh consumption. Although the frequency and prevalence appears to be very low, these industry intercepts within pre-harvest and post-harvest monitoring programs have resulted in substantial losses to individual growers and handlers. Destruction of multiple fields per year, occasionally hundreds of acres, is damaging economically but also may negate initiatives of sustainability for the operation. While the decision to destroy a field or produce lot in cold storage is the responsible action when pathogens are detected, prevention of recurrence of contamination in rotational or replanted vegetable crops, originating from the prior contamination event, is an important component of a farm safety plan. Prior to developing the concept for this project, the research team demonstrated persistence of Salmonella in soil-crop residues following incorporation of more than 100 days. Transfer from soil to baby spinach seeded to the experimental crop, after this fallow interval, resulted in approximately 50% detection of the specific applied Salmonella on spinach leaves at the 2–3 and 5–6 leaf stages, simulating typical commercial harvest maturity. Additionally, in response to dual requests by growers, the analysis of widespread contamination of leafy greens by Salmonella led to the conclusion that inadequately managed composts containing poultry manure and litter were likely responsible. Whether on crop residue, from an irrigation source, the result of flooding, contaminated manure/compost or other acute contamination incident, persistent populations of human pathogens in soil can have devastating impacts for a grower or regionally. This project was initiated to develop practices and supporting data that would apply to remediation and recovery of soil contaminated by Salmonella following intentional application of chicken manure/litter or compost during pre-plant and pre-harvest fertility management of vegetable crops. Low-residue, short-cycle cover crops and solarization were identified as two practical and potentially economical techniques to return farm soil to replant safety in intervals of shorter duration than current industry standards.

The repeated loss of high value specialty crops, such as baby greens and related tender salad greens and leafy culinary herbs (cilantro, basil, parsley), due to replanting into production blocks impacted by various sources of known or suspected contamination has been very damaging to individual growers and the industry at large. Several major incidents of contamination or presumptive contamination preceded this project definition, and the identification of practical remediation to widespread contamination events, specifically contaminated compost, was the motivation for the timing of the initial proposal. A goal of this project has been to provide data in support of options, available to all scales of farming, to modify existing and future guidance and industry standards for produce safety. In addition, this project has potential benefits to improving

sustainability performance because the primary remediation being explored incorporates cover crops to eliminate repeated crop destruction and improve soil health and microbial community diversity.

Although this project did not build on a previously funded Specialty Crop Block Grant Program project, the soil and plant microbiological and molecular detection techniques to accomplish this study were all based on previous Center for Produce Safety (CPS) funded studies related to soil survival of Salmonella and contaminated crop residues.

## Project Approach

A series of replicated experimental trials were conducted, from microcosm to field-level trials, in consecutive seasons to address the work plan objectives related to determining whether a low-residue cover crop will enhance die-off of *Salmonella enterica* in contaminated soils. Three cover crops, selected for their known release of antibacterial compounds during decomposition of residues in soil, were tested in 2 microcosm, 2 mesocosm, and 3 field trials during the two-year grant period. Efficacy of treatments was attempted by following Salmonella survival in fallow soil or after incorporation of cover crops grown for approximately 30–40 days. In general, the experimental implementation followed the work plan as described and approved with minor deviations due to fluctuating personnel availability and seasonal weather. Although population differences were not statistically different among the cover crops and trials, buckwheat was observed to have potential as a low-residue remediation treatment. In Year 2, additional cover crop entries, including broccoli, triticale, Sudan grass, barley, purple vetch, and common vetch, were added to the work plan. 'Greenbelt' broccoli emerged as a potential residue for growers, resulting in more rapid quantitative die-off (4 log in 28 days) and qualitative die-off (~33% positive soil enrichments vs. 100% for controls and most other treatments) than other treatments or controls. After each cycle of post–cover crop survival studies, once Salmonella populations dropped below quantitative and qualitative detection limits, a replant crop of baby spinach and red chard was seeded to each plot. No recontamination of the subsequent crop was detected at harvest in any of the three trials.

Due to the comparable die-off in fallow controls, at the University of California, Davis (UCD) field trials, a specific outcome and guidance regarding cover crops and remediation of Salmonella-contaminated soils was not possible. While definitely encouraging, similar studies in diverse soils and climates would be needed to develop a set of Best Practice standards for industry.

Solarization was evaluated as a method to accelerate die-off of Salmonella introduced to soil via chicken manure and litter. Solarization trials were performed in each year of the award by covering replicated plots with 4- or 6-mil polymer sheets, and temperature dataloggers were placed central to each plot to record diurnal temperature flux. In addition, a microcosm assessment of die-off under different soil temperatures was conducted as an add-on to the work plan. In these studies the time to lethality (no recovered Salmonella in three attempts) was determined for exposures to 29, 37, 48, and 55°C for 0, 2, 4, 18, 24, and 48 h as well as 4, 13, and 21 days. It was determined that 99.99% kill was achieved at 4, 96, 312, and 504 h, at 55, 48, 37, and 29°C, respectively. In the field trials, a 99.99% quantitative reduction was achieved in 14 days for controls and solarized plots, but control plots remained 100% positive by qualitative detection throughout the 55-day experiment whereas solarized plots were observed to have 33 and 0% detectable at 14 and 39 days, respectively. Where economical and in compatible climates with high solar radiation intensity, solarization is a viable remediation option.

One of the unexpected developments which impacted the research in Year 2 was the heavy damage to the polymer tarps on the solarization trials by multiple dozens of American crows. There was minimal interest by the bird populations in Year 1 but, having learned that chicken manure pellets were good food, they poked through the plastic, which impacted heat retention, and the research team had to recover all plots with new tarps.

The principal investigator (PI) presented interim research results at the 2015 CPS Research Symposium in Atlanta, Georgia. The participants (approximately 245) included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies.

The scope of the project and all activities were conducted in a manner to directly benefit leafy greens and other specialty crops. The CPS staff is in constant communication with the industry and the scientists working on this project, and is unaware of any commodities that benefited from this project other than specialty crops.

The project partners were the CPS and the UCD. CPS managed the project and UCD performed and coordinated the research studies. This project was substantially and significantly accomplished by the dedicated effort of the Staff Research Associate, who was assigned a major role with PI to manage, supervise, and implement all aspects of the work plan from the outset and, especially, once it became clear that a qualified and suitable Postdoctoral researcher could not be hired. The Assistant Specialist was instrumental in conducting the molecular detections. In addition, the Facility Manager contributed throughout the award period in coordination of undergraduate lab assistants, research farm personnel, attempts to secure a source(s) of naturally contaminated chicken manure /litter, and budget oversight and management.

## Goals and Outcomes Achieved

Throughout the award period the activities followed the linear experimental steps of inoculum production–inoculum incorporation–soil testing for initial survival-seeding of cover crops OR placement of solarization tarps–growth of cover crops OR time points for solarization treatment–interval soil sampling for survival of Salmonella–cutting of cover crops OR removal of solarization tarps–incorporation of cover crop residues–timeline interval soil sampling for Salmonella–re-planting baby spinach and red chard crops–growth of replanted economic crops–testing for Salmonella contamination at harvest. Measurable data outcomes (log CFU/g; presence/absence) were based on this system and followed Salmonella survival or die-off over time in relation to treatments.

Outcome measures were not long term.

A comparison of actual accomplishments with the goals established are as follows:
(1) Cover crop remediation was completed in full. (2) Solarization remediation was completed in full. (3) Analysis of cover crop residues and microbial community impacts: Due to the lack of significant differences among cover crop treatments in the UCD field trials in two years, the compositional analysis of antimicrobial compounds from cover crops and impacts on the soil microbiota were deferred. In the absence of treatment effects, these were not likely to be productive to explore mechanisms for optimization. However, all retained frozen soil samples have been extracted for analysis and these objectives, though delayed by lack of technical staff, are in progress and the data will be added to journal manuscripts. (4) Similarly, the final stage of

detection, post-enrichment, of Listeria in soil following cover cropping was deferred as being of limited priority due to the primary outcomes of die-off in fallow controls, in the main cover crop field trials.

Baseline data supporting the potential for short-cycle cover cropping to accelerate die-off, and achieve safe replanting of high-value baby greens, are exemplified by a 17% positive rate for Salmonella detection with buckwheat compared with 100% in controls in a high organic matter soil, and a 33% positive rate for Salmonella detection with broccoli residues compared with 100% in controls in a silty clay loam soil. Baseline data supporting the efficacy of solarization as a Salmonella remediation practice are exemplified by a 4-day kill-time in soils able to reach a sustained 48°C temperature, in model studies, and <39 days in field trials under soil temperature conditions reaching at least 6 h of >40°C. In both cases, the target to achieve functional and practical remediation to allow safe replanting in less than 60 days—the current industry standard—was accomplished.

Application of either cover cropping or solarization, to prevent contamination or re-contamination of a commercial salad greens field, and subsequent destruction following detection of soil-borne pathogens, would conservatively save the grower $5,000 per acre and prevent serious product availability shortfalls for the processor.

## Beneficiaries

The primary and immediate beneficiaries are growers, handlers, and processors of leafy greens. The potential for the project accomplishments and outcomes to be translatable to other crops and all scales of specialty crop production is very high.

The California Agricultural Statistics Review for 2014–15 underscores the high diversity and value of specialty crops and most are potential beneficiaries of this research. Handlers enrolled in the Leafy Greens Marketing Agreement, alone, number more than 75 companies with a farm-gate value of over $2 billion. Only a small subset of farms impacted by soil contamination would benefit in any given year, but a substantial loss of leafy greens from more than 200 acres, implicating contaminated compost, is the basis for on-going litigation in the state.

The principle investigator from the UCD, presented final research results in June 2016 at the seventh annual CPS Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, GA, to approximately 245 attendees. The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results will be disseminated at industry meetings, and streamed through social media sources. Results will also be made available online as follows:

1. Final reports submitted to CPS will be posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php
2. CPS works with the scientists to publish results in scientific journals. Publication dates occur after the project is completed. Abstracts and awards can be found on the CPS website.

3. The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "2015 CPS Symposium Summary: Key Learnings and What They Mean for You" on the CPS website at the following link: http://www.centerforproducesafety.org/amass/documents/document/325/2015%20CPS%20Symposium%20Key%20Learnings%20web.pdf.

## Lessons Learned

Coordination and communication remains an essential and challenging component to any research project but is especially acute in any work plan with a heavy open-field research activity. The team had many successes and some failures in executing project timelines and accomplishments, which were co-dependent on the participation and professionalism of others.

To minimize frustration, only propose research projects that have a very strong and linear experimental path and a low potential to require deviation between initial proposal, eventual award, and ultimate project execution timeline.

The team did not fully anticipate the high rate of die-off of the available and only permitted attenuated Salmonella isolate in the UCD trials. This did not meet the research team's expectations and limited the conclusions relative to treatment success and recommendations.

When and where possible, be cautious in depending on others financially bound or not to your project. Limit your vulnerability to project management barriers over which you have no leverage to control.

## Additional Information

The following websites provide additional resources on the final reports and symposium proceedings:

- Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
- Produce Marketing Association: http://pma.com
- Western Growers Association: http://www.wga.com/

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 62 | **Project Title:** Food Safety Risks at the Fresh Produce-Animal Interface: Identifying Pathogen Sources and their Movement on Diversified Farms | |
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| **Grant Recipient:** The Regents of the University of California, Davis, Center for Produce Safety | **Grant Agreement No.:** SCB13062 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Bonnie Fernandez-Fenaroli | **Telephone:** (530) 554-9761 | **Email:** bonnie@centerforproducesafety.org |

## Project Summary

The primary goal of this project was to determine the potential transmission of *Salmonella*, Shiga toxin–producing *Escherichia coli* (STEC) O157:H7, and non-O157:H7 STEC from animal operations that are in close proximity to vegetable production systems on (1) an experimental research station and (2) commercial diversified farming operations in North Carolina and Tennessee. The interface of food animals and fresh produce in agricultural production is an area in need of research that addresses transfer, persistence, and the overall risk factors potentially influencing pathogen transmission to fresh produce through water, air, and soil or basic cultivation practices. The overall goal of the project was to identify those risk factors that, when managed properly, could reduce the risk of contamination. The research team first performed control open-field studies within an agriculture research station and studied the impact of multiple farm variables, including buffer zone distances, temporal factors, air, and insects, on transmission of the above pathogens from dairy and poultry operations to an array of vegetable crops grown under the diversified farming system model. The information gathered throughout the control study was concomitantly used to design and implement studies in small to medium-sized commercial diversified farms in the two states. The aim under the second objective was to identify whether some of the observations determined during the control study, including source of the pathogen, movement and persistence, could explain the key parameters influencing produce contamination, narrow the "how-to" information gap, and help the produce industry to strategize control measures to improve food safety on their farms.

It is clear that the emergence and growth of the "Eat Local" movement has contributed directly to the growth of diversified sustainable farms that promote rearing livestock and growing fresh produce within the same agricultural system. This project was aimed at determining indicator and pathogenic bacterial transmission at the interface between food animal production and fresh produce on these farming systems. Further, the diversity within commercial sustainable farming systems poses a big challenge to the proposed buffer zone distance and to the potential mitigation practices that could provide practical evidence of reducing produce contamination from nearby animal operations across growing seasons. With the signing into law of the Food Safety Modernization Act (FSMA) and the implementation of the Produce Rule, this project began to address one of the major concerns within the rules, which is proximity, and the intrusion of domestic animals and transfer of pathogens to crops from these activities.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

To achieve the goals of objective 1, a control study was conducted on diversified farming operations that were established at two locations, one located next to a dairy unit holding 150 animals and another located next to a layer-hen house. At both locations, plots were placed at 32 ft, 200 ft, and 400 ft downwind from each animal operation. The selected land had not been used for dairy and poultry farming practices for a period of 3 and 10 years, respectively, and both locations were covered with native grasses before the experimental plots were established. Before, during, and after each growing season, vegetables were managed under organic practices except for fertilizer applications or the control of pigweed (which is a major problem in different regions in North Carolina). No manure was applied to any of the plots during the duration of the project. Between growing seasons, cover crops appropriate to the region and season were planted to maintain the field under a green cover. Soil, water, air, produce, and dairy and poultry manure samples were collected and analyzed for the presence of indicator microorganisms, including generic *E. coli*, coliforms, *Enterococci*, and *Salmonella* and STEC pathogens based on the animal production system. Overall, over 2,500 samples were collected from the selected locations, and the transfer of STEC pathogens was established within both animal-produce interfaces. *Salmonella* was not recovered from 99% of the samples, except for two poultry manure samples. This manure was collected within the layer-hen house manure and was never in contact with the diversified plots. Despite being able to collect over $2.1 \times 10^6$ L of air over the entire growing season, no pathogens were recovered from this intensive sampling. Water used mainly for drip irrigation met the adopted water quality standards by the Produce Rule by two-fold, and STEC or *Salmonella* were not recovered from these samples. Soil and produce samples consistently were positive for STEC within the 400-ft buffer zone distance. For soil samples the presence of STEC varied with distance, with a greater number of positive samples collected at 32 ft from each animal operation than collected at distances of 200 and 400 ft. This same trend was not observed with produce samples, in which distribution of STEC was random and present in samples collected at 32, 200, and 400 ft from each animal operation. *Salmonella* was not recovered from soil or produce samples. Although no pathogens were detected in the air samples, air remains the most likely route of contamination since no manure from any of these sources was applied to the fields for over 3 to 10 years.

The focus was on pathogen transfer from animal operations to diversified vegetable farming practices; however, the project findings are not limited to the sustainable agriculture environment since other cropping systems, including standard organic production, conventional farming practices, and biodynamic approaches, also pose the risk of pathogen transfer when in close proximity to animal operations. Under these scenarios and within the studied system, the size of animal operation, proximity to produce fields, and cultural practices seem to impact pathogen transfer to produce, and these parameters are irrespective of farming approaches. Consequently, whether farmers are dealing with fruits, vegetables, tree nuts, horticulture, nursery crops, or others included within the definition of specialty crops, the team's findings and potential approaches to reduce pathogen transfer could benefit all.

To achieve the goals of objective 2, the team collected farm samples, including produce, animal, and environmental, from selected commercial sustainable farms in North Carolina (n=2) and Tennessee (n=5). *Salmonella* and STEC isolated from samples were characterized at phenotypic and genotypic levels. There were clear distinctions between the outcomes based on geographic locations of these farms in the two different states. *Salmonella* was isolated from multiple samples originating from commercial sustainable farms only in Tennessee and not in North Carolina. None of the fresh produce samples from the farms in either of the two states tested positive for *Salmonella*. In Tennessee, STEC was isolated from fresh produce and animal and environmental sources as well as flies, while in North Carolina only the fecal and soil samples

tested positive. Based on the outcomes of the 2-year sampling period in which animal feces, soil, air, and fresh produce samples were collected at varying distances from the animal source (~32–400 ft), the team concluded that a 400-feet distance between the animal source and the produce field as mandated by the California Leafy Green Products Handler Marketing Agreement (LGMA) rules may not be appropriate and that this buffer zone distance requirement needs to be reviewed and extended.

The principal investigator (PI) presented interim research results at the 2015 Center for Produce Safety (CPS) Research Symposium in Atlanta, Georgia, in June.

The scope of the project focused on specialty crops. The CPS staff is in constant communication with the industry and the scientists working on this project, and is unaware of any commodities that benefited from this project other than specialty crops.

The project partners were the CPS and North Carolina State University (NCSU). CPS managed the project and the NCSU coordinated and performed the research studies. The PI led the overall coordination of the project and worked closely with the NCSU Co-PI 1 in ensuring completion of the proposal objectives in the project time frame. The PI led the efforts listed under objective 2 while the University of Tennessee Co-PI led the efforts under objective 2 in Tennessee. The NCSU Co-PI 1 led the control studies at the research station and provided protocols to analyze all the collected samples in both states following the same experimental procedures. The NCSU Co-PI 1 also assisted in the establishing the sampling schemes at the commercial diversified farms. The other NCSU Co-PIs assisted in recruiting sustainable farms in North Carolina and in sample collection, and also played a key role in the extension efforts of this team working on disseminating the information to the participating farmers in our study and across the state at growers meetings.

## Goals and Outcomes Achieved

The transmission of pathogenic microorganisms (*Salmonella*, STEC O157:H7 and non-O157:H7 STEC) from animal production systems to fresh produce was characterized on an agriculture research station farm and commercial diversified farms. The movement of pathogenic organisms from the animal reservoirs and potential environmental sources into fresh produce fields was quantified based on distance from animal operations. A total of three vegetable growing seasons were implemented at each location. During each growing season soil, air, water, produce and manure samples were collected at each location and the presence of indicator and pathogen microorganisms was assessed on all samples. Farm samples including produce, animal and environmental, were collected from two commercial sustainable farms in North Carolina and five in Tennessee. Sampling was conducted multiple times on these farms over the 2-year period to fulfil the sampling requirements proposed in the study. Overall the results of this study suggest that a 400-feet buffer zone distance between animal operations and produce fields is not sufficient to prevent transfer of pathogenic microorganisms from the animal source to contaminate produce.

For the control study at the agriculture research station, all field experimental procedures have been completed and data have been analyzed. The team is finalizing the next generation sequencing analysis of soil, air, water, and produce samples collected at each location. The difficulty in recruiting commercial diversified farms for conducting the experiments in objective 2 was a major hurdle for the project team. To meet the project requirements in terms of samples collected, the team completed multiple sampling rounds on the farms. The molecular characterization of pathogenic organisms collected as part of the research conducted

on the selected commercial diversified farms is complete. Overall, the team met the outcomes listed under the two objectives and generated useful information that will assist multiple farming systems.

Results for the control study (objective 1) suggest that the proposed 400-feet buffer zone distance between animal operations and produce fields may not be appropriate for preventing movement of pathogens from the animal source and into fresh produce. Further, these results suggest that the proposed buffer zone distance requirement needs to be revised and potentially include other barriers to reduce pathogen transfer. Although air sampling followed continuous and large volume capacities, the team was not able to recover pathogens throughout all sampling events; however, generic *E. coli* and coliforms were recovered on over 40% of the collected samples. Based on the data collected from the air filters, the team was not able to find that air was a potential source of pathogen transmission, despite the ability to consistently recover STEC from the soil and produce samples at different distances from the dairy operations (Figures 1 and 2 – see Attachment).

Baseline data obtained for the commercial diversified farm study (objective 2) are as follows:

North Carolina Year 1 – Over the 2-year study period two farms were sampled repeatedly in North Carolina. The team collected multiple samples comprising produce (n=110), soil (n=122), poultry feces (n=60), water (n=3), and insects (n=11) from Farm 1 that was sampled twice in the Piedmont region of North Carolina. The team recruited a second sustainable farm late in the year (2014) and this farm was sampled only once in December. From Farm 2 the team collected 72 samples, including produce (n=40), soil (n=16), and dairy cattle feces (n=16). Samples were processed individually to isolate *Salmonella* and STEC. Based on the results (Figure 3) it was clear that *Salmonella* contamination of fresh produce was not an issue, as none of the samples tested positive for *Salmonella* over the entire sampling period. However, STEC was isolated from eight fecal (13.3%) and three fly (27%) samples on Farm 1 and from three fecal samples (18.75%) on Farm 2. None of the STEC isolated from Farm 1 or 2 tested positive for *E. coli* O157:H7.

North Carolina Year 2 – The same two North Carolina farms were sampled repeatedly (3 times each) between May–September 2015. From Farm 1 the team collected 181 samples comprising vegetables (n=52), soil (n=71), poultry feces (n=45), insects (n=10), and water (n=3). From Farm 2 the team collected an additional 150 samples comprising vegetables (n=47), soil (n=23), dairy cattle feces (32), insects (n=15), and water (n=1). Samples were processed individually to isolate *Salmonella* and STEC. Any presumptive positive cultures collected from agar plates were prepared and stored until further analysis. No *Salmonella*-positive samples were detected from these two farms in year 2 of sampling. From Farm 1, STEC was isolated from 11 fecal samples (24.4%) and a single soil sample (1.4%). From Farm 2, STEC was isolated from five fecal (15.6%) and two soil (8.7%) samples (Figure 4). None of the confirmed STEC isolates were O157:H7, as determined by PCR testing.

Tennessee Year 1 – A total of 769 samples, including cattle feces (n=7), insects (fly traps; n=153), poultry feces (n=72), poultry litter (54), produce (n=265), soil (n=171), water (n=30), and manure (n=17), were collected from three Tennessee sustainable farms in 2014. Each farm was sampled three times during 2014, and sampling dates and locations were recorded. The team isolated and confirmed 110, 17, and 62 isolates of STEC, *E. coli* O157:H7, and *Salmonella*, respectively. STEC was predominantly isolated from samples originating from Farm 1 (n=43) and Farm 2 (n=60) compared with Farm 3 (n=7) during the year (Figure 5). The number of STEC-positive samples was significantly higher from Farm 2 than from Farm 1 ($P = 0.01$). STEC prevalence in both Farms 1 and 2 was highest among the poultry samples, including fecal and litter.

Fresh produce samples from Farm 1 (1.1%) and Farm 3 (6.5%) tested positive for STEC; the produce samples that tested positive included melons, cucumbers and beans. There was no significant difference between STEC prevalence detected in fly traps ($P = 0.31$) and water source ($P = 0.25$) between Farm 1 and 2. Based on PCR testing, a total of 17 STEC isolates (13.3%) were serotyped O157:H7, which were recovered from multiple sample types, including produce (beans), soil (bean field), poultry litter, and poultry feces, and fly traps (Figure 6). The serotype O157:H7 were predominantly isolated from Farm 1. A total of 40 isolates of *Salmonella* were isolated from the multiple sampling conducted on the three farms. *Salmonella* was isolated predominately from Farm 2 (n=50; 80.6%) followed by Farm 1 (n=11; 17.7%) and Farm 3 (n=1; 1.6%). The sample types that tested positive included poultry feces, poultry litter, soil, and manure; none of the produce samples tested positive (Figure 7). The predominant serotype detected was 4,5,12:i:- (45%), followed by Enteritidis (17.5%) and Schwarzengrund (15%).

Tennessee Year 2 – Two farms were sampled in Tennessee in 2015 and each farm was sampled three times. In total, 298 samples (fecal and litter, produce, soil, water, and flies) were collected from the two farms**.** A total of 91 STEC isolates were obtained from Farm 1 (n=27) and Farm 2 (n=64). All the presumptive STEC and O157:H7 isolates were confirmed by PCR. Serotype O157 was detected from two samples (water and cucumber) from Farm 1 but none from Farm 2. *Salmonella* (n=22) was isolated in Farm 2 from feces (n=8), litter (n=10), and fly-traps (n=4); the predominant serotype detected was Schwarzengrund (59%), followed by Kentucky (13.6%) and Typhimurium (13.6%). The detection of similar serotypes in flies and the poultry litter and fecal samples confirm the role of flies in the persistence of *Salmonella* on chicken farms. Since chickens eat the flies, they may become colonized and shed the pathogen thereby contaminating the litter, which becomes an important source of cross-contamination if directly applied to the fields or if composting does not kill the *Salmonella*.

The transfer of STEC pathogens was established between animal operations located in close proximity to diversified vegetable production systems. The project results strongly suggest that there needs to be a reassessment of the proposed 400-feet minimum buffer zone distance between animal operations and the location of fresh produce fields. Based on the project outcomes, this distance does not seem sufficient to prevent the transmission of pathogens from animal sources to produce. The team suggests conducting quantitative studies at varying buffer zone distances to determine the adequate buffer zones to prevent pathogen transmission and the establishment/assessment of other physical barriers to potentially reduce pathogen transfer.

The size and management of each animal operation seems to impact indicator and pathogen transfer within the diversified systems; operations with enclosed and small animal herds showed lower transfer than open and large animal operations. *Salmonella* was not isolated from any of the fresh produce samples at either the research station or the five commercial diversified farms in the two different states. Soil and insects were found to be positive for STEC, *E. coli* O157:H7, and *Salmonella*, which clearly highlights their potential for pathogen transmission to fresh produce.

## Beneficiaries

The primary beneficiaries of the project's accomplishments are specialty crop producers with diversified farming systems or with production areas near/adjacent to livestock. The team disseminated the project findings at the Carolina Farm Stewardship Association (CFSA) Sustainable Agriculture Conference (November, 2015) in a workshop entitled "Food Safety on Livestock and Produce Mixed Production Farms."

The workshop was well attended by ~35 participants representing multiple organic and sustainable production farms in North Carolina, and the team received positive feedback.

Following the outcomes of this study the team also partnered with CFSA to offer a symposium on food safety within sustainable farming practices, held at the 2016 International Association for Food Protection meeting in Saint Louis, MO.

Furthermore, results of this project will benefit the North Carolina Vegetable Growers' Association (NCVGA) and was included in their annual Southeast Vegetable and Fruit Expo in North Myrtle Beach, SC (November 2016).

California growers, handlers, and processors of leafy greens and other specialty crops will benefit from the research findings regarding buffer zone distances with respect to fresh produce production systems.

The annual Southeast Vegetable and Fruit Expo is attended by 400–500 vegetable and fruit growers from North and South Carolina. In 2015, the targeted agent training session was attended by 17 agents and specialists from North and South Carolina.

According to the most recent (2012) Census of Agriculture there are 5,455 farms of produce crops in North Carolina, representing $520 million in sales in the state, and there are 42,729 farms of produce crops in California, representing $23.9 billion in sales in the state: (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/North_Carolina/ and http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/index.asp) .

The project PI, NCSU, presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, GA, to approximately 245 attendees. The symposium participants included California regional and national growers/shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provides expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results will be disseminated at industry meetings, and streamed through social media sources. Results also will be made available online as follows:

1. Final reports submitted to CPS (after the June 2016 symposium) will be posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php
2. CPS works with the scientists to publish results in scientific journals. Publication dates occur after the project is completed. Abstracts and awards can be found on the CPS website.
3. The Board of Directors and members of the Technical Committee of CPS distribute a series of information briefs throughout the year on the website and through presentations, meetings and webinars. An example of this would be the "2015 CPS Symposium Summary: Key Learnings and What They Mean for You" on the CPS website at the following link:

http://www.centerforproducesafety.org/amass/documents/document/325/2015%20CPS%20Symposium%20Key%20Learnings%20web.pdf .

The following websites provide additional resources on the final reports and symposium proceedings:
Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

## Lessons Learned

Management practices for each crop will significantly impact mitigation practices to reduce pathogen transfer. Weather conditions had a profound impact on the project team's initial attempts to establish diversified farming systems. No run-off from poultry or dairy operations was observed. The team cannot discard the possibility that previous farm activities could have introduced some of the STEC pathogens recovered from soil and produce.

The team faced two major challenges. The first challenge was an unexpected extended winter season that delayed sampling from October 2014 to March 2015. This was the trend in both the collaborating states (North Carolina and Tennessee) and it affected both objectives 1 and 2. The atypical weather delayed plantings or prevented full-scale sampling for several months. Adverse weather conditions were also present during the week of March 5 through 8 and again from March 27 through 29; in both instances fall crops suffered frost damage and over 50% of the crops were lost. The second challenge was the difficulty to recruit sustainable commercial diversified farms or rather the unwillingness of farm owners to participate in the study. The team discovered that some farm owners didn't know if they have potential contamination issues because they assumed that microbial communities present in their farming systems will mitigate any risk and/or they didn't want to participate because they felt that they are likely exempt from FSMA. However, the team was eventually able to recruit two farms in North Carolina and sampled multiple times on the two farms.

In spite of facing multiple challenges listed above (willingness to participate and adverse weather patterns), the team was able to generate strong preliminary data that will provide a sound foundation for further research on bacterial transmission at the interface between fresh produce and food animal production on diversified farms. The team met the outcomes that were listed under the two objectives and generated useful information that will assist multiple farming systems. Working closely with the county extension officers was also helpful and it did open some doors for the team.

One recommendation for future projects based on what was learned through this study is to include funds to offset financial burdens to grower participants. The team found it extremely valuable to work closely with county based extension staff on identifying and recruiting grower participants. The team recommends continuing the work on sustainable farming systems as these farmers need assistance and guidance from the produce industry to deal with on-farm challenges that may compromise the safety of their product.

## Additional Information

See Attachment for Figures 1–7.

Presentations :

Thakur S. (2015). Food safety risks at the Fresh Produce-Animal Interface: Identifying pathogen sources and their movement on diversified farms. CPS Produce Research Symposium, Atlanta, Georgia.

Carter R, Massel M, Gunter C, Thakur S, and Gutierrez-Rodriguez E. (2015). Food safety risks at the Fresh Produce–Animal Interface: Identifying pathogen sources and their movement on diversified farms. International Association for Food Protection Annual Meeting, Portland, Oregon.

Thakur S, Gutierrez E, Gunter C, Chapman B and Hanning I. (2014). Food safety risks at the fresh produce–animal interface: identifying pathogen sources and their movement on diversified farms. CPS Produce Research Symposium, Newport Beach, California.

Workshop: Food Safety on Livestock and Produce Mixed Production Farms. (2015). Carolina Farm Stewardship Association Sustainable Agriculture Conference, Durham, North Carolina.

Symposium: A Real-world Conversation about Food Safety and Microbial Quality of Sustainable Diversified Farming Systems. (2016). [Submitted] International Association for Food Protection Annual Meeting, St. Louis, Missouri, July 31–August 3, 2016.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 63 | **Project Title:** Validation of Geospatial Algorithms to Predict the Prevalence and Persistence of Pathogens in Produce Fields to Improve GAPs | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis, Center for Produce Safety | **Grant Agreement No.:** SCB13063 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Bonnie Fernandez-Fenaroli | **Telephone:** (530) 554-9761 | **Email:** bonnie@centerforproducesafety.org |

## Project Summary

The risk of produce contamination can be reduced if contamination is minimized in the production environment, specifically during the growth and harvest stages. On-farm produce safety is complicated by the fact that each farm has a distinct combination of topography, land-use interactions and weather. Combinations of these factors influence the ecology and transmission of pathogens, and subsequently impact the risk of produce contamination. For this project, several extensive field studies were conducted, which identified key factors associated with an increased likelihood of pathogen presence in the produce production environment. Based on these factors, geospatial models were developed to predict on-farm areas that were more or less likely to be reservoirs of *Listeria monocytogenes (L. monocytogenes)*. The overall goal of this research project was to increase the understanding of pathogen transmission in the produce production environment by (a) validating geospatial predictive models for individual produce farms using remotely sensed data in a geographic information system (GIS) platform, and (b) examining the risk of produce contamination during and after precipitation events by quantifying the effect of time after precipitation and amount of precipitation on the frequency of pathogen detection. The validation of the geospatial models is invaluable to the produce industry because it would allow for the development of specific and science-based food safety plans for individual farms by identifying specific or likely hazards (e.g., proximity to domesticated animal operations). Knowledge of such hazards would assist growers in managing contamination risks on their farms by evaluating their current prevention-based programs (e.g., Good Agricultural Practices (GAP)) and implementing new preventive measures.

*L. monocytogenes* is a key pathogen of importance in the produce industry, and has been associated with multiple produce recalls and foodborne disease outbreaks. Understanding environmental factors associated with an increased *L. monocytogenes* prevalence in the produce pre-harvest environment is therefore critical for the produce industry, consumers, and public health professionals. This project specifically quantified the impact of rain and irrigation on *L. monocytogenes* detection over subsequent 24-h periods (i.e., 24, 48, 72, and 144–192 h post rain events). Furthermore, this project validated a specific tool to predict the likelihood of isolating *L. monocytogenes* from produce-field soils. This project was particularly timely since (a) technological advancements, particularly in GIS and remote sensing, had made it possible to integrate the large amounts of data needed to develop and validate this type of tool, and (b) the release of the Food Safety Modernization Act necessitated the implementation of science-based approaches to pre-harvest produce safety. Overall, this project demonstrated the usefulness of geospatial modeling for limiting produce contamination in the production environment, and provided the produce industry with science-based recommendations to prevent pre-harvest contamination of produce by *L. monocytogenes.*

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

Key activities and tasks that were associated with Objective 1 (implement geospatial algorithms to develop predictive maps identifying environmental reservoirs for *L. monocytogenes* on produce farms) and Objective 2 (independently validate each geospatial algorithm's power to predict areas that have a significantly higher prevalence of *L. monocytogenes*, as compared to areas identified as having significantly lower prevalence of *L. monocytogenes* by the algorithm) of this project included (a) development of predictive risk maps to identify environmental reservoirs (i.e., well defined spatial areas) for *L. monocytogenes* for four produce farms in New York State (NYS); (b) sampling of four NYS produce farms (264 samples/farm) to determine *L. monocytogenes* prevalence in on-farm areas with a low and a high predicted *L. monocytogenes* prevalence; (c) calculation of *L. monocytogenes* prevalence in on-farm areas with a low and a high predicted *L. monocytogenes* prevalence; and (d) validation of the geospatial model used to develop the predictive risk maps using univariate and multivariate logistic regression. Overall, *Listeria* spp. (including *L. monocytogenes*) were isolated from 20% (208/1056) of samples. *L. monocytogenes* was isolated from 12% (128/1,056) of samples. The prevalence of *L. monocytogenes* was greater for all field areas with a high predicted prevalence of *L. monocytogenes* compared with the field areas with a low predicted prevalence. For example, areas with <37.5 m distance from surface water showed a *L. monocytogenes* prevalence of 22%, compared to a prevalence of 10% for areas with >37.5 m distance from surface water.

Key activities and tasks that were associated with Objective 3 (quantify the effect of precipitation on the frequency of *L. monocytogenes* detection in high and low risk areas identified by the geospatial algorithms and the risk of *L. monocytogenes* transfer to produce during or after precipitation events) of this project included: (a) selection of two produce fields with a high and low predicted risk of *L. monocytogenes* isolation; (b) cultivation of spinach plants in 0.2 ha fields divided into twenty-one 13×13 m plots; (c) collection of soil (n=1,092), water (n=52), fecal (n=14) and spinach leaf (n=334) samples 24, 48, 72, and 144–192 h after an irrigation event (i.e., any time irrigation water was applied to the field) or rain event (i.e., >6 mm of rain over a 24-h period); (d) prevalence of *L. monocytogenes* for each field, time period (24, 48, 72, and 144–192 h), event type (rain and irrigation) and sample type (e.g., leaf, soil); (e) development of a statistical model to quantify the impact of rain and irrigation events on *L. monocytogenes* isolation from soil samples; and (f) development of a statistical model to quantify the impact of predicted risk on *L. monocytogenes* isolation from soil samples. The overall prevalence of *L. monocytogenes* was 9% (130/1,492). The prevalence of *L. monocytogenes* was higher in soil samples (8%) than in leaf samples (0.6%). Importantly, the prevalence of *L. monocytogenes* was higher in soil samples collected 24 h after irrigation and rain events (18%) than in soil samples collected 48 h (6%), 72 h (4%) and 144–192 h (1%) after irrigation and rain events.

Key results and recommendations:

- Proximity to surface water and pasture was significantly associated with *L. monocytogenes* isolation from produce production environments. Growers for whom *L. monocytogenes* would be a pathogen of concern may want to carefully manage growing areas in proximity to surface water and pastures. Similarly, processors or growers that conduct traceback investigations (e.g., based on a finished product positive) may want to more heavily focus sampling on field sites in proximity to surface water and pastures when trying to identify pre-harvest *L. monocytogenes* sources.

- The likelihood of isolating *Listeria* spp. and *L. monocytogenes* was greatest during the 24 h immediately following rain or irrigation events. Growers for whom *L. monocytogenes* would be a concern should consider enhanced interventions or management practices when harvesting crops within 24 h of rainfall or irrigation. For example, crops harvested under these conditions could be processed last. Alternatively, and where possible, harvest could be delayed for at least 24 h after rainfall or irrigation.

- Based on the project findings for *L. monocytogenes*, future efforts to explore GIS-based strategies to manage other pathogens (e.g., *Salmonella*) and pathogen sources (e.g., surface water used for irrigation) are warranted.

In June 2015, the Principal Investigator (PI) gave an oral presentation of the interim research results at the Center for Produce Safety (CPS) Research Symposium in Atlanta, Georgia.

This project did not benefit other commodities; all samples tested were collected from active produce farms. The CPS staff was in constant communication with the industry and the scientists working on this project, and was unaware of any commodities that benefited from this project other than specialty crops.

The project PI at Cornell University oversaw and coordinated the project. The Co-PI at North Dakota State University completed Objective 1; the Co-PI at Cornell University helped enroll farms in the project, and communicated findings to CPS and growers. The Industry Collaborator with the National GAPs Program provided logistical support and advice about farm management practices and food safety programs used by commercial growers.

## Goals and Outcomes Achieved

Activities associated included (a) implementation of geospatial models to develop predictive risk maps to identify environmental reservoirs for *L. monocytogenes* on NYS produce farms; (b) validation of the geospatial model used to develop the predictive risk maps using univariate and multivariate logistic regression; and (c) quantification of the effects (e.g., amount and timing) of precipitation and irrigation on the frequency of detecting *L. monocytogenes* in NYS produce fields.

Outcome measures set out for the project included the publication of two peer-reviewed manuscripts as well as the citations of said publications. Two manuscripts based on Objective 1 and 2, and Objective 3, respectively, were published in *Applied and Environmental Microbiology* in 2016 and 2015 (see Additional Information for publications). To date, the manuscript based on Objectives 1 and 2 had been cited once, and the manuscript based on Objective 3 had been cited twice. Considering the short time after publication, these citation numbers suggested a high future impact of this work.

The original proposal proposed completion of a study that would (a) accurately predict areas in produce fields with a high or low prevalence of *L. monocytogenes* prevalence, and (b) identify distances and parameter levels that would predict a significantly lower risk of *L. monocytogenes* isolation. Using proximity to water and proximity to pasture, it was possible to accurately identify areas with increased odds of *L. monocytogenes* isolation. Specifically, the odds of isolating *L. monocytogenes* were three times greater in areas that were ≤37.5 m from water than in areas that were >37.5 m from water. Furthermore, the odds of isolating *L. monocytogenes* were 2.9 times greater in areas that were ≤62.5 m from pasture than in areas that were

>62.5 m from pasture. The original proposal also proposed development of a model to predict the effect of precipitation on the detection of *L. monocytogenes* from soil and produce samples. This model was successfully developed; based on the data generated, the model determined that the odds of isolating *L. monocytogenes* from soil samples was twenty-five times greater during the 24 h immediately following a rain or irrigation event compared with time period of 144–192 h after an event.

Key baseline data that was gathered included (a) the on-farm prevalence of *L. monocytogenes* in the soil for five produce farms in NYS (data was collected from four farms as part of Objective 1 and 2, and from a different farm as part of Objective 3); (b) the on-farm prevalence of *L. monocytogenes* in water, feces, and pre-harvest produce for one farm in NYS; (c) the odds of isolating *L. monocytogenes* for areas that were ≤37.5 m from water compared with areas that were >37.5 m from water, and areas that were ≤62.5 m from pasture compared with areas >62.5 m from pasture; and (c) the odds of isolating *L. monocytogenes* 24, 48, and 72 h after a rain or irrigation event compared with144–192 h after an event.

Major successful outcomes for the project included (a) the collection of quantitative data on the prevalence of *L. monocytogenes* in the soil of five produce farms in NYS (data was collected from four farms as part of Objective 1 and 2, and from a different farm as part of Objective 3); (b) the validation of a geospatial model that predicted areas of high and low *L. monocytogenes* prevalence for NYS produce farms; and (c) quantification of the effect of rain on the likelihood of isolating *L. monocytogenes* from on-farm soils. As described above, another major successful outcome for the project was the publication of two peer-reviewed papers.

## Beneficiaries

Key beneficiaries of these data were produce growers, the produce industry and other scientists. Specifically, implementation of geospatial predictive models by the produce industry may increase the understanding of risk factors that promote foodborne pathogen prevalence and persistence in produce fields, and will assist growers in focusing their food safety efforts. Geospatial models allow for the development of preventive measures for individual produce farm fields, as they enable growers to proactively assess and address environmental factors that may increase the risk of contamination events on their specific farms. For example, predictive risk maps can identify areas of high predicted pathogen prevalence within specific fields, and enable growers to make more informed decisions about the management of crops in these areas, including targeted pathogen surveillance programs and altered management practices. Specific intervention strategies that the project findings suggested may be effective at reducing pre-harvest contamination risks included (a) waiting 24 h to harvest crops following rain events, (b) not irrigating within 24 h of harvest, (c) altering cropping schemes (e.g., planting high risk crops in low risk fields), and (d) monitoring pathogen levels in irrigation water.

The potential economic impact from this project will come from improved on-farm risk management strategies and a reduction in produce contamination events in the pre-harvest environment. This will reduce costs associated with crop loss (i.e., crops not being harvested because of known contamination), and costs associated with recalls. It will also reduce costs associated with post-harvest contamination, as low-level random contamination of pre-harvest environments could contaminate environments that are downstream in the produce supply chain (e.g., packing houses, processing plants). Another potential impact from this project is the ability to conduct more efficient traceback investigations—the project data can be used to predict field

sites that are more likely to yield *L. monocytogenes*–positive samples, therefore potentially reducing the number of samples that need to be collected.

The project PI, Cornell University, presented final research results in June 2016 at the seventh annual CPS Produce Research Symposium in Seattle, WA, to 315 symposium attendees. Interim results were presented previously at the 2015 CPS Produce Research Symposium in Atlanta, GA, to approximately 245 attendees. The symposium participants included California regional and national growers and shippers, retail and food service buyers, scientists, academics, produce industry representatives, and members of regulatory agencies. The annual symposium provided expert panels to critique the research results after presentation by the researcher, which helps participants evaluate how the results can be used in their respective businesses.

Project results will be disseminated at industry meetings, and streamed through social media sources. Results were also made available online as follows:

1. Final reports submitted to CPS posted on the CPS website: http://www.centerforproducesafety.org/grant_opportunities_awards.php
2. CPS works with the scientists to publish results in scientific journals. Abstracts and awards can also be found on the CPS website.
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The following websites provide additional resources on the final reports and symposium proceedings:

Center for Produce Safety: http://www.centerforproducesafety.org/resources.php
Produce Marketing Association: http://pma.com
Western Growers Association: http://www.wga.com/

## Lessons Learned

Key lessons from this project included (a) *L. monocytogenes* contamination on produce farms was dependent on the specific ecological context of a produce farm; (b) geospatial, predictive risk maps can be used to prospectively predict *L. monocytogenes* prevalence for NYS produce production environments, and (c) small changes in management practices may have a significant effect on the risk of *L. monocytogenes* contamination in produce production environments (e.g., waiting 24 h to harvest crops following rain events significantly reduced the likelihood of produce contamination). Since the data showed that geospatial models could accurately predict the likelihood of *L. monocytogenes* isolation from soils collected from produce pre-harvest environments in NYS, further work is warranted to develop similar models for other regions, other pathogen sources (e.g., surface water used for irrigation), and other pathogens (e.g., *Salmonella).*

One unexpected outcome was that proximity to impervious cover and available soil moisture did not accurately predict the likelihood of isolating *L. monocytogenes* from produce pre-harvest environments. Another unexpected outcome was that the amount of water applied to a field (i.e., as irrigation or rain) was not significantly associated with the likelihood of isolating *L. monocytogenes* from produce pre-harvest environments.

The Work Plan timeline was met and all project outcome measures were achieved.

One especially positive experience was the willingness of growers in NYS to participate in the study. At some point it may be worth investigating why some growers and/or growers in some states are more likely to be willing to participate in field studies like the one conducted here; this may help to further enhance grower participation in other studies.

## Additional Information

See Attachment 1 for a map related to the project.

This project resulted in two peer-reviewed publications:

Weller, D., M. Wiedmann and L. K. Strawn. 2015. Spatial and temporal factors associated with *L. monocytogenes* contamination of spinach fields in New York State. *Applied and Environmental Microbiology* 81(17): 6059–6069.

Weller, D., S. Swakoti, P. Bergholz, Y. Grohn, M. Wiedmann and L. K. Strawn. 2015. Validation of a previously developed geospatial model that predicts *Listeria monocytogenes* prevalence for New York State produce fields. *Applied and Environmental Microbiology* 82(3): 797–807.

The findings of this project were presented on seven separate occasions:

Weller, D., S. Swakoti, P. Bergholz, Y. Grohn, M. Wiedmann and L. K. Strawn. 2015. *Validation of a previously developed geospatial model that predicts Listeria monocytogenes prevalence for New York State produce fields*. Presented at Cornell Geospatial Forum, October 13, 2015, Ithaca, NY.

Weller, D., L. K. Strawn and M. Wiedmann. 2015. *Microbe detectives: using geographic information systems (GIS) to track and find foodborne pathogens in produce productions systems*. Poster at the Cornell Institute for Food Systems Summit, October 12, 2015, Ithaca, NY.

Weller, D., S. Swakoti, P. Bergholz, Y. Grohn, M. Wiedmann and L. K. Strawn. 2015. *The use of geographic information systems to predict the risk of Listeria monocytogenes contamination in produce fields*. Presented by Laura Strawn at the International Association for Food Protection Conference, July 16, 2015, Portland, OR.

Weller, D., M. Wiedmann and L. K. Strawn. 2015. *Time since irrigation and rain events is significantly associated with an increased prevalence of Listeria monocytogenes in spinach fields in New York State*. Presented at the International Association for Food Protection Conference, July 16, 2015, Portland, OR.

Weller, D. 2015. *Microbe Hunters: Using geographic information systems to identify risk factors for Listeria monocytogenes contamination in produce production environments*. Presented at the Food Science and Technology Spring Seminar Series, Cornell University, April 21, 2015, Ithaca, NY.

Weller, D., L. K. Strawn and M. Wiedmann. 2014. *Microbe detectives: using geographic information systems (GIS) to track and find foodborne pathogens in produce productions systems*. Poster at the Cornell Institute for Food Systems Summit, December 8, 2014, Ithaca, NY.

Weller, D. 2014. *Integrating geographic information systems and produce safety to develop science-based recommendations for disease prevention*. Presented at the Cornell Geospatial Forum, October 14, 2014, Ithaca, NY.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 64 | **Project Title:** Evaluation of Risk-Based Water Quality Sampling Strategies for the Fresh Produce Industry | |
|---|---|---|
| **Grant Recipient:** The Regents of the University of California, Davis, Center for Produce Safety | **Grant Agreement No.:** SCB13064 | **Date Submitted:** December 2016 |
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## Project Summary

Irrigation water has been implicated in a number of outbreaks associated with fresh produce. The United States Food and Drug Administration (FDA) recently finalized guidelines for the sampling of irrigation waters for generic *Escherichia coli* (*E. coli*) when used for produce production as an indicator of the potential presence of fecal contamination. These general guidelines are designed to reduce the risk of produce contamination and provide guidance on sampling frequency, location, and source of irrigation water. The guidelines also acknowledge that they may differ depending upon the types of produce, rainfall events, the methods of irrigation, and source water protection. Therefore, proper documentation and quantification of the impact of these environmental factors was needed. This project offers recommendations towards risk-based sampling strategies for irrigation waters that provide the greatest risk reduction to produce.

The project had four major goals: 1) Assess and quantify factors that determine variability of generic (indicator) *E. coli*, pathogenic *E. coli* (Shiga toxin–producing stains: STEC), and *Salmonella* occurrence in irrigation water over time, based on historic data and data collected as part of this study, at specific locations in Arizona and Southern California. These data were then used to assess the impact of risk events, such as rainfall, water quality factors including temperature and turbidity, canal size, and watershed characteristics (potential sources of fecal contamination), on the occurrence of these organisms. 2) Assess the impact of occurrence, duration and intensity of rainfall events on *E. coli*/*Salmonella* in irrigation waters to determine how long after a specific rainfall event the irrigation water quality will be impacted. 3) Use an exposure scenario risk–based model for *E. coli*/*Salmonella* in irrigation waters to quantify the risks of infection with different sampling frequencies of irrigation waters based on environmental factors (e.g., rainfall), irrigation methods, and type of produce. 4) Develop a cell-phone/computer application (app) that can be used for guidance for frequency of sampling after high-risk (rainfall) events.

General guidelines for water quality sampling for indicator bacteria (*E. coli*) and sampling frequency were finalized by the FDA in late 2015, however, it is not apparent if these guidelines are based on site-specific conditions with quantifiable benefits related to risk reduction. This project was of extreme importance as industry will be working over the next 2 to 4 years to establish water quality monitoring programs in response to the FDA regulations.

Previous research conducted by this team supported the development of a Quantitative Microbial Risk Assessment (QMRA) for irrigation water sources, and methods to determine the relative risk of irrigating leafy greens with various water qualities. The previous research was conducted through the 2011 Specialty Crop Block Grant Program (SCBGP) Project 69: *Assessment of Escherichia Coli as an Indicator of Microbial*

*Quality of Irrigation Waters Use for Produce*. This project built upon that research by looking one step beyond quantifying risk to produce related to irrigation water quality to determine predictive risk factors, both environmental and physical, that impact water quality.

## Project Approach

Over the course of this study, three datasets (based on historic data starting in 2001) were gathered from the field by the principal investigator (PI) and Co-PIs and the student research team from irrigation canals at the Yuma and Maricopa, Arizona and Imperial Valley, California. The datasets have measurements of *E. coli* and coliforms counts per 100 milliliters (ml) of irrigation water and the physical characteristics of the irrigation water. Supplemental datasets included pathogen presence information for some sampling locations and represented *Salmonella*, STEC, and enterococci data. Each region's dataset was analyzed separately to arrive at a regional model for prediction of *E. coli* and coliforms. These results allowed the research team to have significantly better ability to apply correlation statistics to the datasets collected and for use in risk model development. Results of note include the following: Correlation between *E. coli* counts and rainfall amounts occurred on the sampling day. A positive correlation between rainfall amounts occurred on day three and day four prior to the sampling day, possibly due to the travel time for water sources as well as the disturbance of canal sediments that could provide adequate environment for bacterial re-suspension and growth. A significant positive correlation was found among coliform counts, air temperature, solar radiation and heat units. A positive correlation was found between coliform counts and electrical conductivity and between coliform counts and irrigation water temperature.

Using transformed data and associated correlations, the research team was then able to build a set of models (equations) that can be used to predict local water quality conditions related to coliform counts or the presence of *E. coli* bacteria based on physical and environmental data. At the onset of this project the research team anticipated the development of only one model to be available to industry; however, it was determined that multiple models could be produced for users based on data input available as well as confidence level needed.

Overall the team developed a total of 13 models that can be used to predict water quality, based on the user data available to be input for calculation. This report presents the three main models that provide the most straightforward interpretation and with the most appropriate confidence level for the user. These models have been named as follows: 1) complete model (includes both physical and environmental variables for risk calculation), 2) physical model (includes only physical parameters in risk calculation), and 3) environmental model (includes only environmental parameters collected from the Arizona Meteorological Network [AZMET] in risk calculation). Following the development of the water quality risk assessment models, the research team worked with an experienced computer modeler to create a user-friendly application or "App" as the interface to help industry better predict risk-based sampling strategies for irrigation water quality.

To track funds supported by the SCBGP, all purchases were provided a code specifically tied to the SCBGP funds. Additionally, before any purchases were approved, the project PI reviewed and gave final authority that the expenditure was valid and was solely used to enhance the competitiveness of specialty crops.

The Center for Produce Safety (CPS) staff were in constant communication with the industry and the scientists working on this project.

This project could not have been completed without significant contributions of the research team and project partners. The CPS managed the project and the University of Arizona performed the research studies. The Co-PIs all played a significant role in historical data collection, data entry, statistical analysis, and model development. An Assistant in extension helped to coordinate sample collection and verification of new data as well as supervision of supporting students and staff. An Assistant Health Educator played a crucial role in the successful App development and worked closely with the computer modeler and the University of Arizona MobileMatters to ensure all tasks were accomplished on time and with industry in mind. In addition, staff at the Western Center for Food Safety in Davis, California played a significant role in communications with the FDA, validation of user App functions, and evaluation of the developed App.

## Goals and Outcomes Achieved

Stakeholders were surveyed during multiple events in 2015 and 2016 including at the 2015 CPS Annual Research Symposium, the 2016 Desert Collaborative Field Conference, and two times at the Yuma Safe Produce Council monthly meetings in Yuma, Arizona, where participants were given information about risk-based sampling strategies and were provided with resources to aid in the determination of water quality risk. A total of 120 participants were asked whether, after learning about risk-based sample collection protocols and the risk assessment tool, they would change their current practices and modify their sampling protocols from strategies that were used before attending the presentation/workshop. Responses were overwhelmingly positive, with 67 and 82 percent of respondents indicating that they would be willing to change their current sampling protocol and use the risk assessment tool, respectively, to aid in irrigation water quality assessment.

As of January 2017 the team has determined that there have been 606 active users of the risk assessment tool (App) since online user tracking began in August 2016. This result indicates that industry is using the risk assessment tool for the risk-based sample collection protocol at a level that far surpasses the goal of 5 actual users. Over the past 5 months the team has observed a steady increase in the number of new users as well as the page views indicating time spent within the App. The project staff could not closely follow the original expected measurable outcomes and survey the same 10 growers after each presentation to determine whether 50% of those growers changed their sampling protocols. However, online tracking of users of the developed risk assessment tool (App) for the sampling protocol between August 2016 and January 2017 indicated that there have been 606 active users, which far surpasses the original target of 5 growers changing their sampling protocols.

The overall outcome of the project involved activities to integrate the water quality risk prediction model(s) presented above, into a user friendly App for industry. Working with an external computer modeler and App developer the project PI and supporting research team developed both an online application or “web App” as well as a cell phone–based App that is available for download for both iOS and Android devices.

The developed App, called the AgWater App (Attachment, Figure 1), integrates user information related to location of the water source, any available physical water quality data, locally available environmental data in real-time, as well as historical knowledge of the water quality to predict the likelihood of a water quality exceeding current Leafy Green Marketing Agreements (LGMA) or Food Safety Modernization Act (FSMA) standards. Based on the information available, the App automatically selects the most appropriate model (of the 13 created) to determine the likelihood of coliform or *E. coli* bacteria in the water source. Also, during the development of this App the research team was approached by members of the Western Center for Food

Safety and the FDA to incorporate App user functions to help industry calculate their Microbial Water Quality Profile and Statistical Threshold Value as defined by regulations. Due to the finalization of the FDA FSMA in November of 2015, the research team felt that this was an important component to include in the final developed App.

Future work by project PIs and partners beyond the scope of this project will track the progress of industry to integrate risk related principles into water quality monitoring programs and decision making through both formal and informal interactions, including, but not limited to, workshops, conferences, hands-on guides, surveys and personal communication.

The main goals and research objectives established were achieved by the project PIs and research team at the completion of this project. Ongoing work, beyond the scope of this project, will further integrate research products into industry use.

The research findings from this project are going to provide the produce industry with the best strategies for selecting sampling locations, sample volume, and frequency of testing for generic *E. coli* as an indicator of fecal contamination of irrigation waters. Progress towards achieving expected measurable outcomes included work of the PI and co-PIs to track stakeholder needs and communicate findings during outreach events. These outreach events specifically targeted working directly with the leafy greens specialty crop industry to identify a risk-based sampling protocol in order to minimize risk. No such guideline had existed before. The success of the project was measured by interviewing 10 stakeholders at the end of two years project duration to determine if they would be willing to use the risk assessment tools (App) to aid in water quality determination. In final workshops related to this project, of the 40 or more industry members interviewed and/or surveyed, nearly 90% of respondents indicated that they would be willing to use the AgWater App for one or more functions. Additionally, after the review of the data analytics obtained since August 2016 by tracking usage, project staff determined that to date there have been 606 active users of the risk assessment tool (App) and 520 users of the online calculator. This result far surpasses the original goal of 10 stakeholders and indicates that industry is currently following the recommended guidelines by using the risk assessment tool.

Overall, the major successful outcomes of this project support previous work by the project PIs to determine risk related factors that are likely to influence water quality. More specifically, the results of this project have led the team to make a number of recommendations.

First, the data assessment indicated that water quality is highly dependent on localized environmental conditions, and every effort should be made by industry to better understand their water sources through collection of water quality data and historical analysis. Second, scientific data collected and analyzed by the research team indicated that the four main influential factors in the region evaluated were air temperature, solar radiation, rainfall and electrical conductivity. Surprisingly, the ability of a user to input electrical conductivity into developed models greatly increased risk assessment confidence. This lends itself towards the recommendation to industry to include electrical conductivity in routine water quality monitoring plans to increase the likelihood of predicting coliform bacteria and *E. coli* in water sources. Third, currently there is no “one-size fits all” model to predict water quality; however, the development of multiple models allowed for a wider range of users based on available data and location. The team developed a total of 13 models that can be

used to predict water quality, based on the user data available to be input for calculation. The "complete" model developed by the research team, which includes both physical and environmental variables for risk calculation, provides excellent predictions of water quality based on the data available and the region evaluated. Fourth, grower Apps can be useful tools that will allow industry to make more informed decisions about their water sources from both a water use and sampling perspective. And lastly, future work should include testing of additional regional water sources and comparison of water quality data against the developed models (n=13) to validate their use in regions beyond the desert Southwest.

## Beneficiaries

The primary beneficiaries of this project included but are not limited to the following: fresh produce industry, food safety professionals, research scientists, U.S. Environmental Protection Agency, California and Arizona LGMAs, United States FDA and the FSMA, Yuma Safe Produce Council, irrigation districts in the Southwest, and commercial testing labs. Of particular interest to the groups mentioned above would be the water quality risk assessment—the AgWater App. This output built on previous research using real time environmental data and applying it to current regulatory guidelines for irrigation waters used for produce. This research built on the expertise in extension and contributed to a growing body of knowledge related to food safety and water quality research. To date, numerous studies have been conducted evaluating the potential for water to act as a source of enteric pathogens during crop production. In past studies funded by CPS and the Arizona Department of Agriculture, the team collected data that demonstrate varying levels of *E. coli* and the common occurrence of the human pathogens (e.g., *Salmonella* spp.) in canal waters used to irrigate fresh produce during canal maintenance events. The team's additional work on developing risk assessment tools and grower Apps shed light on physical and environmental factors that are likely to influence water quality, and was specifically focused on how food safety professionals can assess their operation to determine if and when water quality may be of concern. This work was critically important as it provides tools that stakeholders can use to best assess, and ultimately make food safety decisions in their operations.

Results from this project directly enhance the competitiveness of specialty crops, as this research and its outcomes showcased local stakeholders and their commitment to food safety. More importantly, this work demonstrated the active engagement between Arizona and California growers and the research and extension communities, working together to find tools and solutions to maintain produce safety. The research and extension team was fortunate to partner with stakeholders across Arizona and California who not only saw the benefits of understanding water quality in their region but also fully comprehended the long-term impact it will play on produce productivity and marketability.

According to the most recent (2012) Census of Agriculture there are 42,729 farms of produce crop growers representing $23.9 billion in sales in the state of California (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/California/. ); in addition, there are 2,716 farms of produce crop growers in Arizona, representing $764 million in sales (http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Rankings_of_Market_Value/Arizona/ ).

## Lessons Learned

As a result of the work on this project, the team was approached to participate in broader research and extension projects related to water quality that would directly benefit the local industry and enhance the competitiveness of the leafy green specialty crop industry. This includes support from the CPS, Western Growers, Washington State Tree Fruit Association, U.S. Department of Agriculture, and additional funding

from the Arizona Department of Agriculture. The project staff are now able to say that they have a "team" of Arizona researchers and extension specialists working together to solve problems for local industry related to food safety. The SCBGP project has been critical to the success of these efforts.

A positive outcome of this and the past CPS projects was the leveraging of the team's food safety expertise and knowledge in the Yuma and Maricopa regions to acquire additional funding from partners in Arizona and California. The addition of Research Specialist was especially beneficial for the research team as it helped tremendously to determine concerns of the produce industry in the Southwest.

As stated above, the initial intention of the research team was to develop one risk assessment model for industry to use to predict water quality in their region. However, after extensive evaluation of the available data, the team developed a total of 13 models that can be used to predict water quality based on the user data. This allowed for the broadest use of risk assessment information that provides industry with the most straightforward water quality interpretation while maintaining the confidence level needed.

Also, after reviewing the historical data, the research team determined that there wasn't enough pathogen data collected to make accurate correlations and/or much of the data were not quantitative (e.g., *Salmonella* data were presence/absence data only) and thus could not be used in ultimate model development.

At the onset of this project, the project team understood that the research goals and objectives were extremely ambitious to accomplish within a two-year time frame. While the work has been completed and the research team is very confident and proud of the resulting research and extension products, it would have been appropriate to build in some additional support to test the developed industry products at a larger scale after completion of the project.

As the AgWater App is used in the future, it is highly likely that revisions will be needed to strengthen its use and to broaden its application beyond the initial test case of the Southwest. Currently, there is no mechanism to update this application as the grant has now closed. In the future, it would be advisable to have a separate set of limited funds that may be applied for in order to meet the needs of such a project that is separate from its main research call for proposals.

## Additional Information

See Attachment for AgWater App.

The following links are for the online calculator and Native/Web App (AgWater). The AgWater App was designed to aid in determining compliance with national FSMA regulations and LGMA recommendations as well as predict the likelihood of microbial contamination based on local environmental conditions.

- Online Calculator: http://agwater.arizona.edu/onlinecalc/
- Native/Web App: http://agwater.arizona.edu/

Presentations – the project PI gave presentations on the project status and research results:

- Oral presentation at the 2015 University of Arizona Desert Collaborative Field Conference, a collaborative effort of University of Arizona Specialists, scientists and local industry; March 31, Yuma, Arizona.

- Poster presentation at the annual Hartnell College Western Food Safety Summit; May 7-8, Salinas, California.
- Invited speaker at local Yuma Safe Produce Council monthly meeting and Water Sampling 101 training; May 20, 2015.
- Oral presentation at the 2015 CPS Produce Research Symposium; June 23, Atlanta, Georgia.
- Oral presentation, along with Assistant Health Educator, at a 2015 industry-testing event with the Yuma Safe Produce Council; November 12, Yuma, Arizona.
- Invited speaker at the Washington State Tree Fruit Association 2015 Annual meeting; December 9, Yakima, Washington.
- Invited speaker at Desert Produce Safety Collaborative 2016 Field Conference; January 12, Yuma, Arizona.
- Hands-on workshop and industry-testing event with Assistant Health Educator at the 2016 Yuma Safe Produce Council; February 3, Yuma, Arizona.
- Oral presentation at the 2016 Southwest Ag Summit; February 26, Yuma, Arizona.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 65 | **Project Title:** Farm to Fork Specialty Crop Database Phase 2 | |
|---|---|---|
| **Grant Recipient:** California Department of Food and Agriculture | **Grant Agreement No.:** SCB13065 | **Date Submitted:** December 2016 |
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## Project Summary

The California Department of Food and Agriculture (CDFA) Office of Farm to Fork sought to create and publish a comprehensive database of specialty crop growers on the Farm to Fork website to be made available to food service institutions, community organizations, and consumers. The increased availability of this data benefits specialty crop growers by providing access to new and non-traditional markets for their produce, increasing their sales potential and enhancing the overall competitiveness of California-grown specialty crops.

Currently, a variety of state agencies, local governments, and community organizations are participating in programs which encourage consumers and large food service institutions to be aware of and purchase from local specialty crop growers in their area. In most cases however, these programs suffer from disjointed coordination and are operating in silos—achieving marginal results in regional food access at the local level. In addition, large food service institutions, consumers and specialty crop growers also face barriers establishing sales relationships. These barriers include: proficient understanding of institutional procedures, local environmental health regulations, price points, transportation logistics, and lack of awareness of specialty crop availability, both geographically and seasonally. Additionally, the U.S. Department of Agriculture's Farm to School census notes that on average, only 30% of California school district food budgets were spent on local food. This figure is only reflective of the 15% of California school districts that had information to respond to the survey. This is indicative of the lack of knowledge and resources available to School Food Authorities and School Food Service Directors about local specialty crops.

The Office of Farm to Fork, working in collaboration with the California Department of Education (CDE), community organizations, and specialty crop growers, developed a comprehensive database to be accessed on the Farm to Fork website. The creation of this database and its publication on the centralized, user-friendly Farm to Fork website with pertinent information (geographic location, types and seasonality of local specialty crops, processing capabilities, GAP/ GHP certifications, and liability insurance) allows specialty crop growers, food service institutions, and public consumers to forge new partnerships. Through these newly established sales relationships, specialty crop growers can now sell directly to food service institutions, and food service institutions (particularly School Food Authorities) can purchase locally-grown, seasonal fruits and vegetables directly from specialty crop growers, with the ultimate effects being increased food access and enhanced competitiveness of California-grown specialty crops.

The Database Phase 2 portion of the overall project was to fine tune the California Farmer Marketplace (CFM). Various feedback features enabled users to contact the CFM by using the "Contact Us" and "Help Us Improve" buttons on the site as well as a "Help Us Improve" popup prompted when users log out. From this feedback the CFM was adjusted to better suit users, solicit new growers outside the pilot counties, as well as answer and address any questions or comments that came through the feedback mechanisms.

There are over 400 specialty crops growing in California and over 4 million school breakfasts, lunches, after school snacks and suppers served in California every school day, as part of the United States Department of Agriculture's (USDA) school meal programs. Connecting specialty crop growers and food service institutions will facilitate the purchase of California specialty crops to be featured in schools. The specialty crop growers, the school food service directors that are trying to get more local, fresh specialty crops in California schools, and the children who consume those local, fresh specialty crops will benefit from this project. Eating locally and including specialty crops into school meals supports the direct connection between the farm and the consumer, and improves product gross margins and farm profitability as well as minimizing operational risk by establishing long-term customer relationships. Making improvements to the CFM enables greater ease of use and increases the likelihood that farmers and School Food Authorities will continue to use the site and recommend it to others, building the user base. Additionally by featuring more specialty crops in school lunches, growers and food service directors can inspire life-long consumers of California specialty crops.

This project builds on 2010 Specialty Crop Block Grant Program (SCBGP) Project 75: *Farm to Fork Website Development – Phase I*, and the 2012 SCBGP Project 70: *Farm to Fork Specialty Crop Database Phase 1*. Project 75 focused on the development of the Farm to Fork Website which created a platform to share innovative information and best practices. Project 70 launched a pilot of a database of specialty crop growers to complement the results of Project 75. This Project further developed and refined the database in response to usability testing as well as specific feedback from users.

## Project Approach

The Office of Farm to Fork seeks to facilitate interactions between growers, food service institutions (particularly schools) and community organizations through an easy-to-use database, connecting schools and other consumers directly with local farmers who produce and sell California specialty crops. In Phase 1 of the project, staff worked with key stakeholders to determine the most user-friendly platform for the database as well as information it should contain. Specific surveys of registered users as well as general feedback were used to make improvements to the website. In Phase 2, feedback has continued to be collected from the CFM using the "Contact Us" and "Help Us Improve" buttons on the site as well as a "Help Us Improve" popup prompted when users log out. From this feedback the CFM was adjusted to better suit users. For example, a major feature that has been added is a "Distance from Me" filter. This allows schools and other institutions to search for farmers closest to them, as many organizations specify that foods need to travel a certain distance, i.e. come from less than 100 miles of their facility. This same feature is in the farmer/ producers view, so farmers can reach out to the nearest institutions interested in what they produce. Hyperlinks were also created for the items listed under "Recently Added Commodities" on the CFM homepage. This allows schools to quickly compare seasonal produce, who is offering this particular commodity, their price, distance, etc. Additionally staff added hyperlinks to farmers/producers when a consumer searches by a particular commodity. This way they can directly pull up the description of the farm and see if they would be a good fit or if another farm would work better for their needs. Descriptions for the various features on the CFM were also added for both the producer and consumer view. An example of this is the "inquiries" button for producers. It provides a visually descriptive button of an envelope with a letter in it, with a description along the side stating "View all Inquiries allows you to see past inquiries sent to you from consumers/businesses and the various communications that could have stemmed from that. This feature helps you keep track of who has reached out and contacted you and who you still need to respond to."

The Office of Farm to Fork has publicized the CFM to both consumers as well as specialty crop growers through several key outreach efforts. On March 11, 2016 the CDE sent out an email to all California Child Nutrition Service Directors in the state, reaching approximately 1,000 school districts, informing them of the CFM and the features it includes as well as how to sign up. On March 14, 2016 the Office of Farm to Fork reached out to all of the farmers/producers signed up on the CFM, at the time totaling 48, to let them know of the email CDE sent out, to encourage them to update their current offerings. The CFM was also publicized at various conferences. The CFM was presented in a session given at the SNAP-Ed Conference on January 14, 2016 to a group of 300 people. The CFM was also highlighted at the California Small Farm Conference in Sacramento March 5-8 2016, through a booth as well as an offsite field course. The booth utilized a computer tablet, allowing specialty crop farmers in attendance to sign up for the CFM with staff assistance. The offsite tour had current and aspiring specialty crop farmers in attendance who learned about innovative ways of connecting with traditional markets and institutions, one of which was through the CFM. The CFM was also publicized through a booth at the California Agricultural Day on March 16, 2016 where students from Natomas Unified School District (a current CFM user) promoted seasonal fruits and vegetables through a fresh salsa they had made. On April 19, 2016, the Office of Farm to Fork presented the CFM to attendees at the California WIC Association Conference in San Diego, which had over 900 people in attendance. The CFM was also presented in a keynote address to the Sacramento Regional Farm to School Network meeting on May 18, 2016.

The Office of Farm to Fork secured matching funds to support non-specialty crop commodities listed on the site. Because of minimal data available, the Office of Farm to Fork proposed using a roughly 60/40 split (specialty crop/non-specialty crop) in the initial grant proposal. This “known target threshold” is based on the farm gate value of specialty crops vs. non-specialty crops in California (60% of the state’s farm gate sales come from specialty crops as indicated in the CDFA’s California Agriculture Statistics Review, 2013, with non-specialty crops making up the remaining 40%). Based on registered site users, specialty crops producers represent 91.2% of users registered as producers (only 5 users out of 57 produce non-specialty crops). Since only 8.8% of producers registered on the CFM offer non-specialty crop products, staff recommend the matching funds reflect this. Therefore staff only requested $3,390.73 in matching funds to cover the portion of the CFM that represents non-specialty crops. This is a more conservative number then by looking at the individual specialty crops listed (42) compared to non-specialty crops (4), which would only represent 8.69% of goods offered on the marketplace. The following specialty crops were listed: Arugula, Basil, Cardoons, Chard, Cucumbers, Eggplant, Plums, Tomatoes, Pumpkins, Jujubes, Eggplant, Onions, Rosemary, Potatoes, Avocados, Lemons, Persimmons, Beets, Carrots, Apples, Bell Peppers, Grapefruit, Grapes, Jicama, Kiwis, Pears, Radishes, Summer Squash, Winter Squash, Turnips, Watermelons, Zucchini, Lettuce, Raisin, Walnuts, Oranges, Olives, Cherries, and Honey. Non-specialty crop commodities include: Eggs, Chicken, Pork and Beef. The Office continuously monitors the site to ensure specialty crops always represent 60 % or more of the items posted.

Project staff have reached out to farmers and school food service professionals to update the site based on their feedback. The contributions from users, farmers and School Food Authorities have been essential to making improvements to the CFM usability. The Office of Farm to Fork also worked with CDE to conduct outreach to school food service directors, which was accomplished on March 11, 2016.

## Goals and Outcomes Achieved

The Office of Farm to Fork publicized the CFM to both consumers as well as specialty crop growers through several outreach events. These activities were done in order to achieve the performance goals of a 10% increase in unique page views, having at least 25 school districts in at least 10 different counties signed up on the CFM, and having a 5% increase in average school food budget in registered counties spent on California specialty crops.

A press release publicizing the CFM was issued in July 2015 by the CDFA and was sent to approximately 500 contacts connected to the Office of Farm to Fork, including individuals working in schools, affiliated non-profits, community groups, and supporting governmental organizations. The release was re-publicized by the Almond Board, Imperial News, CDFA Planting Seeds blog, Pacific Coast Farmers Market newsletter, and Ag Alert. The CFM was also publicized through a poster at the Childhood Obesity Conference held June 29-July 4, 2015 in San Diego, California to an audience of over 2,000 individual educators, researchers, and healthcare professionals in attendance. Handouts were distributed at the Sacramento Farm to Fork Festival in September 2015 to event attendees with information describing the CFM. On March 11, 2016 the CDE sent out an email campaign to all California Child Nutrition Service Directors in the state, reaching approximately 1,000 school districts. On March 14, 2016 the CFM reached out to all of the farmers/producers signed up on the CFM, at the time totaling 48, to let them know of the email CDE sent out, to encourage them to update their current offerings. The CFM was publicized at the SNAP-Ed Conference on January 14, 2016 to a group of approximately 300 people. The CFM was highlighted at the California Small Farm Conference in Sacramento March 5-8 2016, through a booth as well as an offsite field course. The booth had a tablet to allow those in attendance to sign up for the CFM on the spot. The offsite tour had current and aspiring specialty crop farmers in attendance who learned about innovative ways of connecting with traditional markets and institutions, one which was through the CFM. The CFM was also publicized through a booth at California Agricultural Day on March 16, 2016 where students from Natomas USD (a current CFM user) promoted seasonal fruits and vegetables through a fresh salsa they had made. On April 19, 2016 the Office of Farm to Fork presented the CFM to attendees at the California WIC Association Conference in San Diego, which had over 900 people in attendance. The CFM was also presented in a keynote address to the Sacramento Regional Farm to School Network meeting on May 18, 2016.

Staff have also continued to engage with the original pilot school districts School Food Authorities who are leaders in the California farm to school movement. Other food service directors looking to incorporate more locally grown food into their cafeteria often consult with them to determine best practices. The increase in CFM signups can also be attributed, in part, to word of mouth marketing by these individuals.

Though staff did not specifically have any long term measures for this grant, they plan on continuing to promote the CFM to schools and farmers and work toward a greater percentage of school food purchases coming from California specialty crop farmers through the CFM.

The overall goal of the project was to increase access to, and awareness of, specialty crops for food service institutions and local community organizations. Benchmark data was set at registering 25 districts in at least 10 different counties by June 2016. Staff have far exceeded that goal and have had 58 school districts signed up in 33 different counties, as well as a handful of charter schools, preschools, Head Start programs, senior resource centers, and colleges. A total of 57 farmers/producers have registered, ranging from small to large and representing a variety of commodities.

Part of bringing awareness to specialty crops is helping to direct producers and buyers to the CFM. One of the outcomes was to have a 10% increase in unique page views from the 2013 monthly average. In the progress reports staff reported that the website analytics were improperly set up for the initial launch of the site so there is no benchmark data captured for the initial launch. The problem was corrected in October 2015, so the Office of Farm to Fork used the November and December views as a benchmark. Comparing the 2015 monthly average of 619 unique page views to the 2016 monthly average of 829 views, shows an increase of 33.9%, exceeding the goal of 10%.

Another outcome of the project was to see a 5% increase in average school food budget spent on California's specialty crop food dollars by the end of Phase 2 using 2013 and 2015 USDA Farm to School Census (USDA F2SC) Data.

According to the 2013 USDA F2SC (school year 2011/2012), of the 625 districts that responded to the census, 353 districts in California (representing 2,626 schools) were participating in Farm to School activities and spent 11.2% of their food dollars locally, excluding local milk purchases. If the 60/40 split of specialty crop/non-specialty crop proposed above was used, that would mean approximately 6.7% of participating schools' total spending was on local specialty crops in 2013.

The 2015 USDA F2SC (school year 2013/2014) indicates that out of the 679 school districts that completed the census, 373 districts in California (representing 5,498 schools) were participating in Farm to School activities and spent approximately 4.9% of their budget on local products, excluding milk. Applying the 60/40 split again indicates that 2.9% of the total budget was spent on specialty crops in 2015. Although this appears to indicate a decrease in local specialty crop spending, the increase from 2,626 to 5,498 of individual schools these districts are serving needs to be considered.

In 2013, the total cost of local food excluding milk spent by districts that completed the census was $30,804,130. Assuming the 60/40 ratio, this would indicate that $18,482,478 of school budget funds were spent on specialty crops. In data collected in 2015 the amount spent on specialty crops had risen to $33,997,616, an 84% increase between the two reports, which indicates a strong trend of improved interest and money spent towards increasing the average school fund budgets spent on California specialty crops.

The five school districts that were signed up on the CFM and reported values on local purchases for the 2013 and 2015 USDA F2SC were consistent with the response of other school districts in the census. There was an overall increase in local purchases, excluding milk, of 1.33% overall. If the one outlier who reported spending 20% of food dollars on local purchases was excluded, in the 2011-2012 school year to just 1.3% in 2013-2014 school year there would be an average of 4.65% increase, translating to a 2.8% increase in local specialty crop purchases. Though staff did not achieve the goal of 5% increase on local specialty crop purchases, the schools spend more money overall on California specialty crops, which shows the positive effectiveness of the CFM. Although the time period of data collected in the two census data sets were prior to the launch of the CFM, staff are confident the tool will allow schools to build on the trend of increasing budgets allocated to local food and alleviating barriers they may face regarding their ability to find growers. The Office of Farm to Fork look forward to the next census cycle in order to evaluate the data and validate the full positive impact of the CFM.

| Activities | Performance Indicator | Baseline Data | Actually Accomplished |
|---|---|---|---|
| Track website usage | 10% increase in unique page views from 2013 monthly average | 619 average views in 2015 | 33.9% increase in unique page views from 2015 to June 2016 |
| Evaluate database performance | Improvement from 2013 USDA Farm to School Census data—5% increase in average school food budget in the registered counties spent on California's specialty crops | 2013 USDA F2SC-10.05% spent on specialty crops*<br><br>2015 USDA F2SC-12.84% spent on specialty crops* | Improvement from 2013 USDA F2SC data—2.8% increase in average school food budget in the registered counties spent on California's specialty crops* |
| Publicize website to consumers, focusing on school food authorities and other institutional consumers | In Phase 2, at least 25 school districts in at least 10 different counties will be registered on the database by the end of June 2016. | 8 school districts in 6 different counties were registered by the end of September 2015. | 58 school districts in 33 different counties were registered on the database by the end of June 2016. |

*Excluding outlier Hueneme Elementary School District, which experienced a nearly 19% change in local purchases, excluding milk, from 2011-2012 school year to 2013-2014 school year. The next largest percent change was 12% at Moorpark Union School District.

## Beneficiaries

This project benefits specialty crop growers, food service institutions that handle specialty crops and those that the institutions serve. The CFM facilitated connections between specialty crop growers and food service institutions that will contribute to the long-term sustainability and growth of specialty crop endeavors throughout California. The CFM provides a new market for many specialty crop farmers, more direct purchasing for schools and healthy food for children in California schools.

There are over 400 specialty crops growing in California and over 4 million school breakfasts, lunches, after school snacks and suppers served in California every school day, as part of the USDA's school meal programs. Connecting specialty crop growers and food service institutions will facilitate the purchase of California specialty crops to be featured in schools. The specialty crop growers, the school food service directors that are trying to get more local, fresh specialty crops in California schools, and the children who consume those local, fresh specialty crops will benefit. Eating locally and including specialty crops into school meals supports the direct connection between the farm and the consumer, and improves product gross margins and farm profitability as well as minimizing operational risk by establishing long-term customer relationships. Additionally, by featuring more specialty crops in school lunches, growers and food service directors can inspire life-long consumers of California specialty crops.

## Lessons Learned

Targeted marketing and promotion of the CFM was more effective than the email campaign to over 10,000 farmers. It was more impactful to approach parties that were already engaged and/or interested in farm to school activities, as they were more likely to sign up and utilize the CFM as a resource. Staff accomplished this with speaking opportunities, booths at conferences, as well as targeted press releases.

One unexpected outcome was having over twice as many school districts sign up in three times the number of different counties than was the original goal. This shows that there is a strong desire on the side of school districts to have a resource like the CFM to be able to reach out to local farms and reinforces the need for such a site. Another unexpected outcome was not achieving the goal of a 5% increase in average school food budget in the registered counties spent on California's specialty crops. Though staff did see an improvement, the 5% increase was not obtained.

One of the goals that was not achieved was observing an improvement from the 2013 USDA F2SC data. Staff had hoped to see a 5% increase in average school food budget in the registered counties spent on California's specialty crops. Staff observed a 2.8% increase in those schools that were both signed up on the CFM and also responded to all of the relevant questions in the USDA F2SC for both the 2013 and 2015 report. One of the issues was that there were only 5 schools that fit that description, as many schools left large portions of the survey questions blank. With such a small number of schools completing the survey in its entirety, there is uncertainty in the number reported. If staff were to do it again, and if there were the funding, staff would have conducted their own, specific questionnaire to schools to get the exact numbers. This would have required significantly more time and money and would not have been feasible given the scope of this grant.

## Additional Information

Website of the CFM: http://cafarmermarketplace.com/.
The blog, Tales from the Field: http://blogs.cdfa.ca.gov/TalesFromTheField/.
Other photographs that might not have been included in blog posts are provided below.

Booth at Small Farm Conference, which provided attendees the opportunity to sign up on the California Farmer Marketplace on the spot.

Students from Natomas Unified School District at Ag Day serving samples of salsa from local produce. CFM adverting was on display in the background, as well as postcard handouts on the table for more information.

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 66 | **Project Title:** Climate-Smart Agriculture for Specialty Crops – Partnership with the Netherlands and Israel | |
|---|---|---|
| **Grant Recipient:** California Department of Food and Agriculture | **Grant Agreement No.:** SC13066 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Josh Eddy | **Telephone:** (916) 654-0462 | **Email:** josh.eddy@cdfa.ca.gov |

## Project Summary

This project was created to help further the application of climate-smart technologies, methodologies, and management practices within the California specialty crop sector. Climate change is a specific issue that impacts agricultural production on a global basis. In California, the impacts correlate with periods of drought, flood, reduced snowpack accumulation, and lessening of natural groundwater recharge.

By leading delegations to the Netherlands and Israel, the California Department of Food and Agriculture (CDFA) provided specialty crop stakeholders the opportunity to develop strategies that enable California farmers to adapt to climate change and reduce greenhouse gas emissions. During the visits, participants were introduced to a variety of technologies and management practices that could be incorporated within California. These practices included, but were not limited to: irrigation technologies; recycled water use for food production, water management techniques, saline agricultural production, substrate production, root breeding technologies, and sustainable greenhouse technology. Each of these focuses can directly improve the production and market competiveness of California's specialty crop sector.

The project was important and timely for several reasons. California continues to suffer from a significant ongoing four-year drought which is impacting growing practices related to specialty crops. The prolonged drought limits surface water availability and is depleting groundwater resources. Climate-smart agricultural technologies and management practices related to irrigation are critical in assisting growers in adapting to changing conditions. Further, reduced natural groundwater recharge, as a part of the ongoing drought, necessitates the need for specialty crop growers to improve on-farm recharge projects maintaining groundwater basin supplies for future use.

This project did not build on a previously funded Specialty Crop Block Grant Program project.

## Project Approach

The project consisted of two climate-smart agricultural delegations (Israel and the Netherlands) and associated activities connected to each individual trip.

For the Netherlands, the work plan consisted of three key phases (planning, implementation, and follow-up). During the planning phase, elements of the agricultural trip were designed and participants were selected to maximize the exposure and potential for dissemination of learned practices and technologies to specialty crop stakeholders. Pre-trip meetings were held with delegation members to get feedback on proposed schedule and to outline purpose of the trip as well as objectives and goals.

During the implementation phase, the delegation program was facilitated by the project directors and their collaborators in the Netherlands. As a result of the planning phase the following accomplishments were achieved – number of participants: 13; number of site visits: 8; number of business/government/academic meetings: 11; and number of climate smart technologies/practices observed: 6. As a result of the implementation phase, delegation participants made initial contacts for follow-up with more than 50 individuals connected to climate-smart technologies, policy, research and on-farm practices. The program provided a strong foundation for future collaboration between individuals to assist California specialty crop growers in adapting to a changing climate. A concluding meeting of the project participants was held the last day of the trip to help prioritize future outreach and educational components.

During the follow-up phase several activities were designed to provide further outreach and education on climate-smart agriculture. Among these activities were a climate smart agricultural website and webinar for specialty crop stakeholders. Both activities were conducted in collaboration with partners in the Netherlands and resulted in delays for program implementation. The first climate smart agricultural webinar was hosted in July focusing on saline agriculture – growing specialty crops with saline conditions. The webinar had 100 attendees and is hosted on CDFA's website for additional viewership (https://www.cdfa.ca.gov/climatesmartag/).

For the Israeli program, the work plan was very similar to that of the Netherlands and contained the same three phases (planning, implementation and follow-up). During the planning phase, CDFA worked with the consultants to create an in-country itinerary targeting project objectives. Pre-trip meetings were held with delegation members and contractors to elicit feedback and provide an overview of the program and project goals/objectives.

During the implementation phase, the program was facilitated by the project directors, in partnership with the consultants. As a result of the planning phase, the following accomplishments were achieved: number of participants: 16; number of site visits: 4; number of business/government/academic meetings: 10; and number of climate smart technologies/practices observed: 4. As a result of the implementation phase, delegation participants made initial contacts for follow-up with more than 70 individuals connected to climate-smart technologies, policy, research and on-farm practices. A concluding meeting of the project participants was held the last day of the trip to help prioritize future outreach and educational components.

The follow-up phase of the Israeli program included a climate smart agricultural webinar, hosted in November focusing on recycled water us for specialty crops. The webinar had 82 attendees and is hosted on CDFA's website for additional viewership (https://www.cdfa.ca.gov/climatesmartag/). Further information is still being compiled to assist in climate smart agriculture website development.

The project was focused specifically on specialty crops.

Project partners for this program included:

- CDFA's Office of Climate and Innovation - assisted in program planning, webinar design and development of the Climate Smart Agriculture website (in progress).
- CDFA's Information Technology - assisted with website design and facilitated webinar.

- CDFA's Office of Public Affairs - assisted with program outreach and follow-up, specifically through social media postings, videos and performance measure tracking.
- Consultants - led program development/implementation with the subcontractor; facilitated all in-country logistics for program implementation for the Israeli program.
- The Government of the Netherlands - assisted in program development for the Netherlands trip and facilitated all in-country programing in collaboration with CDFA.

## Goals and Outcomes Achieved

Performance goals and measurable outcomes identified in the project focused on the development of a post-mission webinar on climate-smart agriculture and a follow-up survey to gauge the number of growers/producers that gained knowledge about the science-based tools through outreach and education programs.

The first climate smart agricultural webinar was a follow-up to the Netherlands trip and occurred in July 2016. The webinar was on the challenges and opportunities of saline agriculture – a focus on specialty crops. Additional webinars are planned with Netherlands climate partners in 2017.

The second climate smart agricultural webinar was follow-up to the Israeli trip and occurred in November 2016. This webinar focused on the use of recycled water on specialty crop production. Additional webinars are also planned with Israel for 2017.

The project has resulted in an ongoing climate smart agriculture webinar series that links target experts and technologies with delegation participants to provide outreach to California farmers and ranchers. The goal of this project remains to further the application of climate-smart technologies, methodologies and management practices within the California specialty crop sector.

Deliverables (webinars) of the project are both short and long term. The short term deliverable associated with the Netherlands trip were completed in July 2016 within the project time period. The short term deliverable, associated with the Israeli trip, occurred in November 2016.

Additional webinars in 2017 are planned with both Israeli and Netherlands climate exceeding the outlined performance activities of the project.

The measurable defined outcome for this project was to enhance the competitiveness of specialty crops through more sustainable, diverse and resilient specialty crop systems. This was achieved through outreach and educational programing.

Social Media Engagement: 11 blog posts with viewership of more than 4,500; 3 videos with viewership of more than 450.

Webinars: The webinars targeted an audience of 200 individuals. The Netherlands webinar included 100 participants (webinar space limited by technology constraint) and the Israeli webinar included 82 individuals.

As part of the long term deliverables, the project is on course to meet the measurable outcomes identified in the project.

The baseline indicator for this project was an online survey, evaluating progress of those individuals who viewed the webinars.

Survey questions for webinar participants included: 1) Did the program enhance your understanding of climate-smart agriculture practices/technologies associated with specialty crops? 2) Do you see your organization adopting climate –smart agricultural practices/technologies for specialty crops in the next 3-5 years? 3) What value will adopting climate-smart agricultural practices/technologies provide you as a specialty crop grower?

Baseline results of the initial survey fell below a 10 percent participation rate. Among those that participated in the survey, 100 percent of the responses were achieved for questions 1 and 2. Values of adopting climate smart agriculture practices were listed as water conservation/savings and adjusting to salinity levels.

Baseline information will also be collected following subsequent climate smart webinars in 2017.

In quantifiable terms related to project outcomes, more than 5,000 individuals were engaged with climate smart agricultural activities associated with the delegations to Israel and the Netherlands. The outreach and education included not only social media and videos, but a technical webinar on observed technologies and on-farm practices directly related to specialty crops.

In addition, more than 125 farmers, academic and governmental contacts were made as result of the missions. These contacts will further the goals of the project through ongoing collaboration. Combined, the missions included 24 external specialty crop stakeholders representing agricultural organizations, commodity groups, academic organizations and government representatives. The dissemination of information on climate smart practices by these external stakeholders will have strong qualitative benefits to California's specialty crop sector.

## Beneficiaries

This project provided 24 California farm organizations, academia and other agricultural stakeholders information on climate-smart agricultural technologies, methodologies and management practices that can then be shared with their specialty crop membership. Information will also be shared on a statewide basis by CDFA through outreach and website availability.

As a result, the beneficiaries of this project are the specialty crop growers in the state, approximately 45,646 farms producing on more than 4,338,625 acres. This project provided information on climate-smart technologies and practices to farm organizations and specialty crop growers allowing for potential on-farm implementation and greenhouse gas reductions. The projects webinar series and website are available online for all stakeholders to access.

## Lessons Learned

The Climate Smart Agriculture policy missions and associated webinars provide a strong forum to better understand and disseminate technologies and on-farm practices associated with climate change focusing on

specialty crops. In continuing this adaptation of technologies and practices, future emphasis should be placed on establishing demonstration projects with university sponsorship allowing first-hand observations and on-farm testing of applicability.

Among the conclusions for the project is that there are several opportunities for international partnerships in the areas of saline agriculture, root breeding, irrigation technologies/practices, recycled water use for food production, water management, substrate farming and sustainable greenhouse production. The policy missions provided a strong foundation for specialty crop stakeholders to further international collaboration on and dissemination of climate smart technologies and practices within the specialty crop sector.

An unexpected outcome from the project is the continuation of the climate smart agricultural webinar series to be held in collaboration with international partners. Future webinars are planned to include perspectives from Israel, Netherlands, Mexico and Vietnam. Interest among specialty crop stakeholders in regards to climate smart practices that address drought and salinity issues remains very high.

Initial outcome measures were achieved and long term outcomes are also anticipated to meet to projections. These outcomes will help to establish baseline indicators for future work addressing climate smart agricultural practices and technologies.

## Additional Information

Information on California's Climate Smart Agriculture webinars is available at:
www.cdfa.ca.gov/climatesmartag

Blog posting from the California Climate Smart Agriculture Policy Missions are available at:
http://plantingseedsblog.cdfa.ca.gov/wordpress/

Attachements:
Itinerary – Climate Smart Agricultural Policy Mission (Netherlands)
Delegation Profile – (Netherlands)
Itinerary – Climate Smart Agricultural Policy Mission (Israel)
Delegation Profile – (Israel)

# CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE
## SPECIALTY CROP BLOCK GRANT PROGRAM
### FINAL PERFORMANCE REPORT

| **USDA Project No.:** 67 | **Project Title:** Monitoring for Glyphosate in Specialty Crop Produce | |
|---|---|---|
| **Grant Recipient:** California Department of Food and Agriculture | **Grant Agreement No.:** SCB13067 | **Date Submitted:** December 2016 |
| **Recipient Contact:** Tiffany Tu | **Telephone:** (916) 228-6830 | **Email:** Tiffany.tu@cdfa.ca.gov |

## Project Summary

Roundup weed killer (or Glyphosate) is sprayed over millions of acres of food crops and on lawns across the world. Recently, there have been numerous reports that the chemical has been found in the food people consume. A report from the World Health Organization (WHO) referenced many studies suggesting that Glyphosate may cause cancer. These reports have prompted concern among various environmental and consumers protection groups. There has not been any monitoring of this widely used chemical on produce in California. The goal of this project is to demonstrate that California specialty crops conform to EPA established tolerance for Glyphosate. Historical data results clearly demonstrate the safety of California grown produce and this project will enhance the competitiveness of California's specialty crops by evincing that Glyphosate is not present at greater than established tolerance levels. The plan is for the partner, California Department of Pesticide Regulation (CDPR) to collect produce in the channels of trade and deliver them to the California Department of Food and Agriculture (CDFA), Center for Analytical Chemistry (CAC), Pesticide Residue (PR) laboratory for analysis. The project will begin with four commodities (sweet corn, carrots, spinach and green beans) and a total of 300 samples. The number of commodities and samples might increase subsequently.

The PR laboratories monitor for agro-chemicals in specialty crops to ensure their safety and to prevent potential pesticides misuse. The WHO report suggested that Glyphosate may cause cancer which incited concerns among various consumer protection groups. Supplying the lab with new equipment allows the analysis of this important chemical. The project will monitor for and collect data on Glyphosate in produce to show the safety of California grown produce and to protect California consumers. These endeavors enhance the competitiveness of California's specialty crops. Additionally, this is the first large scale project of its kind in California. Data from the project can potentially benefit the risk assessment process of Glyphosate.

This project uses similar instrumentation as the 2012 Specialty Crop Block Grant Program (SCBGP) Project 73: *Improving the Capability of Specialty Crop Pesticide Residue Analysis* in which the Anaheim PR laboratory purchased a Quantiva LCMS system. The PR program was successful in expanding the monitoring capability to screen for 60 more chemicals, many of which are the foreign chemicals being used overseas on specialty crops. The equipment for the current project will not duplicate the efforts of the 2012 SCBGP Project 73, as this equipment will be dedicated solely for the Glyphosate testing because of the different accessories associated with the analysis. This project will complement previous project's effort in screening specialty crop produce for harmful agrochemicals.

## Project Approach

To conduct Glyphosate testing on specialty crop produce, the PR laboratory requires a grinder to effectively homogenize fruits and vegetables, a centrifuge to extract the chemical from produce, a pressure manifold for samples clean-up, a tube writer to label test tubes, a Quantiva LiquidChromatograph- Mass Spectrometer

(LCMS) as the primary detection system and laboratory supplies essential to testing. The project officially began in July 2016, before the arrival of the major instrument. It was necessary that the PR staff use equipment from a different program to start the method development and validation. To date, most of the equipment has arrived and is being put to use for the project; the Quantiva LC-MS has been installed and is being validated for use currently. Analysis is still being conducted on the loaned instrument. During a four month period from July to November 2016, a total of 132 samples have been analyzed. Data results show all but one sample tested negative for Glyphosate. One sweet potato sample had a very low incurred level of Glyphosate, a finding of less than 2% of the allowable limit.

The Quantiva LCMS is set up as a dedicated instrument for the Glyphosate analysis on specialty crops only. All laboratory supplies necessary for testing will solely be used for the specialty crops.

This project would not be possible without the partner, CDPR, to collect samples for the PR laboratory. CDPR inspectors collect produce samples from wholesale, retail, farmers market, distribution centers and deliver to the PR laboratory for analysis. At the beginning of the project, a decision was made to monitor for Glyphosate in five commodities: carrots, sweet corn, green beans, sweet potatoes and spinach. As the project progressed, more specialty crop samples were included for analysis such as papaya, apples, asparagus, grapes and broccoli.

## Goals and Outcomes Achieved

As soon as the award was announced, PR staff started to order equipment and supplies. Most of the equipment and supplies required for the samples processing such as extraction and clean-up arrived quickly except for the analytical Quantiva LCMS instrument. Because of the timing constraint, the scientist had to start the method development and validation on a loaned instrument. Method validation was completed prior to the start of the project on July 2016. Seven commodities were selected for the validation: carrot, sweet corn, green bean, lettuce, orange, potato, and sweet potato. The minimum detection level (mdl) was set at 10 parts per billion even though the instrument was capable of detecting a much lower level. To date, more than 130 specialty crop produce samples have been analyzed and completed results were released to CDPR for enforcement purposes.

The Glyphosate project got off to a good start. The goal for the first year is to conduct testing on 300 produce samples. The project is on schedule with 132 samples completed. With the current sampling rate, the goal of analyzing 300 samples is easily attainable.

The sampling schedule from CDPR up to the second quarter (half way point) shows a total of 168 samples will have been collected.

PR laboratory staff have completed 132 samples in a period of five months. One hundred thirty-two data points were released to CDPR on a timely manner for enforcement purpose. Only one sample tested positive for Glyphosate and at the level of less than 2% of the allowable limit. These data clearly show the safety of specialty crop produce sold in California.

## Beneficiaries

Specialty crops – fruit, dried fruits, vegetables, nuts, and horticulture and nursery crops (including floriculture) – are the mainstay of California agriculture. California is by far the number one US producer of

specialty crops both in quantity and in diversity, with a total of over 400 different crops recorded. Many of California's specialty crops (such as almonds, artichokes, and broccoli) are grown almost nowhere else in the country. This project would benefit the California specialty crops first and foremost. Data will enhance the safety record of California specialty crops. Any tolerance violation report would help growers to monitor their own process and operation.

The California consumers would benefit as they can be assured their food supply is being monitored for potentially carcinogen, Glyphosate.

The specialty crop industry will benefit from the project as past PR laboratories' surveillance data clearly demonstrate that California specialty crops are safe, enhancing the value of California's specialty crops. There are 45,646 farms in California producing specialty crops with a market value of $30,451,932,000 [United States Department of Agriculture National Agricultural Statistics Service, 2012 Census of the Agriculture, Specialty Crops] that will potentially benefit from this project.

## Lessons Learned

This project progressed smoothly and on schedule even though the dedicated instrument (the Quantiva LCMS) has not been deemed ready for use. It was the right decision to start the method development and validation on a loaned instrument because of the timing constraint. The loaned LCMS will be used temporarily until the validation of the Quantiva LCMS is complete.

## Additional Information

No additional information.