

TEXAS DEPARTMENT OF AGRICULTURE

COMMISSIONER SID MILLER

2013

SPECIALTY CROP BLOCK GRANT

Final Report

Submitted by:

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PROJECT 1: FROM ARTISANAL TO MASS MARKET: SCALING UP THE TEXAS OLIVE CROPS TO MEET DEMAND

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Project Summary

As the demand for domestic extra virgin olive oil grows, the opportunity for Texas olive growers to supply significant market share increases. Texas olive agriculture has advanced through trial and error of Texas pioneer growers who have succeeded in bringing in commercial production of extra virgin olive oil. To take advantage of market growth and opportunities, Texas olive growers need to accelerate their efficiencies and scale up production to meet consumer demand for domestic extra virgin olive oil. The Texas Olive Oil Council (TOOC) proposed a plan to accelerate data-driven olive production improvements that will achieve better yields, olive oil quality, and economies of scale for Texas growers. In addition, TOOC created a digital archive for learning modules allowing Texas growers the ability to access information on an as-needed basis, and to continue to educate and inform Texas consumers about locally grown extra virgin olive oil.

Project objectives included provide grower training and education through:

- Increase field technology best practices knowledge base distribution to Texas Olive Growers through collaboration with intensive practical applied agriculture practices.
 - TOOC will work with experienced commercial olive producers in California to understand and develop a library of Texas-based best practices, which will be developed through data-driven trials at commercial orchards. This project will also capture knowledge and make it available to Texas growers through TOOC-affiliated field agents and through online materials to suit the grower's convenience, scale of operation, and seasonal needs. Project staff may also utilize best practices developed through a previous specialty crop grant awarded to Texas Tech University.
- Increase online information and education resources for olive growers
 - Through online video training and downloadable reference materials such as the updated Texas Olive Growers Manual. Industry news will be delivered through quarterly e-zines to membership and archived e-zines will be made available on website.
- Continue olive oil education and demos at farmers markets and community events
 - Create demos of Texas-grown olive oil and education regarding the benefits of fresh, locally produced quality extra virgin olive oil health to increase awareness and demand.
- Maintain website information and interactive features

- Include news and information about Texas producers, module development, commodity and artisanal oil market trends, and research projects. Continued maintenance of map showing locations of Texas olive oil producers and retail outlets.

Project Approach

Increase field technology best practices, knowledge base distribution, to Texas olive growers through collaboration with intensive, practical, applied agriculture practices.

The Master Class for Texas Olive Growers grew out of a conversation between TOOC Directors Jim Henry, Karen Lee, Josh Swafford, and Cliff Little of Agromillora USA, when the question arose as to what would be the best thing that a grant might be able to do for Texas olive growers. Little suggested getting Texas growers in front of experienced, successful California growers so they could leapfrog the painful slow growth that California growers have suffered through and cut right through to the effective, efficient methods now being practiced by California's top olive producers. Little offered to facilitate introductions and get Adam Englehardt, the leading voice for US olive producers today, to take the lead in teaching Texas growers. It was decided that the best way to avoid misunderstandings was to educate a core group of knowledgeable horticulture professionals and experienced olive growers who could be 'boots in the field' for Texas' increasing numbers of newly fledged olive farmers. It also evolved that this opportunity is exceedingly rare and special for Texas participants, opening the door to future collaboration, productivity, and learning. TOOC is fortunate and very grateful to have had this opportunity.

Activities

- Qualifications for participants in training program, knowledge and experience prerequisites completed by Dr. Karen Lee, Jim Henry, Josh Swafford; program instructor Adam Englehardt collaborated to design selection criteria.
- Applications were solicited for program participation from Texas olive growers and support service entities via email announcement, newsletter announcement, and preliminary grower meeting held March 20 at the Williamson County AgriLife Extension office in Round Rock TX. *See Application, Appendix A. 30 Attendees.*
- Texas olive grower census and knowledge base survey distributed via email and at meetings – ongoing, pending December 15 data for final analysis.
- Participant selection – Class size was limited, per instructor Englehardt. Priority selection was for professional field agents with mandates to assist in Texas agriculture development. Texas AgriLife Extension's lead horticulturists in the fruit tree programs agreed to participate, which was a great advantage to the potential outcome of this grant. In addition, Texas Tech Associate Professor of Horticulture, Dr. Thayne Montague, agreed to participate. Additional private parties were selected on the condition that they pay participation fees and had a research or practical history relevant to the course.

Texas A&M University (TAMU) AgriLife Extension and AgriLife Research participants:

1. Dr. Larry Stein, TAMU AgriLife Professor & Extension Horticulturist, Uvalde
2. Monte Nesbitt, TAMU AgriLife Extension Horticulturist, College Station
3. Jim Kamas, TAMU Assistant Professor & Extension Specialist; Pomology & Viticulture, Fredericksburg

4. Thayne Montague, Texas Tech University, Associate Professor of Horticulture, TAMU AgriLife Research
5. Scott Willey, TAMU AgriLife Extension Agent, Fayette County, Texas

Private Participants (\$15,000 private participation fees were contributed to pay instructor fees for program, net revenue to TOOC \$0)

1. Steve Coffman and Michael Paz, Artesia Wells, TX
 2. Dr. Mark Beaman, Consulting Soil Geologist, George West, TX
 3. Dr. Tom McCulloch and Rebecca McCulloch, McCulloch Orchard, Castroville, TX
 4. Dunham Jewett & Jill Jewett, Jewett Farms, Moulton, TX
 5. Mike Burris, Consulting Horticulturist, Victoria, TX
 6. Daniel Gustafson, Orchard, Berclair, TX
 7. Joshua Swafford, Project Manager, Texas Olive Oil Council, Central Texas Olive Ranch and Heart of Texas Olive Co., Round Rock, TX
- Tours and reviews of Texas olive orchards and growing practices were conducted over the growing season, with several trips taken between February and October to cover the widest range of topics and observations, and simultaneously the team determined the non-producing orchard training priorities. They conducted multiple visits to potential research sites.
 - Program participants traveled to California for early season field training April 13-16, 2014. *See Appendix C-1 for itinerary. See Appendix D for photos.*
 - Texas Olive Growers met to review California learning and present additional Texas specific information and training on May 29, 2014 in Victoria TX. Presentations by were made Dr. Karen Lee, Dr. Larry Stein, Monte Nesbitt, and Jim Kamas. *120 attendees.* The orchard field trip to Victoria orchards was cancelled due to flooding.
 - Program participants traveled to California for optimized fruit management field training from June 29-July 2, 2014. *See Appendix C-2 for itinerary.*
 - Texas Olive Growers Field Day and meeting to review California learning plus additional Texas-specific information and training were held on August 29, 2014 in Walburg TX. Presentations were made by Josh Swafford, Central Texas Olive Ranch manager; Dr. Larry Stein, Monte Nesbitt, Thayne Montague, and Jim Kamas. *82 attendees.*
 - Program participants traveled to California for harvest season field training October 19-22, 2014. *See Appendix C-3 for itinerary.*
 - Texas Olive Growers Master Class Review Meeting is scheduled for December 15, 2014 in San Antonio TX. Speakers slated to present include: Adam Englehardt, Dr. Larry Stein, Monte Nesbitt, Dr. Thayne Montague, Jim Kamas, Dr. Karen Lee, and Jim Henry.

Increase Education Resources for Olive Growers

Texas Olive Oil Council has provided TAMU AgriLife Extension full access to all of TOOC's resources in addition to the Master Class training in olive orchard management. Already, a great deal of information and teaching has transferred to Texas AgriLife Extension websites including all of the presentation materials from all of the meetings held in conjunction with TAMU AgriLife Extension and TOOC in 2014. This material is available to all interested parties at no cost for information or membership on the TAMU AgriLife Extension website, and is archived

on the Texas Olive Oil Council website. TOOC continues to work in cooperation with Texas universities and educators with the goal of facilitating the publication of these resources at no additional cost to TOOC. Dr. Karen Lee and Josh Swafford with Texas Olive Oil Council have worked closely with Dr. Larry Stein, Monte Nesbitt, Jim Kamas, Raul Cabrera, and Thayne Montague to build strong inter-entity working relationships and cultivate trust between Texas olive growers and Texas AgriLife Extension. This collaboration has resulted in a new SCBG project awarded for the period beginning 12/1/2014 to cultivate a data intensive longitudinal study of olive varietal performance under different climate conditions for Texas olive horticulture.

In the interval between writing this grant proposal and the grant award period, Adam Englehardt, the principal expert providing training and widely recognized as the most experienced and knowledgeable olive production manager in North America, left his position as Director of Field Operations at California Olive Ranch and became an independent consultant. Our original proposal contemplated that he would provide instruction as part of his involvement with COR, which is partially owned by Agromillora USA, which cooperated with TOOC in developing the Master Class agenda. Upon his termination at COR, we made a practical adjustment in our schedule in consideration of Englehardt's time and to optimize our information gathering. Englehardt also stipulated a consulting fee which was not in our original grant proposal budget. Englehardt's revised availability and costs necessitated a restructuring of the class, and the decision was made to hold the classes in well managed California orchards, with class participants traveling to California for three seasonal class windows over the course of the growing season: bloom, fruiting, and harvest. In order to cover Adam Englehardt's fee and compensate for the increase in travel expenses, we cancelled our video production component as it appeared it would not meet expected standards due to low production values, and reallocated those funds.

Field Conditions Unsuitable for Filming: Our original project outline contemplated video training modules to be filmed in the field, which would then be edited and posted on the website, covering fruit management and orchard management topics. Our initial efforts to film these training modules were unsuccessful due to wind noise, which could not be reduced to reasonable levels in the field with the resources and equipment available. In addition, one planned field trip to Victoria area orchards was cancelled due to heavy rains and extensive flooding.

Our goal to update "Texas Olive Growers Manual" using compiled module training to eBook readers and tablets was restructured into ongoing presentations at regional olive meetings reviewing the lessons of the Master Class for all Texas olive growers. Information gleaned from the Master Class has formed the foundation of the Texas olive horticulture research program implemented and managed by Texas AgriLife Extension and Texas AgriLife Research, and the scientifically documented results of that material is being collected in order to publish a new Texas Olive Growers Manual through their ongoing collaboration at a future date.

Continue Olive Oil Education/Demos at Farmers Markets and Community Events.

Goal: 50 percent increase in olive oil retail sales over previous 12 months at Product demonstrations at Farmers Markets and Community Events – Since the beginning of the grant period, Texas olive oil demos have been conducted at 1134 events and farmers markets, with an

average of 220 sample demos per event day, for a total of 249,480 0.5-oz samples given (975 gallons over the year to date). The majority of this extra virgin olive oil was donated by Texas olive oil producers including Texas Olive Ranch, Central Texas Olive Ranch, Jewett Farms, Farrell's Olive Orchard, and Anderson Ranch. In addition, the TOOC purchased oil from non-contributing Texas olive producers Texas Hill Country Olive Company, Sandy Oaks Olive Orchard, Heart of Texas Olive Oil, Lone Star Olive Orchard, Salud Olive Oil, and First Texas Olive Oil to include in demonstrations so that customers could learn the breadth of Texas olive oil production and availability. As awareness of Texas olive oil has grown, participation in farmers markets and community events has been spread across a greater number of venues, with many venues reporting a trend toward reduced traffic per site. At the same time, many of the customers frequenting these events have already sampled Texas olive oil and have become repeat customers. While the total number of samples per venue has decreased since last year (274 sample demos per event), total sales have continued to increase. Of the people sampling Texas-grown olive oil for the first time, approximately two-thirds reported not being aware of the taste and properties of freshly grown extra virgin olive oil, expressed surprise at the flavor and complexity of the oil, and made purchases. Approximately 8 percent of tasters had previously tasted fresh olive oil from Texas or while traveling in Europe or California and were pleased to know freshly pressed Texas-grown olive oil is more readily available. Approximately 4 percent of people sampling fresh Texas olive oil did not like it, saying it was "too hot," or "too peppery," and this is consistent with research conducted by the University of California at Davis in 2009 showing that 33 percent of American olive oil consumers prefer flat, tasteless, or rancid olive oil. Overall, sampling at events has shown consistently to be the most effective method of converting consumers to purchasing fresh Texas grown olive oil. The presence of the GO TEXAN brand is important for most customers. All Texas-grown extra virgin olive oil bears a label certifying authenticity by the Texas Olive Oil Council, and we encourage Texas Olive Oil Council members to proudly display the GO TEXAN logo on their labels.

The goal was to increase total Texas olive oil sales by 10 percent over estimated 2013 retail sales of \$2 million. With an average unit price of \$11.94, this represents approximately 183,000 bottles sold. For the last 12 months, November 2012-October 2013, total retail sales of Texas grown olive oil is estimated at \$2.52 million, based on sales venue reports from participating resellers and Texas olive oil brands distributed through retail channels including Texas Olive Ranch, Texas Hill Country Olive Company, Sandy Oaks Olive Orchard, First Texas Olive Oil, Lone Star Olive Farm, and Charta Olive Farm. Converting sales dollars to bottles sold at the 2014 weighted average unit price of \$12.07, this represents approximately 208,782 bottles sold. This increase represents approximately 115 percent increase over the previous 12 months, exceeding our goal of a 10 percent increase in sales.

Dr. Karen Lee, Executive Director of the Texas Olive Oil Council solicited the cooperation of Texas A&M AgriLife Extension and other educational entities including Texas Christian University in Fort Worth, Concordia University in Austin, Tarleton University in Mingus, and the University of Texas at Austin, providing informational seminars to communications and business school students regarding Texas olive horticulture and the Texas olive oil industry. Abbie Rutledge of Next Door Pantry provided ongoing educational presentations and product demonstrations. Barbara Wardlow, Ron Johnson, Josh Swafford, Jim Henry, Sandy Stewart, Gerald Smallwood, Maria Castro, Jose Castro, and Dr. Karen Lee provided educational

presentations, product demonstrations, online responses to consumer queries, and ongoing coaching and support for olive oil education and sales, and the GO TEXAN Program. Jaleah Colon provided recipes and cooking blogs, and linked to the Texas Olive Oil Facebook page.

Goals and Outcomes Achieved

Goal 1: Accelerate olive orchard development through best practices knowledge base distribution to Texas olive growers via digital training modules and reference.

Goal 2: Increase Texas olive orchard productivity and yield by providing state of the industry training for optimizing fruiting and harvesting management practices using digital technology distribution.

Maintain Website Information and Interactive Features:

Goal: Increase website viewership by 10 percent over previous 12 months

This year, TOOC's website audience continued to grow at a robust pace. Feedback comments from users and members on the new website has been very positive. Overall, users like the look and feel and find the website very user-friendly.

Building Awareness: Jaleah Colon, Birdcage Bakeshop, Blog and Recipes.

Ms. Colon has developed, documented, and posted 74 blog posts with original recipes and tips on her blog for Birdcage Bakeshop, and has linked all of them to Texas Olive Oil on Facebook with positive feedback.

Social Media Promotion: In 2013 TOOC launched a Facebook campaign promoting "Texas Olive Oil" to generate word of mouth advertising in the social media realm. As of this writing, Texas Olive Oil has 3,266 new "likes" and a constantly growing Texas Olive Oil fan base. Facebook stats show 400 percent increased traffic and click-throughs to the Texas Olive Oil Council website during periods of paid promotion, so TOOC will utilize Facebook 'boosting' when they post new information to the Texas Olive Oil Council website, which is driving a lot of their increased website viewership.

Google AdWords Promotion: Since the 2012 grant cycle report, the Google AdWords program has captured consumers searching for information on olive oil in the popular search engine. Using this tactic, TOOC created an average of 981 impressions per day for Texas olive oil searches including "Texas olive oil," "Texas olive trees," "Texas olive," "olive oil," and "olive orchard." This tactic has to-date yielded an average click-through rate of 0.39 percent.

Expected Measureable Outcomes: Across all activities and tactics, results have been strong. Unique visitors increased 31 percent and remained higher throughout the year for a total result of 992,386 hits in this grant year to date, a 30 percent increase on a month-to-month basis over 2013. This increase is significantly greater than the 10 percent goal set for this grant period. Daily average hits for the past twelve months are 2320, up from 1787 the previous 12 months. Website statistics are from AWSTATS, a statistical analytics package provided by their domain hosting service, Bluehost, as well as Facebook Ads Manager, and Google Analytics.

Quarterly Ezine & Newsletter: The ezine mailing list includes 612 Texas Olive Oil Council (TOOC) members comprised of growers, potential growers, suppliers, industry resources and sponsors. TOOC published four quarterly issues in the past 12 months covering timely events in the olive industry and plan to publish one more before the end of the grant period.

Scott Herron and Neely Ashmun of BAH Design in Austin have been key to the success of this project providing design and writing services, consumer insights, positive user experiences and timely execution. Edward Vermillion has provided website coding and technical development for specialized needs. Karen Lee of Texas Olive Oil Council is responsible for all content.

Goal Outcome: Surpassed Goal and Continued to Improve on Metrics, Achieving 30 percent Increase in Viewership Over Previous 12 Months.

Beneficiaries

The current and future olive growers of Texas are the beneficiaries of the newly created new media archive that summarizes and reviews significant peer-reviewed research on Texas olive horticulture and makes this material available to members and nonmembers on demand via the Texas Olive Oil Council website. The growth of Texas olive oil production is detailed below, showing a very strong increase in the rate or growth since this program began.

Year	Number of Growers	Number of Acres	Number of Trees	Gallons of Olive Oil Produced
2000	6	<100	10,950	0
2002	8	150	13,590	0
2004	12	175	14,850	5
2006	21	300	69,800	1,200
2008	24	320	80,800	4,500
2010	40	780	183,100	16,893
2012	50	920	248,090	14,380
2013	85	1,500	950,000	18,800

Lessons Learned

It is also important to note that the Texas olive industry is experiencing significant growth and has a lot of potential for grower groups to form cooperatives to enhance, enable, and improve resource availability on a local scale. This development will potentially impact the organization’s approach to information dissemination on a personal level. It should be noted that virtually everyone in Texas is a potential olive oil customer, and that the widely recognized Mediterranean Diet recommends two tablespoons of fresh extra virgin olive oil per person, per day. If Texas’ entire population were to consume this much olive oil, Texans would consume over a million gallons of olive oil PER WEEK. We believe that the future of the Texas olive industry is robust, and are grateful to the Texas Department of Agriculture and the Specialty Crop Block Grant Program for their support in promoting this specialty crop.

Additional Information

For the latest information on the Texas olive industry, please visit texasoliveoilcouncil.org

See appendix information.

APPENDIX A

**Texas Olive Oil Council
Olive Orchard Management Master Class Application**

**Fax: 512-597-3285
Email: info@texasoliveoilcouncil.org**

Name

Address

Phone

Email

Olive Orchard Location/Address

Acres

#Trees

Variety _____ Quantity _____

Style: HD, MD, Traditional

Year Planted

Have you harvested a crop? Y N What year? _____ Yield _____ # T

Issues/concerns/problems for your orchard

Mill processing your olives _____

Educational Background:

Research Background:

Professional Background:

Current Position:

Other experience relevant to olive orchard management:



APPENDIX B

RESEARCH AND EXTENSION PARTICIPANTS CURRICULA VITAE



Curriculum Vitae

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M.S. Horticulture, 1981, Texas A&M University, Magna Cum Laude

B.S. Horticulture, 1979, Texas A&M University, Summa Cum Laude

September 2012 – present	Associate Department Head for Extension Horticulture
September 1999 – present	Professor and Extension Horticulturist, Texas A&M AgriLife Research and Extension Center, Uvalde, TX
September 1992 – September 1999	Associate Professor and Extension Horticulturist, TAMU Research and Extension Center, Uvalde, TX
December 1991 – August 1992	Associate Professor and Extension Horticulturist, TAMU Research and Extension Center, Stephenville, TX
June 1985 – December 1991	Extension Horticulturist, TAMU Research and Extension Center, Stephenville, TX
June 1982 – June 1985	Extension Assistant in Horticulture, Extension Horticulture, College Station, TX
January 1982 – May 1982	Technician II, Department of Horticultural Sciences,

College Station, TX

December 1981 – June 1980

Graduate Assistant in Research, Department of Horticultural Sciences, College Station, TX

August 1979 – May 1980

Graduate Assistant in Teaching, Department of Horticultural Sciences, College Station, TX

Recent Publications

- Stein, L.A., G.R McEachern and M. Nesbitt (eds.) 2012. Texas Pecan Handbook, Texas A&M AgriLife Extension Service, College Station.
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1

Monte L. Nesbitt Curriculum Vitae

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Education

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B.S. Horticulture, Texas Tech University, December 1987.

Professional Work History

Extension Program Specialist, Texas A&M AgriLife Extension, October 2009-Present.
Agriculture Program Associate, Auburn University, June 1994-September 2009
Agricultural Science Technician, USDA/ARS Pecan Genetics, January 1993 to May 1994
Graduate Teaching Assistant, Texas A&M University, September 1990-December 1992
Research Technician, Texas A&M University, July 1988-August 1990

Peer Reviewed Publications (chronological order)

Lombardini, L., Volder, A., Nesbitt, M.L. and D.L. Cartmill. 2013. Consequences of injury caused by *Cameraria caryaefoliella* (Lepidoptera: Gracillariidae) on pecan gas exchange and chlorophyll fluorescence. *J. Amer. Soc. Hort. Sci.* 138(4):263-266. 2013.

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Conference & Symposia Proceedings (chronological order)

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Nesbitt, M., T. Hargroder, R.C. Ebel, W. A. Dozier and H. Fadamiro. 2007. Effect of petroleum oil sprays on mite control, fruit production, and fruit quality of Satsuma mandarin (*Citrus unshiu* Marc.). (abstract) *HortScience* 42(4):979-980.

Ebel, R.C., M. Nesbitt, D. Findley, B. Wilkins, D. Himelrick, and S. Burchett. 2003. Response of satsuma mandarin to mid-winter defoliation. *Proc. Intl. Soc. Citriculture IX*: p. 699.

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Nesbitt, M.L., and R. C. Ebel. 2000. Freeze hardiness of Satsumas: What we know and don't know. *Proc Ala. Fruit & Vegetable Growers Assn.* 21:18-20. 3

Nesbitt, M.L., W.D. Goff, and B.W. Wood. 2000. Pecan orchard management for hurricane-prone areas. *Proc. Southeastern Pecan Growers Assn.* 93:106-111.

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McWilliams, E.L., J.B. Storey, D. A. Harp, and M.L. Nesbitt. 1999. The impact of Gulf Coast hurricanes on pecans, ornamental trees, and invasive exotic species. *HortScience* 34(3):563 (Abstr).

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Extension Publications

Nesbitt, M., Stein, L. & J. Kamas. 2013. Texas Fruit & Nut Production: Avocados. Texas A&M AgriLife Ext. Bull. EHT-018.

Nesbitt, M., Stein, L. & J. Kamas. 2013. Texas Fruit & Nut Production: Blackberries. Texas A&M AgriLife Ext. Bull. E-602.

Nesbitt, M., J. Kamas. & L. Stein. 2013. Texas Fruit & Nut Production: Blueberries. Texas A&M AgriLife Ext. Bull. E-603.

Nesbitt, M., Stein, L. & J. Kamas. 2013. Texas Fruit & Nut Production: Improved Pecans. Texas A&M AgriLife Ext. Bull. E-609.

Stein, L., Nesbitt, M. & J. Kamas. 2013. Texas Fruit & Nut Production: Native Pecans. Texas A&M AgriLife Ext. Bull. E-610.

Stein, L., Nesbitt, M., & J. Kamas. 2013 Texas Fruit & Nut Production: Persimmons. Texas A&M AgriLife Ext. Bull. E-611.

Stein, L., Kamas, J. & M. Nesbitt. 2013. Texas Fruit & Nut Production: Olives. Texas A&M AgriLife Ext. Bull. EHT-021.

Stein, L., Kamas, J. & M. Nesbitt. 2013. Texas Fruit & Nut Production: Plums, Nectarines, Apricots, Cherries, Almonds & Prunus Hybrids. Texas A&M AgriLife Ext. Bull. E-612.

Stein, L., Kamas, J. & M. Nesbitt. 2013. Texas Fruit & Nut Production: Pomegranates. Texas A&M AgriLife Ext. Bull. E-613. 4

Wallace, R., Masabni, J., Gu, M., Nesbitt, M., Porter, P., & M. Palma. 2013. Specialty Crops for High Tunnel Production in Texas. Texas A&M AgriLife Ext. Bull. EHT-029.

Nesbitt, M. 2013. Fruit trees & small fruits for Earth-Kind landscapes, in Gu, M. (Ed.) *Earth-Kind Landscape Management Handbook*. Texas A&M AgriLife Ext. Bull. HT-013.

Stein, L.A. G.R. McEachern & M.L. Nesbitt (Eds.). 2012. Texas Pecan Handbook. Texas A&M AgriLife Extension Publication SP-445.

Popular Press/Industry Publications

Quarterly contributor to "Southeastern Shakings" column in *Pecan South* magazine. 57 articles from 2000 to 2013. Published by Texas Pecan Growers Association

Book Chapters

Nesbitt, M.L. 2008. Successful fruit plants for coastal Alabama, p. 117-121. In: J. O'Donnell (ed.) *In full bloom; the delta, the bay, the beach*, Amer. Image Publishing, Montrose, AL.

Nesbitt, M.L. 2008. Importance of soil testing, p. 221. In: J. O'Donnell (ed.) *In full bloom; the delta, the bay, the beach*, Amer. Image Publishing, Montrose, AL.

Nesbitt, M. and L. Wells. 2007. Estimation of pecan tree value, p. 135-136. In Wells (ed.) *Southeastern Pecan Growers Handbook*. Univ. of Georgia Coop. Ext. Serv. Bulletin 1327.

World Wide Web Publications

<http://www.ipmcenters.org/cropprofiles/docs/ALsatsumamandarin>

<http://www.alabamapecangrowers.com/Thinning/advisenutthinning.htm>

<http://www.alabamapecangrowers.com/Members/culthome.asp>

CURRICULUM VITAE

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Assistant Professor & Extension Specialist - Pomology & Viticulture

Texas Pierce's Disease Program Outreach Coordinator

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Education

B.S. Horticultural Sciences, 1977, Texas A&M University

M.S. Horticultural Sciences, 1982, Texas A&M University

Research, Teaching and Extension Experience

January 1978-September 1983-Research Associate, Texas Agricultural Experiment Station, College Station, Texas (Fruit Breeding and Variety Development)

September 1980-September 1983-Instructor, Department of Horticultural Sciences, Texas A&M University, College Station, Texas. (Introductory Pomology, Temperate Fruit Production, Undergraduate Honors Program)

May 1988- March 1996-Area Extension Grape Specialist & Extension Team Leader Lake Erie Regional Grape Program Cornell University/Penn St. University

March 1996- Present- Asst. Professor & Extension Fruit Specialist, Texas Cooperative Extension, Fredericksburg, Texas

Program Emphasis

Jim Kamas has a 100% Extension appointment with Texas Cooperative Extension. In this role, he works closely with tree fruit and grape growers across Texas. Through on-site visitations, phone and email contacts, he assists growers with cultural practice problems including fruit nutrition, pruning and crop-load management, orchard/vineyard ground cover management and disease and insect control. He also currently is involved in several applied research projects on Pierce's disease. Kamas currently serves as the outreach coordinator for the Texas Pierce's Disease Research & Education Program.

Current Committees

California Dept. of Food & Ag. Glassy Winged Sharpshooter Scientific Advisory Committee Meeting 2001-present

Viticulture Consortium East- Regional Guidance Committee 2006-2011

SELECTED PUBLICATIONS

Kamas, Jim and Larry Stein. Texas Peach Handbook: The Art & Science of Growing Peaches in Texas. Texas A&M University Press. (Copyright finalized, scheduled for printing Spring, 2011).

Úrbez-Torres, José Ramón, Penny Adams, Jim Kamas and Walter Douglas Gubler. Identification, Incidence, and Pathogenicity of Fungal Species Associated with Grapevine Dieback in Texas. *American Journal of Enology & Viticulture* (60:4, pp. 497-507).

Kamas, Jim, Mark Black, Penny Adams, James Davis and Alfred Sanchez. 2006. Response of ungrafted grape rootstocks to *Xylella fastidiosa* at a Pierce's disease site in Texas. *Proceedings of 2005 CDFA Pierce's Disease Research Symposium* p229-231.

Black, Mark , Jim Kamas, Alfred Sanchez, Penny Adams and James Davis. 2006. Greenhouse responses of *Vitis vinifera* 'Chardonnay', *Ambrosia trifida* var. *texana*, and *Iva annua* with *Xylella fastidiosa* isolates from Texas host plants. *Proceedings of 2005 CDFA Pierce's Disease Research Symposium* p202.

Black, Mark, Jim Kamas, Alfred Sanchez, James Davis and Penny Adams, 2005. Aspects of Pierce's disease risk in Texas. *Proceedings of 2005 CDFA Pierce's Disease Research Symposium* p150-151.

Kamas, Jim, 2004. Unraveling Pierce's disease in its ancient origin. *Wine Business Monthly*, Vol. XI, No. 12, p34-38.

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Pool, R.M., J. S. Kamas and R.M. Dunst. 1994. Estimating and machine thinning the crop of Concord grapevines post-bloom. *Proc. 2nd Ann. Lake Erie Regional Grape Program*.2; 18-20.

- Dunst, R. M., R.M.Pool and J. S. Kamas. 1994. Postemergence weed control development of a complete postemergence strategy. Proc. 2Nd Ann. Lake Erie Regional Grape Program. 2; 10-13.
- Pool, R.M., R.M. Dunst and J.S. Kamas. 1992. Managing weeds in New York vineyards. New York State Ag. Exp. Station grape facts bulletin V.1 No. 5.
- Martinson,T.E.,T.J. Dennehy and J.S. Kamas. 1992. Trials of conventional and nonconventional insecticides for control for the eastern grape leafhopper. Insecticide and Acaricide Tests. p.63.
- Dennehy, T.J., L.G. Clark and J.S. Kamas. 1991. Pheromonal control of the grape berry moth: An effective alternative to conventional insecticides. New York's Food and Life Sciences bulletin #135.
- Pool, R.M., R.M. Dunst, J.S. Kamas, A.N. Lakso and M.C. Goffinet. 1991. Shoot Positioning Native American (Concord-type) Grapevines. Cornell Grape Fact Sheet No.6.
- T.E. Martinson, C.J. Hoffman, T.J. Dennehy, J.S. Kamas and T. Weigle. 1991. Risk assessment of grape berry moth and guidelines for management of the eastern grape leafhopper. New York's Food and Life Sciences Bulletin #138.
- Gerald B. White and James S. Kamas. 1990. The economics of 'Concord' and 'Niagara' grape production in the Great Lakes Region of New York. Cornell Ag. Economics Extension publication 90-3.
- Byrne, D.H. and J.S. Kamas. 1984, 'Texstar' peach. Hortscience 19 (3): 453-454.
- Kamas, J.S. 1982. The effects of rootstock and pre-emergence herbicide application on growth and nutrient uptake in peach, *Prunus persica* (L.) Batch. (Thesis)
- Bowen, H.H., R.L. Perry, and J.S. Kamas. 1981. Evaluation of grape cultivars and selections for the hill country and coastal plains areas of Texas. Texas Agri. Exp. Sta. Progress Report 3873.
- Drews, D., D.T. Steinbrunner and J.S. Kamas. 1981. The effect of oryzalin, napropamide, simazine, and glyphosate on weed control and vigor of seedlings in a peach nursery. Hortscience 16 (3): 455.

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Department of Plant and Soil Science
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Curriculum Vitae (March 2014)

Education:

Ph.D. Utah State University. 1999. Plant Science
M.S. Auburn University. 1993. Ornamental Horticulture
B.S. Brigham Young University. 1990. Ornamental Horticulture

Professional Experience:

Associate Professor of Horticulture. Texas AgriLife Research and Extension Center, Lubbock, Texas (25% research appointment). 2006-present
Associate Professor of Horticulture. Department of Plant and Soil Science. Texas Tech University (75% teaching appointment). 2005-present
Assistant Professor of Horticulture. Department of Plant and Soil Science. Texas Tech University. 1999-2005

Awards and Honors:

Texas Tech University President's Excellence in Teaching Award Recipient (2013)

Principal Research Interests:

Woody plant physiology and water use; Woody plant/microclimate interactions; Nursery production; Propagation; Grapevine physiology; Olive tree physiology.

Refereed Publications (last 3 years):

Michael A. Arnold, Donita L. Bryan, Raul I. Cabrera, Geoffrey C. Denny, Jason J. Griffin, Jeffery K. Iles, Andrew R. King, Gary W. Knox, Leonardo Lombardini, Garry V. McDonald, Cynthia B. McKenney, D. Thayne Montague, Genhua Niu, H. Brent Pemberton, Adam L. Purnell, Larry J. Shoemaker, Daniel K. Struve, 2 and W. Todd Watson. 2012. Provenance experiments with Baldcypress, live oak, and sycamore illustrate the potential for selecting more sustainable urban trees. *Journal of Arboriculture and Urban Forestry*. 38:205-213.
Henry, G., J. Hoyle, L. Beck, T. Cooper, T. Montague, and C. McKenney. Evaluation of Mulch and Preemergence Herbicide Combinations for Weed Control in High Density Olive (*Olea europaea* L.) Production. *HortScience*. In Press.
Fox, L., A. Bates, and T. Montague. Influence of Irrigation Regime on Water Relations, Gas Exchange, and Growth of Two Field-grown Redbud Varieties in a Semiarid Climate. *Journal of Environmental Horticulture*. Accepted.

Abstracts and Proceedings (last 2 years):

Montague, T., C. McKenney, and K. Decker. 2012. Response of Redbud (*Cercis canadensis*) Trees to Post-establishment Applied Organic Mulch. Southern Nursery Association Research Conference. 57:183-189.
Arnold, M, D. Bryan, E. Bush, R. Cabrera, G. Denny, J. Griffin, J. Iles, A. King, G. Knox, L. Lombardini, G. McDonald, C. McKenney, T. Montague, G. Niu, A. Owings, B. Pemberton, A. Purnell*, L. Shoemaker, D. Struve and T. Watson. 2012. Ten-site evaluation of advanced clonal selections of *Taxodium distichum* (L.) Rich. yields data

aiding in selection of improved trees for built environments in the Eastern and Central United States. *HortScience* 47(9):S369.

- Plank, C., E. Hellman, and T. Montague. 2013. The effects of sunlight and LED light on methoxypyrazine content of ripening berries of cabernet sauvignon. 64th ASEV National Conference Technical Abstracts. p. 163.
- Grubbs, Rebecca, C.B. McKenney, T. Montague, and S. Oswalt . 2013. Determining salinity tolerance of three High Plains bedding plant species in a hydroponics setting. *HortScience* 48(9):S18.
- Poole, Jessica, C.B. McKenney, and T. Montague. 2013. Evaluation of salinity effects on four Texas native plants using a hydroponics system. *HortScience* 48(9):S19.
- McKenney, Cynthia B., and T. Montague. 2013. Where did all the students go? *HortScience* 48(9):S24.
- McKenney, C., T. Montague, and A. Elle. 2013. Effectiveness of online laboratory experiences. *HortScience*. 48(9):S201.
- Montague, Thayne, C.McKenney, S. Parks, and K. Decker. 2013. Gas exchange and growth of two field grown oak species in response to post establishment applied organic mulch and drought. *HortScience* 48(9):S30.
- Parks, Staci, T. Montague and C.B. McKenney. 2013. Effects of irrigation regime on gas exchange of field grown *Olea Europaea* L. *HortScience* 48(9):S35.

Seminars and Presentations (last 2 years):

- Baliga, V., T. Montague, and C. McKenney. 2012. Effects of Drought Stress on Greenhouse Grown Olives. Annual Conference of the Southern Region of the American Society for Horticultural Science. Birmingham, AL. Feb.
- Montague, T., V. Baliga, and C. McKenney. 2012. Gas Exchange of Drought Stressed Greenhouse Grown Olive Varieties. Annual Conference of the Southern Region of the American Society for Horticultural Science. Birmingham, AL. Feb. 3
- Decker, K., C. McKenney, and T. Montague. 2012. Response of Greenhouse Grown Olive Varieties to Irrigation and Fertilization Regimes. Annual Conference of the Southern Region of the American Society for Horticultural Science. Birmingham, AL. Feb.
- Montague, T., E. Hellman, and K. Jenkins. 2012. Physiological Differences of Five Grapevine Varieties Grown on the Texas High Plains. Annual Conference of the Southern Region of the American Society for Horticultural Science. Birmingham, AL. Feb.
- Montague, T. and C. McKenney. 2012. Olive Oil Research at Texas Tech University: What Have We Done Lately? Texas Olive Oil Council Research Conference. San Antonio, TX. August.
- McKenney, C. and T. Montague. 2012. Olive Oil Research at Texas Tech: Where Are We Going? Texas Olive Oil Council Research Conference. San Antonio, TX. August.
- Plank, C., E. Hellman, and T. Montague. 2013. The effects of sunlight and LED light on methoxypyrazine content of ripening berries of cabernet sauvignon. 64th ASEV National Conference. Monterey, CA.
- Grubbs, Rebecca, C.B. McKenney, T. Montague, and S. Oswalt . 2013. Determining salinity tolerance of three High Plains bedding plant species in a hydroponics setting. Annual Conference of the Southern Region of the American Society for Horticultural Science. Orlando, FL.
- Poole, Jessica, C.B. McKenney, and T. Montague. 2013. Evaluation of salinity effects on four Texas native plants using a hydroponics system. Annual Conference of the Southern Region of the American Society for Horticultural Science. Orlando, FL
- McKenney, Cynthia B., and T. Montague. 2013. Where did all the students go? Annual

Conference of the Southern Region of the American Society for Horticultural Science. Orlando, FL

Montague, Thayne, C. McKenney, S. Parks*, and K. Decker*. 2013. Gas exchange and growth of two field grown oak species in response to post establishment applied organic mulch and drought. Annual Conference of the Southern Region of the American Society for Horticultural Science. Orlando, FL

Parks, Staci, T. Montague and C.B. McKenney. 2013. Effects of irrigation regime on gas exchange of field grown *Olea Europaea* L. Annual Conference of the Southern Region of the American Society for Horticultural Science. Orlando, FL

Montague, T. 2013. Water requirements and irrigation strategies for woody landscape plants on the West Texas High Plains. Lubbock Master Gardeners. Lubbock, TX. (invited).

Montague, T. 2013. Woody landscape plants on the West Texas High Plains: Challenges and water requirements. Plainview Master Gardeners. Plainview, TX. (invited).

Montague, T. 2013. Asexual Propagation of Horticulture Plants: It's Alive! Osher LifeLong Learning Seminar. Lubbock, TX. (invited).

McKenney, C., T. Montague, and A. Elle. 2013. Effectiveness of online laboratory experiences. Annual Conference of the American Society for Horticultural Science. Palm Desert, CA. 4

Principal Subject Matter for Teaching:

Principles of Horticulture, Woody Landscape Plants, Arboriculture, Plant Propagation, Viticulture, Crop Physiology

Relevant Information in Regard to Olive Oil Production:

Working with the Texas Olive Oil Council, over the past 4 years Dr. Cynthia McKenney (Texas Tech University) and I have secured Specialty Crop Block Grants through the Texas Department of Agriculture. During this time we have investigated several aspects of olive production in Texas: orchard irrigation, salinity, herbicides. Future plans are to gain increased understanding of olive production (particularly in reference to irrigation, training, harvesting, and variety trials for Texas), and assist Texas producers as they make orchard management decisions. **Texas Olive Oil Council April 14-15 California Grower Workshop Itinerary**

APPENDIX C – MASTER CLASS ITINERARIES

C-1 SPRING MASTER CLASS

C-2 SUMMER MASTER CLASS

C-3 HARVEST MASTER CLASS

C-1 SPRING MASTER CLASS

April 13th:

Group Arrives via SMF (Sacramento International Airport)

Hotel: Oxford Suites, Chico, CA (I will arrange our corporate rate)

April 14th:

8:00am - Meet at Agromillora, California Gridley, CA

8:00-9:00 - Nursery Tour

9:00- 12:00 - Classroom Time

12:00-1:00 - Lunch in Gridley

1:00 - 2:00 - Classroom Time

2:00-3:00 - Travel to Black Butte Ranch

3:00 - 5:00 - Black Butte (230 Acres planted to central leader system in 2006, 180 Acres planted to Short Trellis in 2012)

6:00 - Dinner in Chico

April 15th:

8:00 Meet at Hotel

8:00-9:00 Drive to Big W - Orland Ranch

9:00-12:00 Tour Big W Ranch (800 Acres planted in 2008 on hill ground)

12:00-1:00 Lunch in Willows

1:00-3:00 Tour Schmidt Ranch (240 Acres planted in 2009 on flat ground)

3:00-5:00 Kennedy Ranches (800 Acres planted over several years on flat ground)

6:00 - Dinner in Chico, CA

April 16th:

Depart via SMF

C-2 SUMMER MASTER CLASS

Texas Olive Oil Council June 30, July 1 California Grower Workshop Itinerary

Sunday June 29

Sunday afternoon	Arrive Sacramento airport
Sunday Evening 2700	Check into Hampton Inn, 1337 S Beckman Rd, Lodi CA 95240, 209-369-
7:00	Group Dinner Hosted by Adam Englehardt Lodi Beer Company, 105 S School St. Lodi CA 95240, 209-368-9931
9:00 PM	Stay at Hampton Inn, Lodi

Monday June 30

8:00 AM	Meet in Hotel Lobby
8:30 AM	Depart Hotel for Coldani Olive Ranch, 14000 N Guard Road Lodi CA 95242.
9:00 AM	Tour Coldani Olive Ranch, Mill and Orchard Medium sized mill and orchards on heavy delta soil.
11:00 AM	Lunch at Phillips Farms, 4580 W Highway 12, Lodi CA 95242
1:15 PM 95212	Depart Phillips Farms for Corto Olive, 11292 N Alpine Road Stockton CA
2:00 PM	Tour Corto Olive Mill and adjacent SHD ranch
4:00 PM	Depart Corto Olive for Hampton Inn, Lodi
6:00 PM	Group dinner at Rosewood Bar and Grill, 28 S School St. Lodi CA 95240
8:00 PM	Stay at Hampton Inn, Lodi CA

Tuesday July 1

8:00	Classroom time in hotel lobby
9:30	Depart for Livermore CA
11:00	Lunch at Terra Mia, 4040 East Ave, Livermore CA 94550
12:30	Tour Olivina Ranch 4555 Arroyo Rd, Livermore CA 94550 Medium density orchards and olive mill
3:30	Depart Olivina for Hampton Inn, Lodi CA
5:00	Arrive at Hampton Inn, tour concludes

C-3 HARVEST MASTER CLASS

Texas Olive Oil Council October 20-21 California Grower Workshop Itinerary

Sunday October 19th

Sunday Afternoon	Arrive Sacramento airport
Sunday Evening	Check into Hampton Inn 2060 Freeway Dr Woodland CA 95695

Monday October 20th

8:00 am	Meet in Hotel Lobby
8:30 am	Depart Hotel for Cal Ag Properties, County Road 19, Woodland CA
9:00 am	Meet with John Post and John Williams, watch harvest operations onsite 1400 acres of arbequina and arbosana on hilly terrain
12:00 pm	Lunch at Road Trip Bar & Grill, 24989 CA Hwy 16, Capay CA 95607
1:30 pm	Depart for Seka Hills Olive Mill 19326 Rd 78, Brooks CA 95606
2:00 pm	Tour Seka Hills Olive Mill and tasting room
5:00 pm	Depart Seka Hills for Woodland CA
6:30 pm	Group dinner at Kitchen 428, Woodland CA

Tuesday October 21

8:00 am	Depart Hampton Inn
10:00 am	Tour The Olive Press Mill & Tasting Room, visit with miller, observe rushing and oil processing , 24724 Arnold Dr, Sonoma CA 95476
12:00 pm	Depart Olive Press
12:30 pm	Lunch at Park 121 Café
1:30 pm	Depart Park 121 for McEvoy Ranch Olive Orchard
2:00 pm	Tour McEvoy Ranch, organic medium density orchard, mill, and tasting room, visit with orchard manager Samantha and miller Deborah Rogers, 5935 Red Hill Rd, Petaluma CA 94952
4:00 pm	Depart McEvoy Ranch for Hampton Inn, Woodland CA

Tour concludes

APPENDIX D – PHOTOS © Karen Lee Henry



Josh Swafford, Mike Burris, Jim Henry, Tom Rial, Monte Nesbitt, and Dr Larry Stein visit the site of an olive orchard about to be planted in Victoria, Texas. May 2014.



Water filtration system at California Olive Ranch, near Corning CA. This orchard is comprised of 1.2 million trees, managed through a computerized fertigation system.



Cliff Little, CEO of Agromillora USA discusses tree management and production research at the California Olive Ranch orchard in Oroville CA.



Example of new trellis design with a single wire at 30". Single wire trellis systems are now thought to be more efficient than the previously preferred double wire trellis, and managed results show greater productivity along a horizontally managed fruiting area.



Dr Karen Lee Henry walks through a newly planted orchard near Corning CA, using the single wire trellis system, with tree protectors.



Presenters and Master Class Participants Jim Kamas, Dr Larry Stein, and Monte Nesbitt of Texas AgriLife Extension, with Josh Swafford at the August Texas Olive Growers Meeting and Field Day held in Walburg and Georgetown TX in conjunction with the Texas Olive Oil Council.



Jim Henry and Josh Swafford visit with the Bauer family of Salt Grass Olive Orchard in Winnie TX, as they prep for planting, while touring Texas olive orchard sites for this project.



An example of olive knot, an olive tree affliction caused by damage to the tree during harvest which is common in California but not yet present in Texas. Texas growers learned about causes and treatment, including management techniques that prevent the introduction of olive knot.



Cliff Little, CEO of Agromillora USA, visits with east Texas olive farmers at Gino Venitucci's olive orchard in Liberty, Texas, while touring Texas olive orchards in preparation for this project.



Two of the orchards visited on the tour: near Corning (top) a newly planted orchard. At Jacuzzi Vineyards in Sonoma, an established olive orchard skirts the winery and olive mill, and is part of the tourist experience.



Dr. Thayne Montague of Texas Tech University and Dr. Larry Stein, TAMU AgriLife Extension Horticulturist, visit a young orchard near Lodi, CA



The Master Class toured the mill at Coldani olive orchard. Coldani is renowned for their agromato processes of crushing fruits and peppers along with their olives to produce some intensely flavorful specialty olive oils.



The Master Class listens with great interest to the discussion of orchard management at harvest time from the top producers of California olives: John Post, John Williams, Adam Englehardt, and Cliff Little of Agromillora USA. Near Sacramento CA.



At Coldani olive orchard, the particular details of milling olives are discussed with attention to producing the best possible oil.



The master class tours the brand new mill and tasting room at Seka Hills Olive Orchard, which is partially supported through tribal income from an adjacent casino.



The ancient millstones in front of The Olive Press at Jacuzzi Winery in Sonoma CA. While of historical interest, this equipment is not used to make olive oil today.



The tank farm at Corto, the second largest olive oil producer in California.



Brady Whitlow of Corto Olive guides a tasting of Corto's premier olive oil compared to an imported olive oil that exhibited notes of 'play-doh,' and discusses the history and future of Corto.



Corto Olive's farming operations director discusses harvest timing and technique with the Master Class.



Adam Englehardt and Charles Crohare discuss artisanal oil production and varietal management in a small family olive orchard, near Livermore CA.



Jim Henry and Charles Crohare compare notes on their olive orchards and experiences, with Mark Beaman.



**Back row: Dr Larry Stein, Jim Kamas, Scott Willey of TAMU AgriLife Extension
Front row: Cliff Little of Agromillora USA, Jim Henry of Texas Olive Oil Council and Texas Olive Ranch, and Charles Crohare of The Olivina, Livermore CA.**



California olives, just about harvest time.



Adam Englehardt discusses laboratory equipment used in fruit quality assessment and how to accurately estimate oil yield from field samples.



John Williams, Cliff Little, John Post, and Adam Englehardt have all offered to help Texas olive growers with information and advice as needed.



Master class tour bus.



Another California olive orchard, near Sacramento.



California olive harvest. The guy driving this harvester was wearing a University of Texas sweatshirt!



Dr Larry Stein and Monte Nesbitt listening to John Post.



Milling demonstration at The Olive Press in Sonoma CA.





Jim Henry (above) examines a pneumatic rake used for harvesting the trees at McEvoy Ranch olive orchard, an organic operation with grape vines planted between the rows of olive trees, making over-the-row harvesting impossible (below)



Deborah Rogers, miller at McEvoy Ranch, prepares to greet the Texas Master Class. In addition to a state of the art stainless steel olive mill, this miller still offers archaic milling processes that can be requested by growers.



**Master Class participants l to r
Monte Nesbitt, Dr Larry Stein, Dr Thayne Montague, Scott Willey, Steve Coffman, Mike Paz,
Rebecca McCulloch, Daniel Gustafson, Tom McCulloch, Josh Swafford, Dunham Jewett, Jill
Jewett, Mike Burris, Jim Henry, Mark Beaman, with Cliff Little and Adam Englehardt.**

PROJECT 2: SUSTAINABLE FOOD CENTER DOUBLE DOLLAR INCENTIVE SPECIALTY CROP PROMOTION EXPANSION

Partner Organization: Sustainable Food Center

Project Manager: Suzanne Santos

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Type of Report: Final

Date Submitted: June 2015

Project Summary

The objective of the Sustainable Food Center (SFC) Double Dollar Incentive Specialty Crop Promotion Expansion was to grow the Double Dollar Incentive Program (DDIP) to an additional two SFC Farmers' Markets (to operate the DDIP program at four total SFC markets), increase DDIP sales of specialty crops among 32 Texas farmers participating in at all four SFC markets up to \$120,000; reach 2,600 low-income families in Austin; and prepare DDIP for expansion into other farmers' markets. The specific strategy used was doubling the dollar value of Supplemental Nutrition Assistance Program (SNAP) and Women, Infant and Children (WIC) benefits using electronic benefits transfer (EBT) technology and Farmers' Market Nutrition Program (FMNP) vouchers utilized to purchase specialty crops at participating farmers' markets. SFC also sought to create a replicable model of the Double Dollar Incentive Program (DDIP) to increase the sale of specialty crops to low-income families at Farmers' Markets community-wide. SFC did increase the DDIP from two sites to four sites within this grant period. At the end of this grant period (March, 2015) SFC was into its second full year of working at four markets to streamline and normalize the back office systems to get ready for replicating the DDIP at other area farm markets and farmers' market systems.

Since SFC is very focused on hunger/food insecurity and obesity prevention, programming primarily targets families, neighborhoods and schools within the most economically disadvantaged zip codes of Austin. SFC also serves the more than 50 specialty crop farmers, who make up the majority of the vendors in the SFC Farmers' Market system. The DDIP proved to address both needs: 1) Increase consumption of fruits and vegetables to begin the trend to address diet related disease; and 2) Contribute to the viability of small local family farms by increasing the competitive sales in fruits and vegetables.

The Center for Disease Control confirms there is a high correlation of diet-related illnesses and poverty (<http://www.cdc.gov/chronicdisease/states/pdf/texas.pdf>), and recommends that communities, "improve availability of mechanisms for purchasing foods from farms." Studies also strongly demonstrate that the consumption of nutritious food, such as fresh fruits and vegetables, can improve academic performance in children and reduce the incidence of diet-related diseases by half.

This project expansion did benefit from a previous Specialty Crop Promotion grant that helped Sustainable Food Center initiate the operations for Double Dollar Incentive Program as the first one in the state at our two pilot markets.

Project Approach

The Double Dollar Incentive Program (DDIP) expansion grant continued the momentum of a roll out to the third and fourth markets of Sustainable Food Center in October, 2013. The 2012 SCBG allowed staff to continue operations of the program at two sites to increase the competitiveness of the fruits and vegetables from local farmers, and, to begin the planning and refining of operations to replicate them at two additional sites in FY 2013-2014. This grant allowed staff to move forward to train all farmers at the four markets now operating the DDIP, and increase staff for conducting the food access and doubling transactions at the market in efforts to make specialty crops more competitive. Specialty crop farmers selling fruits and vegetables at the market in this final grant period of 12/1/13 through 3/31/15 sold \$101,563 as a result of the DDIP. During this same time, the grant allowed farmers to reach 2,233 unduplicated clients. Including family members in the client households, this represents a total of 7,816 individuals who benefited from the program. 100 percent of the participating specialty crop farmers reported some increase in sales, while the objectives were that 80 percent would. Staff in this third full year and beginning fourth year continued to refine the processes for the on-site operations team that were executing the program, and also instituted training sessions for the volunteers who assist the DDIP coordinator.

There is now a brief, easy to read tip sheet that is readily available for new incoming volunteers to use in the action-packed market setting when DDIP volume is high. Two at-market Food Access Coordinators were hired year-round to cover weekly transactions at the four markets, and during the busier season from May – July, we hired two additional staff who could manage both DDIP transactions, as well as the seasonal Farmers' Market Nutrition Program processing. Up to eight additional market staff, including on-site market coordinators, co-coordinators, operations manager, and program director as well as the new program manager were trained extensively in the DDIP operations. During the expansion into the third and fourth Sustainable Food Center markets, the SFC Farm Direct Program Director and SFC Food Access Manager refined the training materials for the farmers and conducted on-site trainings with 29 farmers. This was three less than the 32 anticipated. The operations steps for implementing the program at farmers' markets were designed with such detail and precision that Wholesome Wave Foundation and USDA requested SFC's operational description for use nationwide.

Training includes details on the types of scrip (WIC, SNAP, DDIP), the significance of each of these scrip types, customer interaction standards, redemption processes, and tracking requirements. In order to support the training, the SFC Farm Direct Program Director, the SFC Food Access Manager, each of the DDIP coordinators, the SFC Farmers' Market Coordinators, and Information Booth Volunteers conduct role playing with the farmers to prepare them for participating in the program and understanding how to sell their specialty crops competitively. Additional training and monitoring continues constantly as new representatives from farms come into the markets.

A strong operational and programming team designed a quick and efficient process to access DDIP benefits, and maintained a consistently high quality market with ample volume and variety of specialty crops for the clients, many of whom had not experienced a farmers' market before, and who certainly had never used DDIP before. The operations of the market implementation on market day consists of two hours of set up, four hours of running the market, then two hours of

break down. The market manager was on site at all times for market operations, trouble shooting of electronic benefits transfer (EBT) terminals, collecting scrip for reimbursement to farmers, and generally making clients and shoppers feel welcome to be in the market. There was also a bilingual DDIP coordinator, who provided the explanations to clients and who ran the SNAP, Texas WIC EBT and FMNP doubling process, which included direct client interaction, operation of the SNAP and WIC EBT terminals, and client data entry used to track and evaluate program impact.

In order to track the SNAP, Texas WIC, and FMNP benefits spent and to document increased competitiveness of specialty crops, specialty crop purchases and the corresponding Double Dollar Incentive dollars were recorded via a paper scrip system. Previously, SFC used a token system for SNAP purchases at SFC markets for over five years and the farmers and other vendors were already trained on how to accept the tokens for SNAP eligible products like milk, eggs, etc. Tokens were phased out over several months and adopted counterfeit-proof paper scrip, easily transportable and also easy to count in a money counter machine, increasing our efficiencies.

Staff separated the SNAP benefits for fruits and vegetable buys from the other SNAP-eligible, non-fruit and vegetable purchases in the following manner:

Step 1: A customer approaches the central information booth to use a SNAP card.

Step 2: The market coordinator asks the customer the following questions: “How much would you like to purchase today from your SNAP card for fruits and vegetables, knowing that you will get a ‘match’ for those fruit and vegetable purchases with double dollars in a one for one match up to \$10? Would you like to get tokens for any eligible, non-fruit/vegetable SNAP purchases such as eggs, bread or honey, which are not matched with double dollars?”

Step 3: The customer tells the coordinator they want to take \$10 from their SNAP account for fruits and vegetables and \$10 for non-matched eligible items. (This is just a sample, it has been a number of different variables each time).

Step 4: The market coordinator swipes the card and processes a \$20 transaction.

Step 5: The market coordinator indicates the following on the \$20 SFC receipt of the transaction: \$10 in TOKEN amount for non-matched, eligible items (non-fruit and vegetable), and \$10 in Double Dollar matched eligible items. The customer will receive \$10 in scrip to signify the withdrawal from their SNAP account, which indicates that it can only be used for fruits and vegetables. The customer will also receive \$10 in scrip for the ‘doubling’ of their \$10 SNAP purchase in fruits and vegetables. The total in scrip the customer receives is 20 \$1 SNAP Double Dollars that can only be used to buy fruits and vegetables. The customer will also receive \$10 in market tokens for the non-matched portion of the transaction.

Step 6: The coordinator asks the client for their first name and if this is their first visit to the market. They also ask them for the last group of four digits on their SNAP card. The coordinator then records this information immediately on the laptop computer at the market.

Step 7: The coordinator then records on the laptop the amount of non-matching SNAP scrip that the client receives, the amount of scrip that the client receives, and the matching amount of scrip double dollars that the client receives – exactly one to one – for the fruit and vegetable portion of the SNAP purchase.

Step 8: The coordinator then gives the client their scrip, and ensures that the customer understands the difference between the two forms of payment before they leave the central

information booth. All farmers and vendors at the market understand what these forms of payment can be used for which is how the spending is controlled once the customer leaves the booth to shop.

In addition, the Sustainable Food Center (SFC) was one of the 501 (c) (3) entities that were contracted with the Texas Department of Agriculture to administer the Farmers Market Nutrition Program. All entities in other cities in Texas in the FMNP program were food bank organizations working with area farmers' markets. In Austin, SFC distributed the FMNP in voucher booklets. This put SFC in a unique situation to distribute the vouchers designated for Women, Infant and Children (WIC) eligible clients right at the farmers' markets, where the clients would then be able to immediately purchase fruits and vegetables from the farmers. The FMNP program specifically limits purchases to only fruits and vegetables at participating farmers' market associations. At the time of the implementation of the TDA supported FMNP program, SFC Farmers' Market worked with other farmers' markets in the area to accept FMNP (though other markets did not have the capacity to issue the vouchers). The issuance of the voucher booklets at SFC Farmers' Markets (all four sites) was conducted by an SFC staff person hired for the season, but also trained in the processes of the DDIP operations in order to provide backup for the year-round Food Access Coordinator, if needed. The location of the farmers' markets as the distribution point was an added incentive for WIC moms to come to the markets in the first place, and because we already had the staffing for the DDIP program, and the funding (from private foundations) for the matching dollars, we instituted doubling of purchases on the FMNP purchases as well, tying in the traceability of the fruit and vegetable purchase with a receipt that was written by the farmer, that was then brought back to the information booth for the DDIP coordinator to record the receipt of the FMNP purchase total. Data was then entered for the amount of the purchase, and the amount of the matching scrip (marked as FMNP scrip double dollars only) that was issued. The farmer kept the vouchers that they had received from the FMNP client, and then turned them in according to prescribed processes for the voucher system.

Key to the success of this project were the outreach and advertising efforts designed to inform potential clients about the program details. SFC sought culturally appropriate outlets through which to promote the program, including radio and outdoor advertising, as well as grassroots outreach both directly with clients and through other community partners. Spanish radio station Radio Mujer, which targets its broadcasts to Hispanic women and families and addresses topics related to health and nutrition, hosted several interviews with SFC's Food Access Program Manager. SFC also purchased a billboard near the site of our East market, which was displayed for several months during the height of harvest season for specialty crops. Purchased media is costly, however, and so much of the approach centered on grassroots connections with clients. SFC collaborated with various non-profits, schools, churches, and state and local agencies, that interact with potential clients. These partners distributed flyers about DDIP in the community, and many of them hosted presentations or events where SFC staff could share information directly. Among the most notable connections were the local WIC clinics, where SFC could distribute flyers at their vegetable fairs and also work with the WIC nutritionists to share info with their clients. SFC staff also distributed flyers and information through our own programming, such as gardening workshops and healthy cooking classes. SFC will continue to utilize effective paid advertising and earned media to raise awareness about DDIP. SFC will also continue cultivating community connections that enable staff to directly reach individual clients.

Goals and Outcomes Achieved

SFC expanded DDIP to the SFC Farmers' Market Downtown and SFC Farmers' Market at the Triangle, making DDIP available to the community at all four SFC Farmers' Market. SFC anticipated that specialty crop farmers would receive \$120,000 in additional sales because of this expansion. Between the December 1, 2013 to March 31, 2015, DDIP sales reached \$101,563 across all four farmers' markets. In the previous year, farmers had a total of \$86,757 in sales. We reached less than the desired goal of \$120,000, due largely in part that the number of FMNP vouchers we were able to distribute (and then thus "double") was limited in 2014 and we ran out of vouchers more than three months early before the end of the issuance period.

SFC anticipated that we would reach 2,600 individual, unduplicated clients during this period. We did reach 2,233, when counted with 3.5 family members, includes 7,816 people reached. In the previous year, with just two markets, we had reached 1,726 unduplicated clients. While the number of unduplicated clients is slightly less than anticipated, there was an encouragingly high number of repeat shoppers.

SFC surveyed 50 DDIP clients between May and June of 2014 to evaluate client participation, healthy eating behaviors, and barriers or facilitators to healthy eating. Surveys were conducted at all four SFC Farmers' Markets. Of the initial 50 surveys conducted, 31 participants were available to complete a follow-up survey. Of the follow-up surveys, 41.9 percent of them reported an increase in the consumption of fresh fruits and vegetables. Survey data revealed that 80.6 percent of participants reported DDIP was moderately to very important in their decision to shop at the farmers' market. Based on analysis of survey data the primary reasons, in order of importance, for which clients visit SFC Farmers' Markets are 1) The quality of fresh fruits and vegetables; 2) Acceptance of SNAP, WIC, and FMNP federal benefits; 3) Selection of fresh fruits and vegetables. An additional one day snapshot survey was taken this past June, 2014, at our longest-standing DDIP farmers' market, the one on East MLK Boulevard; 20 customers revealed that 90 percent of them were increasing their fruit and vegetable consumption.

Beneficiaries

A total of 29 local farmers, the same as the previous year, were involved in the Double Dollar program. There were also 2,233 unduplicated clients (up from 1,726 the previous year) who benefitted. The shoppers, who also shared their purchases of fruits and vegetables with approximately 3.5 other members of the family, were preparing healthy foods for 7,816 individuals. The Double Dollar program, upholding the competitiveness of fruits and vegetable farmers in central Texas, could not have been possible without the funding of the incentive dollars by foundations like St. David's Foundation, Anderson Foundation, Farm Aid, and Wholesome Wave to match the purchases made by SNAP and WIC shoppers.

Lessons learned

The outreach for the DDIP needs to continue each year, as new clients from SNAP and WIC enter into the system. And, new staff at SNAP and WIC offices need to stay informed. The importance of community outreach and engagement has become so important for SFC that we have one full-time and one part-time staff dedicated to reaching out to strong organizations with similar constituents with the information about the DDIP that they in turn can disseminate to their clients.

SFC proposed that 80 percent of families participating in a survey would report an increase in the consumption of fresh fruits and vegetables. According to the results from the survey conducted between May and June of 2014, only 41.9 percent of them reported an increase in the consumption of fresh fruits and vegetables. The evaluation tool that was used was designed to capture general data, but it may need to be changed in future years in order to account for new and returning DDIP clients. The short time frame between the pre and post survey may have also accounted for the results, since many of the participants had only visited the market once. Our on-the-spot snapshot survey continues to garner high percentages of respondents that do report that they have increased their vegetable consumption. We have yet to administer the 4th year (summer) snapshot survey this year, in 2015, to see if there is any change in the responses based on new questions.

We did establish a smaller replication of the DDIP program, after the Austin/Travis County Sustainable Food Policy Board recommended funding Sustainable Food Center to train and administer an expansion of DDIP operations at neighborhood farm markets and other area farmers' markets. The training and implementation is occurring this summer and fall, 2015.

PROJECT 3: TRUFFLE PRODUCTION AND PROMOTION IN TEXAS: ADDING VALUE TO THE PECAN INDUSTRY

Partner Organization: Texas Pecan Growers Association

Project Manager: Ms. Cindy Wise

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Type of Report: Final

Date Submitted: 31 July 2015

Project Summary

Truffles have not been commercially produced in Texas because production knowledge and promotional programs are lacking. At about \$200/lb., American truffles are worthy of attention for commercial production and development of a specialty industry in Texas. Pecan truffles can be found by looking just under the soil surface around the roots of pecan trees. Truffles are easier to locate in commercial pecan orchards because weeds are controlled. Although Texas has roughly 175,000 acres in pecan production, the pecan truffle is largely unknown to pecan growers although this is changing due to the support from the Specialty Crop Block Grant Program. Little information exists on methods for dual cropping of pecans and pecan truffles. The purpose of this project is to promote and support the development of a specialty crop industry for truffles, which adds value to the pecan industry and complements other fledgling specialty industries in Texas including olive oil, wine grapes and lavender. Information developed on dual cropping of truffles and pecans will be shared with growers and consumers to enable the industry to capitalize on this high value crop. In summary, in this 3rd year of this novel research and outreach effort, project team discovered and disseminated information to growers and educators on the distribution of pecan truffles, optimal production methods for producing truffle-inoculated seedlings, and culinary use of truffles. Locating large quantities of naturally occurring truffles under current pecan orchard management practices remained a challenge, which highlights the fact that management of irrigation and other factors may be especially more important in Texas. Project staff expanded the number of directly involved growers by another 20 percent over the previous two years. Positive indication of interest in pecan truffle was again observed in 100 percent of the participants.

Project Approach

In collaboration with the Texas pecan: industry, growers, researchers and educators, project staff accomplished the objectives listed below:

Objectives 1 & 2: Promote truffles to growers and consumers and assess the presence of: (a) pecan truffle inoculum in roots of pecan nursery stock, (b) pecan truffle fruiting bodies in orchards, and (c) evaluate the longevity of truffle inoculum in inoculated trees transplanted at orchards:

One of the primary activities for the funding year was to promote the use of truffles to growers and consumers in Texas. Toward this end, several activities were completed. First, project staff visited pecan orchards statewide and also conducted workshops to provide hands-on opportunities for exposing the producers and consumers to truffle production and use. A Pecan and Truffle

promotion workshop was conducted at the Texas Pecan Growers Association meeting in July 2014. Approximately 600 attendees had an opportunity to learn about the culinary use of truffles and were able to also observe a demonstration of the inoculation process (Fig. 1). A display booth was set up to demonstrate the inoculation procedure whereby interested personnel were shown how to inoculate pecan seedlings with truffle inoculum.

Figure 1. Culinary use of truffles was demonstrated at Texas Pecan Growers Association annual conference in San Marcos, Texas in July 2014.



Additionally, approximately 30 participants completed oral or written surveys to indicate that they enjoyed the taste of truffle-enhanced dishes at the Conference, and they were interested in having their orchards surveyed for pecan truffles.

One grower that the project staff worked very closely with hosted a group of 10 – 12 students from a culinary school in Austin. The students were shown pecan truffles at the grower's orchard. Their culinary use also was demonstrated to the students, who were impressed by the aroma of pecan truffle.

Bi-monthly pecan surveys indicate that pecan truffles are found fruiting throughout the year in New Mexico and Northern Texas where the orchard or the home lawn is irrigated. Soil moisture is emerging to be key for fruiting. Fall and winter appear to be better times of the year to locate the truffles in Texas.

In November 2014, an organized pecan truffle survey was conducted at targeted farms, including the USDA Pecan Breeding Station in Somerville, TX. At this time, the station staff were trained in how to plant inoculated pecan trees. They were also given plants of 4 cultivars that were inoculated with pecan truffle inoculum. Please see the salinity test section to see the details of the

cultivar names and the inoculation treatments. Three other farms were targeted for planting inoculated plants. Growers were given up to 20 inoculated pecan seedlings each.

Figure 2. Inoculated plants were distributed to growers in Texas to be planted at their orchards. Figures 2a to 2d show the planting activities at various farms in Texas.

2a.



2b.



2c.



2d.



To assess the fruiting of pecan truffles in pecan orchards or under pecan trees, project staff sampled for the presence of pecan truffle in pecan orchards in year 2014 and pecan trees in home yards. Truffle fruiting bodies in orchards were located in 2014 (Fig. 3) near an irrigation line in southeast Texas at a pecan orchard. Moisture from the irrigation lines is expected to create favorable environment for truffle fruiting. When dog-assisted searches were conducted in November 2014, few truffles were located. The largest proportion of truffles were located in home yards in NW Texas in Lamb County. Collaborators from New Mexico, Tennessee, North Carolina, and Georgia reported truffles but only a few grams were located in each of the States.

Figure 3. *Tuber lyonii* fruiting bodies were located near an irrigation line in a pecan orchard. Soil moisture appears to be an important factor in stimulating pecan truffle fruiting.



It was also observed that *T. lyonii* generally fruits in October, November and December although we now have evidence of pecan truffle fruiting in April (Fig. 3). Although the yields decline in December in colder/drier weather, it indeed produces fruiting bodies even in December in Northwest Texas. Results from the SCBGP studies also indicate that moisture availability is likely very important for the fruiting of pecan truffle.

When the seedlings planted across several orchards in 2013 were examined, their roots contained ectomycorrhizal colonization and the plants continued to grow. Staff observed only 1 percent mortality across all the seedlings that were planted (Fig. 4).

Figure 4. New growth was documented in 2014 on pecan seedlings planted in Fall 2013. All plants planted in 2013 have survived and are producing foliage. Their roots continued to be colonized by ectomycorrhizal fungi. Inoculated seedlings were 1-yr old when they were first transplanted in September 2013.



Objective 3: Evaluate the effect of salinity on pecan root stocks and on pecan truffle symbiosis: In August 2013, project staff planted 3,500 seed representing 48 diverse pecan seedstocks originating from as far south as Ixmiquilpan, Mexico, as far north as Peruque, Missouri. Seed from indigenous stands of pecans on Gulf Coast of Louisiana were included, along with seed from native pecans growing at the western edge of the range in Schleicher County, Texas. Seed was planted in a split plot test on 5 benches in a greenhouse, with each bench divided to receive two irrigation treatments: one was irrigated with rainwater and the other with well water high in bicarbonates (620 ppm) and relatively high in Cl (100 ppm). Seedlings were irrigated as needed, once per week in the winter and up to three times per week in the summer. Seedling emergence was monitored and recorded. Diameter at 2 cm above the soil and seedling height was measured in December 2014, and again in June, 2015. Due to excessive mortality and seedling dieback, only results from the December measures are presented.

Water treatment had a significant effect on seedling height, but not on diameters or dates of emergence. Diameters are greatest in the southern provenance. Height was also significantly affected by provenance of origin, with the southern seedstocks growing tallest and the northern being the shortest. This is consistent with other studies. The salty irrigation water resulted in a significant reduction in seedling heights across the entire test. There was a strong interaction between seedstocks and the salinity treatment, with some entries showing increased height in the salty water treatment.

Seed from ‘Curtis’ and a selection from Ixmiquilpan Mexico (87MX4-5.5) were the most vigorous seedstocks tested, and showed negligible deleterious effect of the salty water irrigation.

Selected cultivars were then further tested for truffle inoculation and salinity interactions. Because seedlings were not completely dormant when received for these experiments, and because inoculation requires smaller root systems, a 2-stage fibrous root removal system was developed to prepare the plants for inoculation. First stage of fibrous root removal involved removal of 2/3rd of the fibrous roots from each seedling (Fig. 5). Five weeks were subsequently allowed for new root growth. Second stage of fibrous root removal occurred after the 5-week period when only the new roots were left on the plant while all old fibrous root were removed. Each seedling was planted into 30cm cone-tainers for further growth in sterile medium (developed previously for optimizing pecan growth). After two weeks of root growth in sterile medium, plants slated for inoculation with *T. lyonii* were supplied with truffle spores. Plants to be treated with saline water receive city water whereas RO (reverse osmosis) water is applied to those in the low salinity treatment. Staff are also testing different inoculation methods whereby either a 3-stage aqueous drench is applied or a one-time slurry application is conducted. All plants are fertilized via foliar application of Miracle-Gro water soluble all-purpose plant food (24-8-16) and with Nickel Plus at the recommended rate. Pest control for aphids is conducted as needed. Plant growth is monitored and data are recorded every 3 weeks. After a period of 6 months from inoculation, first root assessment was conducted.

Figure 5. Pecan seedlings before (left) and after (right) removal of fibrous roots to prepare the seedlings for inoculation.



Results from the inoculation and salinity tests are presented below in Tables 1 through 4.

Table 1. One rootstock variety was tested for different application methods of inoculation to assess the efficiency of the application method. The table below shows that each of the two application methods was equally effective when the response variable was plant height.

Rootstock	Inoculation	Replicate	Plant height	sd
Major	Aq3	1	19.6	3.3
Major	Aq3	2	16.1	3
Major	Aq3	3	24.1	3.6
Major	Aq3	4	16.3	3.4
Major	Aq3	5	19.8	3.2
Major	Aq3	6	15.1	3.5
Major	Aq3	7	16.9	3
Major	Aq3	8	21.4	3.5
Major	Paste	1	21.4	3.6
Major	Paste	2	18.7	3.3
Major	Paste	3	19.8	3.2
Major	Paste	4	17.5	3.2
Major	Paste	5	21.7	3.5
Major	Paste	6	24.1	3.8
Major	Paste	7	27.0	3.6
Major	Paste	8	20.7	3.1
Major	Control	1	19.6	3.5
Major	Control	2	9.0	1.8
Major	Control	3	28.2	3.3
Major	Control	4	19.4	3.7
Major	Control	5	29.1	3.4
Major	Control	6	14.7	3.1
Major	Control	7	14.1	3
Major	Control	8	20.5	3.4

Table 2. One rootstock variety was tested for different application methods of inoculation to assess the efficiency of the application method. Results showed that because the project period allowed for short-term evaluation only, the ectomycorrhizal colonization had not yet become measurable. T.1 stands for *Tuber lyonii*.

Rootstock	Inoculation	Replicate	Sample Length	Total Root-tips	EcM(T.1.)	Tip Density
Major	Aq3	1	10.4	28	0	3
Major	Aq3	3	8.5	28	0	3
Major	Aq3	6	6.9	31	0	4
Major	Paste	8	4.4	18	0	4
Major	Paste	2	6.4	42	0	7
Major	Paste	6	6.8	26	0	4
Major	Control	7	6.4	49	0	8
Major	Control	6	5	31	0	6
Major	Control	3	7.1	38	0	5

Table 3. Three pecan rootstock varieties were tested for the interactive effect on plant height in response to inoculation and salinity in irrigation water.

Rootstock	Inoculation	Water	Replicate	Plant height	sd
San Felipe	Aq3	RO	1	26.6	2.9
San Felipe	Aq3	RO	2	20.7	2.7
San Felipe	Aq3	RO	3	30.4	3.5
San Felipe	Aq3	RO	4	32	3.2
San Felipe	Aq3	RO	5	31.1	3.4
San Felipe	Aq3	RO	6		
San Felipe	Aq3	CW	1	30.8	3.6
San Felipe	Aq3	CW	2	28.4	3.8
San Felipe	Aq3	CW	3	24.8	3.5
San Felipe	Aq3	CW	4	34.7	4
San Felipe	Aq3	CW	5	20.9	3.3
San Felipe	Aq3	CW	6	10.7	2.6
San Felipe	Control	RO	1	10.8	3.4
San Felipe	Control	RO	2	21.2	3
San Felipe	Control	RO	3	24.4	3.2
San Felipe	Control	RO	4	8.9	2.6
San Felipe	Control	RO	5	18	3.4
San Felipe	Control	RO	6		
San Felipe	Control	CW	1	27.4	3.3
San Felipe	Control	CW	2	20.2	3.1
San Felipe	Control	CW	3	25.4	3.8
San Felipe	Control	CW	4	23.6	3
San Felipe	Control	CW	5	31.1	3.5
San Felipe	Control	CW	6	21.9	3.1
87Mx4-5.5	Aq3	RO	1	19.3	3.6
87Mx4-5.5	Aq3	RO	2	22.1	3.4
87Mx4-5.5	Aq3	RO	3	32.6	3.9
87Mx4-5.5	Aq3	RO	4	24.2	3.6
87Mx4-5.5	Aq3	RO	5	29.8	3.8
87Mx4-5.5	Aq3	RO	6	25.4	3.3
87Mx4-5.5	Aq3	CW	1	29.4	3.7
87Mx4-5.5	Aq3	CW	2	46.3	3.8
87Mx4-5.5	Aq3	CW	3	36.7	3.1
87Mx4-5.5	Aq3	CW	4	17.1	2.7
87Mx4-5.5	Aq3	CW	5	8.7	2.2
87Mx4-5.5	Aq3	CW	6	24.9	3.5
87Mx4-5.5	Control	RO	1	37.4	3.3

87Mx4-5.5	Control	RO	2		32.1	4.1
87Mx4-5.5	Control	RO	3	40.3		3.6
87Mx4-5.5	Control	RO	4	18.5		2.5
87Mx4-5.5	Control	RO	5	18.4		3.1
87Mx4-5.5	Control	RO	6	18.1		3.7
87Mx4-5.5	Control	CW	1	25.9		2.9
87Mx4-5.5	Control	CW	2	21.9		3.2
87Mx4-5.5	Control	CW	3	31.3		2.6
87Mx4-5.5	Control	CW	4	32.5		4.1
87Mx4-5.5	Control	CW	5	27.2		3.9
87Mx4-5.5	Control	CW	6	37.1		3.4
A-93	Aq3	RO	1	26.7		4.4
A-93	Aq3	RO	2	17.7		3.6
A-93	Aq3	RO	3	29.4		3.3
A-93	Aq3	RO	4	35.3		3.8
A-93	Aq3	RO	5	35.4		3.9
A-93	Aq3	RO	6	11.4		2.5
A-93	Aq3	CW	1	34.6		3.9
A-93	Aq3	CW	2	29.7		4.4
A-93	Aq3	CW	3	26.3		3.5
A-93	Aq3	CW	4	20.5		3.4
A-93	Aq3	CW	5	25.5		4
A-93	Aq3	CW	6	19.1		2.8
A-93	Control	RO	1	30.3		3.6
A-93	Control	RO	2	21.4		3.3
A-93	Control	RO	3		2	0.9
A-93	Control	RO	4	20.6		3.1
A-93	Control	RO	5	20.8		3.8
A-93	Control	RO	6	30.9		4.2
A-93	Control	CW	1	24.1		3.2
A-93	Control	CW	2	31.4		3.6
A-93	Control	CW	3	30.8		3.3
A-93	Control	CW	4	18.2		2.4
A-93	Control	CW	5	23.6		3.2
A-93	Control	CW	6			

Table 4. Three pecan rootstock varieties were tested for the interactive effect on plant height in response to inoculation and salinity in irrigation water. T.I stands for *Tuber lyonii*.

Rootstock	Inoculation	Water	Replicate	Sample Length	Total Root-tips	EcM(T.I.)	Tip Density
San Felipe	Aq3	RO	3	8.4	45	13	5.4
San Felipe	Aq3	RO	1	5.6	25	0	4.5
San Felipe	Aq3	RO	4		29	0	7.3
San Felipe	Aq3	CW	1	5.4	36	0	6.7
San Felipe	Aq3	CW	6	8.4	35	0	4.2
San Felipe	Aq3	CW	5	8.5	31	0	3.6
San Felipe	Control	RO	1	6.6	34	0	5.2
San Felipe	Control	RO	3	6.9	29	0	4.2
San Felipe	Control	RO	5	8.2	30	0	3.7
San Felipe	Control	CW	1	6.4	30	0	4.7
San Felipe	Control	CW	4	7.9	27	0	3.4
San Felipe	Control	CW	5	4.5	27	0	6.0
87Mx4-5.5	Aq3	RO	3	4.4	24	0	5.5
87Mx4-5.5	Aq3	RO	5	4.7	23	12	4.9
87Mx4-5.5	Aq3	RO	4	7.8	50	0	6.4
87Mx4-5.5	Aq3	CW	3	4.2	20	0	4.8
87Mx4-5.5	Aq3	CW	4	3.1	14	0	4.5
87Mx4-5.5	Aq3	CW	2	5.1	22	19	4.3
87Mx4-5.5	Control	RO	2	5.9	35	0	5.9
87Mx4-5.5	Control	RO	5	9.1	36	0	4.0
87Mx4-5.5	Control	RO	6	3.6	17	0	4.7
87Mx4-5.5	Control	CW	3	11.5	24	0	2.1
87Mx4-5.5	Control	CW	4	4.3	24	0	5.6
87Mx4-5.5	Control	CW	6		20	0	5.0
A-93	Aq3	RO	4	6.8	34	0	5.0
A-93	Aq3	RO	6	3.7	14	0	3.8
A-93	Aq3	RO	3	4.1	14	0	3.4
A-93	Aq3	CW	1	4.5	17	0	3.8
A-93	Aq3	CW	5	6.5	35	0	5.4
A-93	Aq3	CW	2	5.9	25	0	4.2
A-93	Control	RO	1	9.3	43	0	4.6
A-93	Control	RO	2	7.5	40	0	5.3
A-93	Control	RO	6	7.4	26	0	3.5
A-93	Control	CW	2	10.1	37	0	3.7
A-93	Control	CW	3		19	0	3.8
A-93	Control	CW	1	9.4	40	0	4.3

Goals and Outcomes Achieved

The goal was to provide best production practices for co-cropping of truffles and pecans in Texas and increase truffle production knowledge of Texas pecan growers to ultimately increase truffle production and use in Texas. Project staff shared results with growers, consumers, industry and general public during state-wide surveys of truffles, and via presentations at industry and academic conferences. Up to 600 attendees were exposed to truffle inoculation and culinary use at TPGA conference. Additionally, at least 50 other growers and consumers were directly trained or educated in truffle production, inoculation, and/or culinary use. Furthermore, the project team increased the number of growers and industry personnel who were exposed to relevant information by 20 percent over the last two years. Our surveys indicated that 75 percent of the participants increased their knowledge of the culture, use, and harvesting methods for culinary truffles and pecan truffles especially.

Beneficiaries

1. Texas Pecan Growers Association (TPGA) members - this is an organization whose members include pecan growers, pecan value-added industry members (i.e. pecan oil, pecan bread, etc.), farm-equipment industry personnel, academic members from various universities including those in Georgia, Oklahoma, New Mexico, and from across Texas. Approximately 600 members were exposed to the educational and research information.
2. Non-TPGA members in Texas - pecan growers that are not paying members of TPGA. Approximately 50 non-TPGA members were exposed to educational and research information via direct inquiry (individuals e-mailing or calling with questions).
3. USDA ARS Pecan Breeding Station (Somerville, TX) - staff at the USDA Pecan Breeding Station. At least 4 members of the station directly participated in the truffle searches, educational activities, and providing research materials.
4. Montz Pecan Orchard (Charlie, TX) - pecan orchard owner and staff. At least 5 members of the operation directly participated in educational discussions and truffle searching at the orchard.
5. Yegua Creek (Elgin, TX) - pecan orchard owner and value-added vendor - At least 4 staff members assisted with truffle searching, planting the inoculated seedlings, and/or educational discussions.
6. Kleins' (Bastrop, TX) - homeowner who has a pecan orchard at his property. At least 3 members of the family assisted with truffle searching and educational discussions.
7. Pecan Grove Plantation (Bastrop, TX) - commercial pecan orchard.
8. Cinco B Farms (Brenham, TX) - homeowner and pecan orchard owner.
9. University of Georgia - One research collaborator from UGA.
10. University of Florida - Three research collaborators from UF.
11. Homeowners in Texas - At least 6 homeowners with pecans on their property were directly involved in the truffle searching activities.
12. Homeowners in New Mexico - Two homeowners who have dog breeding operations and pecan orchards on their property provided data on truffle fruiting.
13. Truffle dog trainers in Oregon, Tennessee, New Mexico. - Two trainers assisted with truffle searches and helped to disseminate information on pecan truffles from Texas.

Lessons Learned

1. As expected, inoculation of pecan seedlings with *Tuber lyonii* inoculum is a technical skill that requires special training and conditions. Project staff is gaining expertise in this method and yet many questions remain unanswered. This skill itself can be a value-added industry for pecan nurseries. It is an opportunity currently unexplored in Texas. Maximizing the colonization while minimizing the inoculum needed is a broad question that needs to be investigated further.
2. Production of pecan seedlings in containers has additional challenges of disease management and fertilization management. Project team has discovered some environmental conditions and management conditions necessary for culturing truffle-inoculated seedlings of pecan. However, the conditions still need to be optimized.
3. Working with pecan truffles is a process that requires patience and time. Time to first fruiting could be up to 7 or 8 years (similar to that of the pecan trees). If inoculated seedlings are planted, fruiting of the tree and that of the mycorrhizal partner could occur about at the same time. The natural abundance of the truffle seems to be restricted by moisture availability. With sufficient soil moisture, pecan truffles produce fruiting bodies reliably.

Publications and Presentations

Hamilton, WM and J Sharma. 2014. *Tuber lyonii*. Poster Presentation, Texas Tech University.

Hamilton, WM and J Sharma. 2014. *Tuber lyonii* - uses and production. 30 March. Oral Presentation, Texas Tech University.

Hamilton, WM, J Sharma, LJ Grauke, and C. Wise. 2014. A workshop on inoculating pecan seedlings with *Tuber lyonii*. Texas Pecan Growers Association Annual Conference. 13-16 July. San Marcos, Texas.

Hamilton, WM. 2014. Maximizing the symbiosis of *Tuber lyonii* with *Carya illinoensis*. M.S. Thesis. Sharma, J. (Supervisor). Texas Tech University.

PROJECT 4: PECAN SCREENING NURSERY FOR COTTON ROOT ROT RESISTANCE

Partner Organization: Texas Pecan Growers Association (primary) Texas A&M AgriLife Extension Service (partner)

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Project Summary

Texas pecan growers do not yet have highly effective control techniques for cotton root rot disease, caused by *Phymatotrichopsis omnivora*. Profits are decreased in warmer parts of Texas, New Mexico, Arizona and northern Mexico because pecan (*Carya illinoensis*) trees often die after infection by *Phymatotrichopsis omnivora* (syn. *Phymatotrichum omnivorum*; hereafter, *P.o.*), an endemic soilborne fungal pathogen causing root and crown decay in more than 2,000 dicotyledonous plant species. The project is timely because increasing mean temperatures are rising and *P.o.* is a high temperature pathogen. Monocots are highly resistant or immune. Common names of the disease include cotton root rot (CRR); *Phymatotrichopsis* root rot, and Texas root rot. Grafting pecan varieties on a resistant rootstock at high risk sites would reduce tree losses and improve profits. No technique was previously available to evaluate pecan germplasm for reaction to *P.o.*

Project staff estimate statewide potential income lost at \$435,000 per year, with highest losses in warmer calcareous high pH soils of Texas. The disease also kills pecan trees in regions of New Mexico, Arizona and northern states in Mexico which have similar soils and high temperatures. Grafting pecan varieties on a resistant rootstock would reduce direct losses, allow replanting and improve profits.

Pecan co-evolved with *P. omnivora* because the center of origin for pecan and the current ranges of both native pecan (*Carya illinoensis*) and the cotton root rot fungus overlap in large areas of Texas and northeast Mexico. Researchers hypothesize that some native pecan genotypes have useful resistance to *P. omnivora*.

Native pecans are considered moderately resistant (Taubenhaus and Ezekiel, 1936), but losses in improved variety pecan orchards can be significant (Nesbitt, 1992). Commercially recommended rootstocks for Texas appear to be more susceptible than native populations located in hyperthermic climates in the southern part of the center of origin (native geographical range) for this tree nut species. Populations from lower (southern) latitudes may have more resistance to *P.o.* than populations from higher (northern) latitudes. Rare or near zero mortality in native pecan stands may be due to less fruit load as well as partial resistance, so documentation of resistance variation is needed under controlled plot conditions. L. J. Grauke previously collected germplasm from southern (south Texas, northeast Mexico), western (New Mexico, West Texas), northern (Kansas, Oklahoma, Illinois), and eastern (Georgia, Alabama, etc.) parts of the native and current cultivated range (Fig. 3). In other plant species, early senescence seems to be

associated with CRR susceptibility. Late leaf senescence phenology, frequent among provenances from lower latitudes, may be a useful indicator of CRR resistance.

Attempts to screen pecan, grape, cotton, and other plant species for *P.o.* resistance in greenhouse containers have failed because the disease is very difficult to induce in container grown plants. Plant breeding and variety improvement projects that select only for horticultural traits (yield, grade, winter hardiness, etc.) typically develop varieties susceptible to disease. There is currently no fungicide effective and labeled for control in pecan. Various soil amendments and fumigation have not provided long term control and are prohibitively expensive. Replanted trees usually die from the same disease. High average temperatures in recent years favored growth of this high-temperature fungus for more weeks of each year, and in more Texas pecan acres.

Vacant places in affected orchards decrease production efficiency because irrigation and other inputs often continue on surviving trees. Growers are encouraged by recent periods of high prices for pecans and need strategies to bring heavily diseased blocks back into production.

Funded by the 2012-13 SCBG, project staff established a pecan screening nursery with conditions favorable for cotton root rot disease to compare diverse populations and appropriate checks. The short term objective is to continue maintenance and evaluations of a high-density disease screening field nursery at Uvalde, Texas site at high risk of CRR to evaluate diverse pecan germplasm for *P.o.* survival, and to inform growers of early disease ratings among entries. A robust and rapid screen will reduce time required for new rootstock development from decades to a few years. Seeds of commercially available rootstocks (control treatments) and diverse pecan populations (half-sib families from single trees) from a range of latitudes and longitudes were gathered, germinated, and transplanted in replicated field plots. Our long term objective is to develop a high quality resistant pecan rootstock. Clonal micropropagation techniques have recently shown promise for pecan and could soon be used to increase unique individuals within low-disease families. Currently, named rootstocks are deployed as half-sib families with various male parents.

Researchers anticipate additional evaluation periods to thoroughly challenge each population. This report summarized progress in year two of a multiple-year effort to develop a pecan seedling disease screening nursery protocol. Pecan is a perennial crop that requires long term testing protocols. Major activities included site maintenance, self-seeding of interplanted susceptible and glyphosate-resistant alfalfa (*Medicago sativa*) to increase disease intensity and uniformity, and plot evaluations. Growers continue to be informed about the project in regional and state meetings in Texas.

Pecan rootstocks resistant to *P.o.* will be available at similar cost as currently used rootstocks to socially disadvantaged groups or beginning farmers. Improved production efficiency from new rootstocks, useful only for pecan production, will enhance competitiveness of farmers markets, general buy local, etc. because even small scale plantings will benefit. Rootstocks will be useful to organic producers.

Texas Pecan Growers' Association helped secure funds, and TAMU System staff did the field work, data analysis, and reporting.

Project Approach:

Activity in Work Plan	Activity, accomplishment, or work conducted 2013-14
Irrigate and fertilize plots	Sub-surface drip irrigation system was winterized and maintained (repairs, acid to reduce emitter calcification). Irrigation was applied frequently as needed. Nitrogen, zinc, and a mixture of minor elements were applied.
Control weeds and other pests, exclude wildlife	Weed control included hand weeding as needed and spot applications of grass-specific herbicide or nonselective herbicide (shielded nozzle). Alfalfa was cut back with hand-held string weeder, sickle mower, and/or lawn mower on multiple occasions. Fence was improvement north of the nursery on Lou Stroop Drive in early 2014; improvement south and east of plots was scheduled for late 2014. Vegetation adjacent to the nursery was disked to reduce rabbit damage to lay-flat irrigation line. Insecticide was injected through the drip irrigation lines to manage white grubs.
Measure plant growth, evaluate other phenology	Senescence 20Nov13 explained some 2Jul14disease variation (covariance analysis). Seedling height and caliper (at 2 cm) was estimated in July 2014 (Table 2).
Evaluate disease in interplanted alfalfa to indicate disease occurrence at the site, patchiness/uniformity of disease among plots and replications and increase intensity of challenge to young pecan seedlings. Representative dead pecan seedlings will be dug and examined under magnification for unique <i>P.o.</i> fungal strands.	Alfalfa dead or dying from cotton root rot was evaluated 8August14 within 6.7 ft ² around each planting site. Disease distribution in alfalfa is approaching uniformity among and within replications. Alfalfa produced seeds between mowings, and all residues was left in the plots. In areas where alfalfa died in 2013, autotoxicity (a form of allelopathy) was interrupted and numerous volunteer seedlings emerged and grew during lower temperatures that inhibited <i>P.o.</i> Diseased areas that greened-up with small seedlings in the cool season had repeated alfalfa mortality as rising temperatures in 2014 again favored <i>P.o.</i> Dead pecan seedlings were recorded and subsequently dug on 8 dates between 2July14 and 9Oct14 for

Activity in Work Plan	Activity, accomplishment, or work conducted 2013-14
	examination for <i>P.o.</i> strands or other cause of death. Area under the disease progress curve (AUDPC) was calculated by plot, and those data then analyzed with PC-SAS Proc GLM.
Plant evaluations including seedling survival over time, senescence, minor-element deficiency symptoms	Percent senescence estimated 20Nov2013 was digitized & analyzed and compared to seedling height reported previously (Table 1, Figure 2).
Present findings at the annual Pecan Growers Convention and regional grower educational meetings	<p>Larry Stein discussed progress to date with pecan growers (approx. 85) during the January 2014 Pecan Short Course presented by Texas A&M AgriLife faculty in College Station</p> <p>Presentation of “Pecan Screening Nursery for Cotton Root Rot Resistance” was delivered to participants (approx. 150) at the Texas Pecan Growers Association annual meeting by Larry Stein July 13-16, 2014, San Marcos, TX.</p> <p>Appel, Black, Sanchez, Stein & Grauke informed growers (approx. 15) about the project during 1-on-1 contacts. Projected number of pecan growers informed about this project and progress-to-date exceeded our goal.</p>

Average cotton root rot in pecan seedlings increased more than 10-fold between 2 July 14 and 9 Oct 14 (0.7 percent to 8.7 percent; Tables 2,3). Season-long AUDPC ($P=0.16$) is weighted a little more for early mortality (more variable earlier in the epidemic) and cumulative disease incidence (DI) on 9 Oct 14 ($P=0.06$) is weighted a little more for mortality (less variable as epidemic progresses) late in the season. Neither parameter was significant at $P=0.05$ late in the 2014 growing season. With this trend for entries to affect cotton root rot mortality, we expect significant differences in 2015, year 3.

Pecan entry effect on dead plant-root area with *P.o.* mycelium was not significant (Table 3) but it is interesting that greatest percent root area with *P.o.* was on mid-range entries ranked for AUDPC and 9 Oct cumulative DI. Perhaps plants of entries with the most mortality died too rapidly for maximum *P.o.* root surface mycelium growth, and perhaps plants of entries with the least mortality somehow limited *P.o.* mycelium growth.

Total seedling mortality was also not significant at $P=0.05$, but losses from *Macrophomina phaseolina*, *Rhizoctonia solani*, white grub damage, and unknown causes were insignificant to

mortality associated with *P.o.* (Table 3). Origin (source) of entries (north, east, south, west) did not closely follow rankings for AUDPC or DI 9Oct14 (Table 3) through season two of this study.

Rapid seedling growth (vigor) is a priority for nursery production of pecan rootstocks. Height (7July) and caliper (8July) were plotted with 9Oct14 cumulative disease incidence associated with *P.o.* and seven or six entries with the most growth and least *P.o.* mortality are illustrated (Fig. 2). As of late 2014, the entries listed to the right in Fig. 2 best meet presumed nursery criteria for rootstocks to increase for growers with cotton root rot problems.

Table 1. Pecan seedling senescence (0% for green leaves intact, 100% for leaves color-faded and/or defoliated) on 20November2013 before a killing frost at disease screening nursery at Uvalde, Texas.

Entry	Data from eight replications		Data from surplus plants in borders		
	N= ^a	Senescence, % ^b	N= ^a	Senescence, % ^c	Std. dev.
87MX4-5.5	80	41 a ^d	33	45	11
87MX5-1.7	80	48 b	33	49	13
VC-168	80	49 bc	33	50	14
Elliott	80	49 bc	33	54	13
Sioux	80	52 bcd	32	58	8
Stein	80	52 bcd	33	50	11
San Felipe	76	53 bcde	35	50	7
87MX1-1.2	80	53 bcde	42	53	12
Curtis	78	53 bcdef	41	55	12
Wichita	80	54 bcdef			
A-93	80	54 bcdef	32	49	10
Moore	78	54 cdefg	32	58	17
Frutoso	80	55 cdefg	33	56	15
Choctaw	33	56 cdefgh			
Riverside	80	56 defgh	10	51	9
Shoshoni	80	56 defgh	32	52	14
Barton	80	56 defgh			
97CAT11.3	80	59 fgh	31	56	15
Apache	80	59 fgh	19	58	8
Baker	76	60 ghi	30	63	13
Ideal	78	61 hi	38	58	16
Burkett	68	66 ij			
Allen 4	80	66 ij	33	66	15
Colby	10	66 ijk			
Giles	61	70 jk			
Peruque	37	70 jk			
Major	57	76 kl			
Allen 3	79	82 l	39	70	18

^aNumber of plants from which data were collected. Limited seedling inventory of some entries at transplanting required an unbalanced randomized block design. Target plot size was 10 plants at 2-ft spacing. Most entries were well represented in all 8 replications.

^bLeast squares means from PC-SAS Proc GLM.

^cArithmetic means.

^dLeast squares means followed by the same letter were not significantly different at P=0.01 with PC-SAS Proc GLM PDIF option.

Table 2. Plant height, diameter, and cotton root rot caused by the fungus *Phymatotrichopsis omnivora* in a pecan seedling disease nursery at Uvalde, Texas in July 2014.

Entry	Source ^a	N= ^b	Height, cm ^c	Caliper, mm ^d	Cotton root rot incidence, % 2Jul14
Colby	N	10	16 l ^c	3.4 ij ^c	0.0 a ^c
Giles	N	61	22 hijk	4.7 f	0.0 a
Major	N	57	22 ijk	4.5 fg	0.1 a
Peruque	N	37	17 l	4.7 f	0.2 a
97CAT11.3	E	80	21 k	4.2 gh	3.8 ab
A-93	E	80	26 cdefg	5.5 bc	0.0 a
Baker	E	80	26 cdefg	5.1 e	0.0 a
Curtis	E	80	23 ghijk	4.7 f	0.0 a
Elliott	E	80	28 bc	5.3 bcde	0.0 a
Moore	E	78	21 jk	4.0 hi	1.3 a
87MX1-1.2	S	80	27 cde	5.3 bcde	0.0 a
87MX4-5.5	S	80	30 b	5.5 bcd	2.5 a
87MX5-1.7	S	80	28 bc	4.3 gh	0.0 a
Frutoso	S	80	27 cd	4.7 f	0.0 a
Allen3	W	79	16 l	3.2 j	0.0 a
Allen4	W	80	23 hijk	4.3 gh	0.0 a
Apache	W	80	30 b	5.4 bcd	0.0 a
Barton	W	80	24 fghij	5.4 bcd	6.3 b
Burkett	W	68	25 defgh	5.3 cde	0.0 a
Choctaw	W	32	22 hijk	5.2 cde	0.0 a
Ideal	W	78	26 cdef	5.6 b	0.0 a
Riverside	W	80	25 defg	5.3 cde	0.0 a
San Felipe	W	77	25 efghi	5.2 de	1.3 a
Shoshoni	W	80	26 cdef	6.1 a	1.3 a
Sioux	W	80	26 cdef	5.3 bcde	0.0 a
Stein	W	80	23 hijk	4.7 f	1.3 a
VC-168	W	80	36 a	6.2 a	1.3 a
Wichita	W	80	25 fghij	5.1 e	0.0 a
P>F			<.0001	<.0001	0.0004
Mean			25	5.0	0.7
CV, %			31	20	1144 ^f

^aCollected or developed in north, east, south, or west regions of native pecan range and North American pecan production.

^bNumber of plants available.

^cLeast squares means from PC-SAS Proc GLM.

^dAt 2 cm above soil surface.

^eLeast squares means followed by the same letter were not significantly different at P=0.05 with PC-SAS Proc GLM PDIF option.

^fHigh CV value was expected for initial disease counts due to clustered disease loci at the site.

Table 3. Cotton root rot caused by the fungus *Phymatotrichopsis omnivora* in a pecan seedling disease nursery at Uvalde, Texas in 2014. Data were sorted by entry rank for AUDPC. Color represents one-third of the range of parameter values (green low 1/3, yellow middle 1/3, blue high 1/3).

Entry	Source ^a	N= ^b	AUDPC ^c	DI, % 9Oct ^d	Dead plant %root area with <i>P.o.</i> ^e	All mortality ^f
Colby	N	10	0.0	0	0.0	0.00
Burkett	W	68	0.2	1	0.1	0.01
A-93	E	80	0.3	1	1.3	0.03
Riverside	W	80	0.3	1	0.1	0.03
Ideal	W	78	0.6	1	0.1	0.01
Frutoso	S	80	1.4	5	1.5	0.05
Choctaw	W	32	1.7	8	2.8	0.08
Major	N	57	1.9	4	1.9	0.04
Apache	W	80	2.1	5	0.9	0.05
Baker	E	80	2.2	6	2.8	0.06
87MX5-1.7	S	80	2.3	6	2.1	0.10
Giles	N	61	3.0	3	0.3	0.05
87MX4-5.5	S	80	3.3	5	2.6	0.05
Elliott	E	80	3.7	14	3.3	0.14
Wichita	W	80	4.6	10	4.1	0.10
Curtis	E	80	5.1	11	4.6	0.13
Stein	W	80	5.4	10	2.9	0.10
87MX1-1.2	S	80	5.7	9	1.3	0.09
Shoshoni	W	80	5.8	11	3.3	0.11
Allen4	W	80	6.1	11	1.5	0.11
Moore	E	78	6.2	11	1.8	0.13
Sioux	W	80	6.3	14	1.9	0.14
San Felipe	W	77	6.4	11	3.1	0.11
97CAT11.3	E	80	6.5	9	1.6	0.11
VC-168	W	80	6.7	13	5.0	0.13
Peruque	N	37	6.9	15	3.2	0.15
Allen3	W	79	11.0	24	3.2	0.25
Barton	W	80	14.1	19	1.2	0.20
P>F			0.1613	<.0643	0.2598	.0594
Mean			4.4	8.7	2.1	0.093
CV, %			180	143	163	136

^aCollected or developed in north, east, south, or west regions of native pecan range and North American pecan production.

^bNumber of plants available.

^cAUDPC, area under disease progress curve from eight evaluations between 2July and 9October. All means are Least Squares means from PC-SAS Proc GLM. Other parameters sorted by AUDPC rank.

^dDisease incidence on 10Oct2014 (1.00=all plants dead).

^eAverage root area covered with *P. omnivora* mycelium for dead plants with cotton root rot.

^fAll mortality included *P. omnivora*, *Macrophomina phaseolina*, *Rhizoctonia solani*, white grub damage, and unknown causes.

Figure 1. Seedling height and senescence after one season of a pecan disease nursery at Uvalde, Texas before onset of pecan seedling mortality from cotton root rot (caused by *Phymatotrichopsis omnivora*). Moderate vigor and delayed senescence may be associated with cotton root rot resistance or tolerance. Selected entries are labeled with abbreviations.

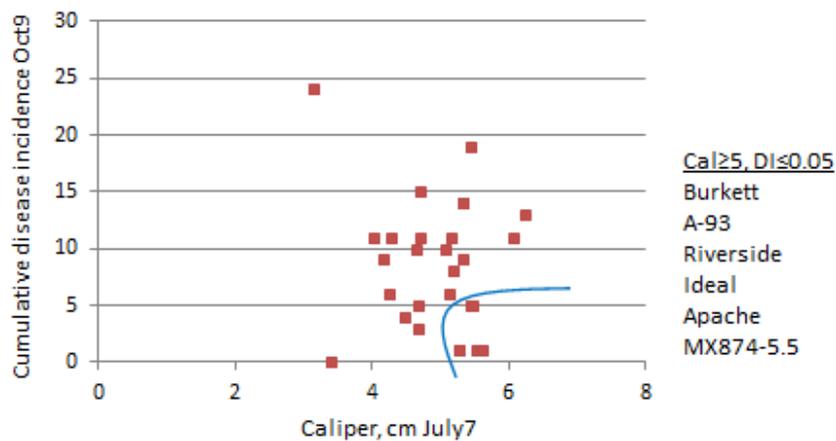


Figure 2. Seedling height 7Jul14 and caliper (at 2 cm) 8Jul14 compared to 9Oct14 cumulative mortality (&) from cotton root rot caused by *Phymatotrichopsis omnivora*. Entries were half-siblings in a Uvalde, Texas disease nursery interplanted with susceptible alfalfa. Entries meeting arbitrary criteria for average size and disease are indicated by the blue arc and the list.

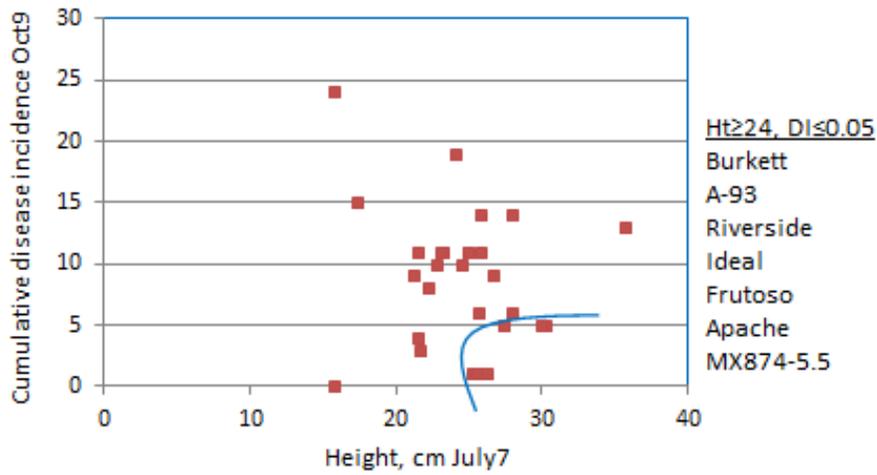
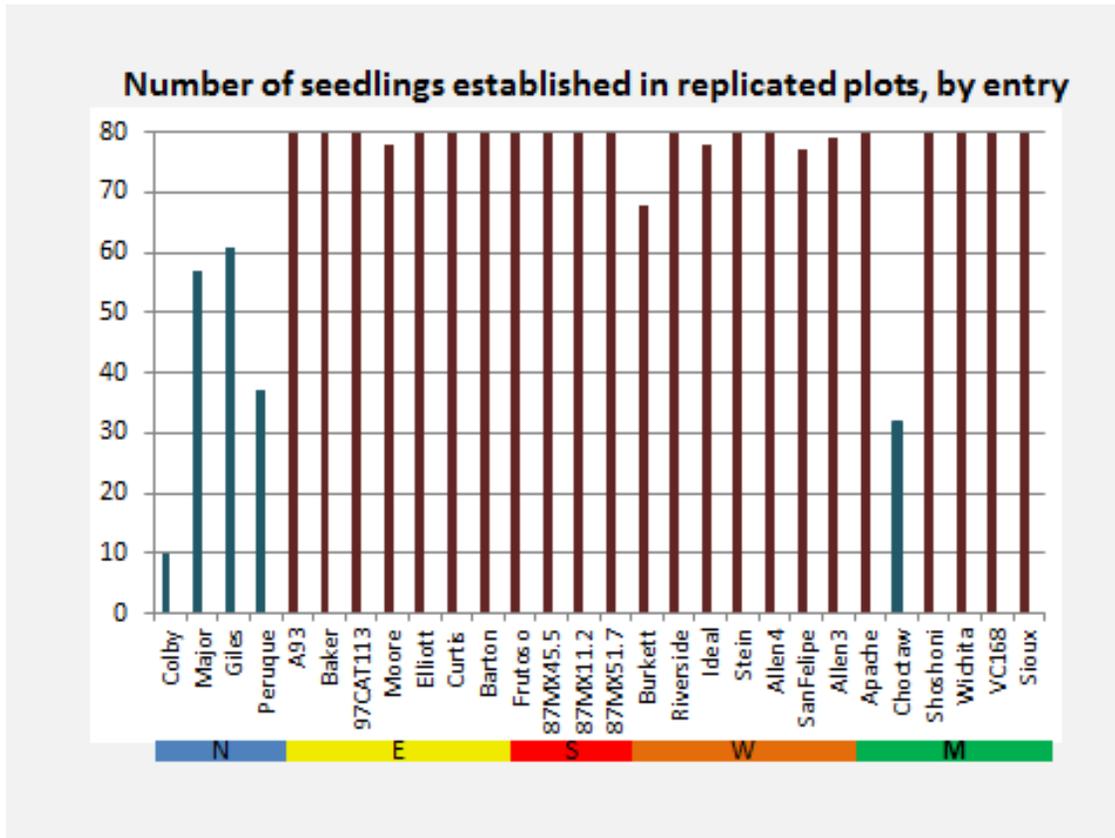


Figure 3. Revised (L.J. Grauke, 2015) origin designation for pecan entries in a disease nursery at Uvalde, Texas now with a “mixed” category (N=north, E=East, S=south, W=west, M=mixed). Low germination in the Somerville, Texas greenhouse produced a low number of seedlings for the nursery (all four northern origin entries of Colby, Peruque, Major, and Giles, and mixed origin Choctaw). This was probably a combination of low seed quality (drought where seeds were produced, age, storage/handling practices, and variety traits).



Goals and Outcomes Achieved

Activities described in detail above were completed to achieve the performance goals and measurable outcomes. This is a long term project because it involves a long-lived perennial tree nut species, but remarkable progress has been made for phenotyping pecan entries in a high density disease nursery.

The goal was to inform pecan growers of early cotton root rot evaluations among pecan germplasm being evaluated. Project staff had anticipated that at least 150 pecan growers would attend presentations and learn of early cotton root rot evaluations; 250 growers were informed about the most susceptible rootstocks and potential for new resistant rootstocks, as measured by polling growers at the end of presentations on this project. Preliminary data were not appropriate to make statements to growers on which entries were susceptible and which were resistant; 250 growers did learn of the potential for improved pecan resistance to *P.o.*

Beneficiaries

Approximately 500 pecan growers producing on 15,000 acres in the warmer production regions of Texas would benefit from resistant rootstocks. Growers will see increased yields and quality, improved production efficiency due to more uniform stands, and reduced replanting costs. Abandoned orchards will potentially be replanted. Rootstock development for a perennial tree crop is a long term project because new varieties must be evaluated over time at multiple locations before release and recommendation for grower use. Availability for planting entire production blocks could occur in four to ten years. Project staff estimate that replanting two to three percent of trees every year due to CRR losses incurs an additional cost to growers of \$65 an acre. Assuming two to three percent mortality rate each year on 15,000 acres in the U.S., staff estimates \$975,000 per year benefit when a superior resistant rootstock is available to growers at risk for CRR. Losses to *P.o.* are probably underestimated because some infected trees survive, but with reduced yield and quality due to compromised root systems. Assuming a resistant rootstock will improve yield and quality on trees with sub-lethal *P.o.* infections, production would improve by five percent a year (800 lb/ac, \$2/lb retail) on 15,000 acres, for an additional \$1,200,000 per year benefit. Total impact would be \$2,175,000 per year. There would be additional impact in Arizona and New Mexico.

Outputs from this project will be useful for organic pecan production. In addition to *P.o.* resistance, a rootstock should not be vulnerable to any other root pathogen or pest, should perhaps have a moderate growth rate for high water use efficiency and long-term orchard management, should have low risk of spring freeze damage, should be efficiently grafted, and should support consistent and sustainable yields of high quality in scion varieties.

Lessons Learned

The Uvalde pecan nursery is apparently the first screening of a commercial crop species for *P.o.* resistance in replicated field plots. No entry is immune to *P.o.*, as expected. Trends predict that there will be significant differences among entries in 2015.

Project staff estimated that *P.o.* kills a plant only when ≥ 1 percent root surface is covered by the fungus.

Increasing average temperatures suggests that cotton root rot risk will continue to increase in southwest USA.

Pairing resistant pecan parents in isolated blocks for a controlled cross should provide improved *P.o.* resistance and more uniform rootstocks than is currently available.

Overall pecan seedling growth was less than expected at the nursery site. This was attributed to a combination of partial root loss due to *P.o.* and to alfalfa competition for P, K, and Mg in this thin upland soil type. Those macronutrients will be supplied in 2014-15.

PROJECT 5: DEVELOPING VIRUS-RESISTANT, HIGH QUALITY TOMATO CULTIVARS FOR VINE-RIPE PRODUCTION IN SOUTH TEXAS

Partner Organization: J&D Produce, Texas AgriLife Research

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Type of Report: Final

Date Submitted: May 2015

Project Summary

Tomato is the most popular vegetable among consumers in Texas, yet local production has declined dramatically over the last 20 years. In the 1960's Texas was a net exporter of tomatoes, yet now, less than 2 percent of the tomatoes consumed in the state are produced here. Demand for locally produced, Texas tomatoes is high due to potential for fresher flavor than green-gassed or long shelf life tomatoes imported into the state. The long growing season and rich soils in South Texas provide a desirable environment to produce quality tomatoes for the fresh market, both in open-field and protected environments. The main limitation is virus infection mostly tomato yellow leaf curl virus (TYLCV) and abiotic stresses such as heat and wind, all of which may negatively impact yield and fruit quality.

This project directly addresses the need for new cultivars, which produce high yields of quality tomatoes under varied environmental stresses found in Texas. The tomato breeding program at Texas A&M University has focused exclusively on selection and breeding of new cultivars adapted to Texas. This program has created more than 2,600 new breeding lines and experimental hybrids over the past 12 years (Crosby et al, 2011). These include lines with resistance to TYLCV and fusarium wilt, and plants with large, firm fruit, early maturity and high yields.

J&D Produce has been collaborating with the TAMU breeding program for several years in an effort to develop new tomato cultivars with virus resistance, heat tolerance and high quality fruit for open-field production. Firmness, resistance to cracking, high lycopene, and a favorable balance of acids to sugars are traits crucial to expand the market for Texas grown tomatoes. This project tested new hybrids and lines from TAMU, and conducted field trials to continue selection for superior quality and yield. The demand for better tasting tomatoes is growing, as evidenced by the success of the 'Ugly' and 'Tasti-lee' varieties in Florida. This project seeks to make Texas tomatoes more competitive and provide consumers with high quality, vine-ripe flavor. This project followed up on the 2012 Specialty Crop Block grant project of Dr. Crosby to expand trials of new TAMU tomato hybrids during 2013. Results were positive from trials in Weslaco, Uvalde, College Station and Bastrop, Texas. This project focused on 3 TAMU hybrids identified by the previous effort, which matured earlier and had better TYLCV resistance than commercial check cultivars. It also examined new hybrids from Dr. Crosby's program and integrated site-specific nutrition protocols to enhance yield and fruit quality. Seed production and chemical analyses for the new hybrids were also expanded to expedite commercialization of the best new cultivar(s).

Project Approach

Prepare transplants for field trials

This objective was completed by TAMU in the greenhouse during January 2014. About 3,000 plants of experimental, TAMU tomato hybrids and lines were raised in seedling trays and transported to Edinburg for planting. An additional 3,000 transplants of a commercial hybrid cultivar was produced by Tropical Star greenhouses for J&D.

Plant and grow all lines and commercial checks at Edinburg

This was commenced on February 24, 2014 on a farm near Edinburg by J&D produce. Transplants were established on plastic mulch with subsurface, drip irrigation and treated with a nutrient solution and systemic pesticides for control of insects. Rows were covered with commercial, white fabric row cover for whitefly deterrence. Plants were uncovered in late March and string supports put in place with double rows of wood stakes. Fertigation and chemical pesticide practices were followed until May 2014. Fruit maturity was delayed by cool weather, beginning in June 2014.

Implement mineral nutrition practices

This was commenced at planting with a special nutrient solution for enhanced root development and reduced transplant shock.

Collect maturity, resistance, yield, quality data

This aspect was carried out by Dr. Kevin Crosby. Beginning in late May 2014, maturity, fruit size and shape and yield per plant were recorded for 30 experimental TAMU hybrids and 28 breeding lines. At Edinburg, the tomato planting was very late to mature due to an unusually cool spring. This made it somewhat difficult to assess heat tolerance and maturity as nearly everything matured within a 10 day period when the temperatures spiked to 100 F. However, yield and relative earliness were compared among the TAMU lines and two commercial cultivars. Earliness and high yield potential was evident in 6 TAMU experimental hybrids out of 28 and also in 8 breeding lines. Darker red color was also a distinct difference noted between the best TAMU hybrids and the commercial cultivars. This is likely due to higher lycopene accumulation at high temperatures, which is a genetic trait of the TAMU germplasm. Disease and insect damage were also recorded, but were insignificant, likely due to the suppression of whiteflies by the cool weather and fabric row covers. Fruit size, color and firmness were measured based on an average of 6-8 fruits per plant over three replications. Fruit from the six best hybrids and two commercial hybrids (Charger and Tycoon) were also transported to the Vegetable and Fruit Improvement Center for chemical analyses. The following table provides data from these elite lines.

Hybrid	Maturity	Size (g)	Yield (g)	Firmness (lb)	Color	TSS-TA*
JDT1-14	Mid	280	2240	3.9	Pink	4.0-3.1
JDT5-14	Early	250	2500	4.2	Med red	4.5-3.7
JDT8-14	Very early	190	2470	5.4	Dk red	4.0-3.8
JDT13-14	Early	216	2592	5.2	Dk red	4.7-3.9

JDT17-14	Early	196	2352	4.8	Dk red	4.4-3.9
JDT27-14	Mid	185	2035	4.6	Med red	na
Charger	Late	240	2400	6.1	Lt red	3.5-3.3
Tycoon	Mid	212	1696	6.2	Med red	3.9-3.8

*Total soluble solids and total acidity

Pack and ship tomatoes to retailers

The spring field production led to 923 cartons packed and shipped from J&D produce.

Conduct taste panel, distribute pamphlets in select markets

The taste panel was not conducted because the fruit quality was not acceptable in either planting. The very short harvest due to the unusual climate in the spring precluded having the best quality tomatoes. All entries including the commercial hybrids turned soft too quickly with rapid onset of extreme high temperatures. The Fall planting received over 20 inches of rain and most plants dropped their fruit or had very few marketable fruit. Pamphlets were distributed to some growers and extension personnel describing the release of a new hybrid, heat-tolerant, and virus resistant tomato from TAMU- ‘TAM Hot-Ty.’ A poster presentation about this new tomato was also delivered at the annual meeting of the American Society for Horticultural Sciences.

Increase seed of productive lines

The greenhouse seed increase of elite hybrids and some inbred, parent lines was started in December and continued until June. More than 300 controlled pollinations were conducted between elite inbred lines to generate more F1 hybrid seed for field production in multiple locations and release of a new cultivar. All seed was hand harvested and cleaned to prevent any contamination by pathogens. Seed was then dried, packaged, labeled and stored in a 4 C cooler at TAMU. Additionally, due to likely demand for larger amounts of seed in the near future, parent lines of the two most promising hybrids from 2012-2013 were sent to Emerald seeds for production of the F1 seed in March (2014). The hybrid seed was received in late March (2015), so will be available for a Fall planting. Seed of the four best TAMU experimental hybrids from the spring trials was produced in a greenhouse at College Station and ready for Spring 2015 trials and small acreage production.

Plant and evaluate selected lines in field and tunnels for virus screening.

Dr. Crosby planted 40 elite breeding lines and 50 experimental hybrids at Weslaco, Uvalde, Overton, Amarillo and College Station to assess resistance to TYLCV (in south Texas) and TSWV everywhere else. Whitefly and subsequent TYLCV pressure at Weslaco was severe. All of the TAMU materials except two breeding lines exhibited resistance to this virus as they carry combinations of the *Ty-2* and *Ty-3* resistance genes. The commercial check ‘Tygress’ is supposed to be resistant but had moderate symptoms of the virus. Fruit quality was not assessed but visual ratings for fruit set under no spray conditions were recorded in March. The plants were also exposed to high levels of potato psyllids and subsequent infection by *Candidatus Liberobacter solanacearum*. Surprisingly, some of the TAMU breeding lines exhibited no symptoms compared to highly symptomatic potatoes in an adjacent plot. This is a positive discovery as this disease is spreading on solanaceous crops.

At Uvalde, College Station and Amarillo, the main virus was TSWV. At the first 2 locations, more than 20 percent of the plants in the trial exhibited symptoms of this virus. TAMU hybrids were compared to two commercial hybrids with known resistance (Tribute and Marianna). Early yields were not affected as symptom onset was late in the season. About 5 percent of the plants at Uvalde and 15 percent at College Station were lost to this virus, but a greater percentage were killed by *Alternaria* (early blight). At Uvalde, three TAMU hybrids carrying known resistance genes exhibited good TSWV resistance and 2 were also highly tolerant of early blight compared to everything else. At College Station, 2 TAMU hybrids with TSWV resistance genes held up as well as the resistant commercial hybrids Tribute and Tycoon, and both had superior early blight resistance. At Amarillo, no virus was present on any plants during 2014.

Collect resistance and quality data and prepare reports and manuscripts

Dr. Crosby collected the virus resistance and quality data (above table) and utilized this for preparation of release documentation for a new tomato cultivar and presentation at the ASHS meeting. Approximately 15 people visited at the poster time. This data is also being used to prepare a cultivar release manuscript for HortScience.

Repeat trials with productive lines and expand commercial production acreage

A second trial at Edinburg with the best performing TAMU hybrids and several commercial cultivars was planted during late August for December harvest. This trial consisted of several acres and was established with transplants on plastic mulch and drip irrigation. Virus resistance and fruit quality was assessed beginning in late November. A third trial was planted by Dr. Crosby to screen for virus resistance in a field near Alamo, where severe virus pressure has been documented over the last 5 years. These include both fresh-market and processing tomatoes which would appeal to a range of producers. The results from these trials were mixed. Excessive rains (over 20 in) resulted in severe disease pressure from bacterial leaf spot (BLS) and very poor fruit quality. The positive outcome was the chance to assess virus, BLS and *alternaria* resistance. At Edinburg, five of the TAMU experimental hybrids and several breeding lines had better resistance to TYLCV, early blight and BLS than the commercial check Tycoon. However, many of the TAMU hybrids were highly susceptible to TSWV. No fruit were collected due to unacceptable quality. At Alamo, 3 TAMU processor breeding lines exhibited excellent virus and early blight resistance, as well as high yields. The fruit were harvested to collect seed for 2015 trials.

Goals and Outcomes Achieved

Our goals were to facilitate greater production of tomatoes in Texas and increase awareness of growers about new, virus resistant TAMU tomato cultivars.

Production at J&D farms was about 5 acres, but harvest was impeded by bad weather. However, Dr. Crosby's efforts to expand processing acreage with his two virus-resistant, open-pollinated lines was successful, as several growers near La Feria and Alamo planted and harvested about 80 acres for Rio Valley Canning. Multiple field trials with growers and a field day at Texas AgriLife Uvalde helped improve awareness of the TAMU tomato breeding program and new cultivars in the pipeline. Participating growers included Johnson's Backyard Garden, Rene Garza, Ed Bauer, Verstuft Farms and the San Antonio food bank.

Dr. Crosby convened a field day for growers and researchers at Texas AgriLife Research and Extension Center at Uvalde during June 2014. This included a field trial of both commercial and TAMU tomato cultivars and slide presentations about tomato culture and new traits. There were only 3 growers in attendance and about 20 Texas AgriLife faculty and extension agents. High quality fruit with better flavor was the priority mentioned by growers and attendees after a taste testing session with 8 cultivars. Drought and heat tolerance were also mentioned. The low turnout from industry may have been due to the distance from major population centers. Dr. Crosby e-mailed information about the new TAMU cultivar 'Hot-Ty' to 6 additional growers and asked them about their interest in attending future field days. Travel to the location was the common problem mentioned.

Six experimental tomato cultivars, four fresh-market and two processor types were introduced to growers and feedback was solicited about performance and quality. Responses were received from three growers, leading us to choose four of these for increased seed production in 2015. In all cases, yield was listed as the most important attribute.

We assessed acreage by direct interaction with each grower and estimated about 85 acres of tomatoes produced in response to our efforts and seed distribution. We received a positive response from HEB about this collaborative effort to improve quality and productivity of Texas tomatoes. Dr. Crosby compiled a phone (and e-mail when possible) list of 10 commercial tomato growers in Texas and is continually updating the contact list for future field days. He also followed up with two commercial seed companies on F1 hybrid production for subsequent years. The first 100,000 seed arrived in late March of 2015.

Beneficiaries

There were numerous beneficiaries of this project. These included growers, packers, a processor, retailers, consumers, two seed companies, and agribusinesses which served the growers. Specific growers and packers include J&D Produce, Bauer Farms, Rene Garza, Johnson's Backyard Garden, San Antonio Food Bank, and Verstuyft Farms. Rio Valley Canning benefitted substantially from the increased processing tomato harvest, while HEB and Kroger benefitted from the store brand, canned tomatoes produced at the cannery. Emerald and Lark Seeds stand to benefit from additional hybrid seed sales of new TAMU cultivars. Finally, every consumer in Texas or elsewhere who purchased canned or vine ripe product from these producers benefitted from the quality, freshness and affordability. This is likely in the tens of thousands.

The estimated economic impact from fresh and canned tomatoes produced was roughly \$500,000, based on close to 100 acres grown in the Rio Grande Valley during 2014. This is just the retail value of the products and does not include any additional impacts from agribusiness products, labor wages, etc. The potential impact of the virus resistant cultivars, if weather would be favorable, could exceed \$2 million in sales in south Texas alone.

Lessons Learned

One positive lesson learned was that cultivars can make a big difference under stressful conditions. The virus resistance, heat tolerance and early yield of TAMU tomato lines was very evident in trials and appealed to all the collaborating growers. The TAMU processing lines were

superior to any other cultivars tested by the growers and demand for the seed exceeds current supply.

Another lesson learned was that demand for locally produced tomatoes is increasing in Texas and many small growers are planting this crop in diverse regions of the state. The problems they face are often unique to their location and more research on cultivar by location interactions would be useful.

Some negative experiences with very poor weather conditions in the Rio Grande Valley provided a lesson with negative economic ramifications. Even the best cultivars and production practices will not compensate for poor climatic conditions in a given season.

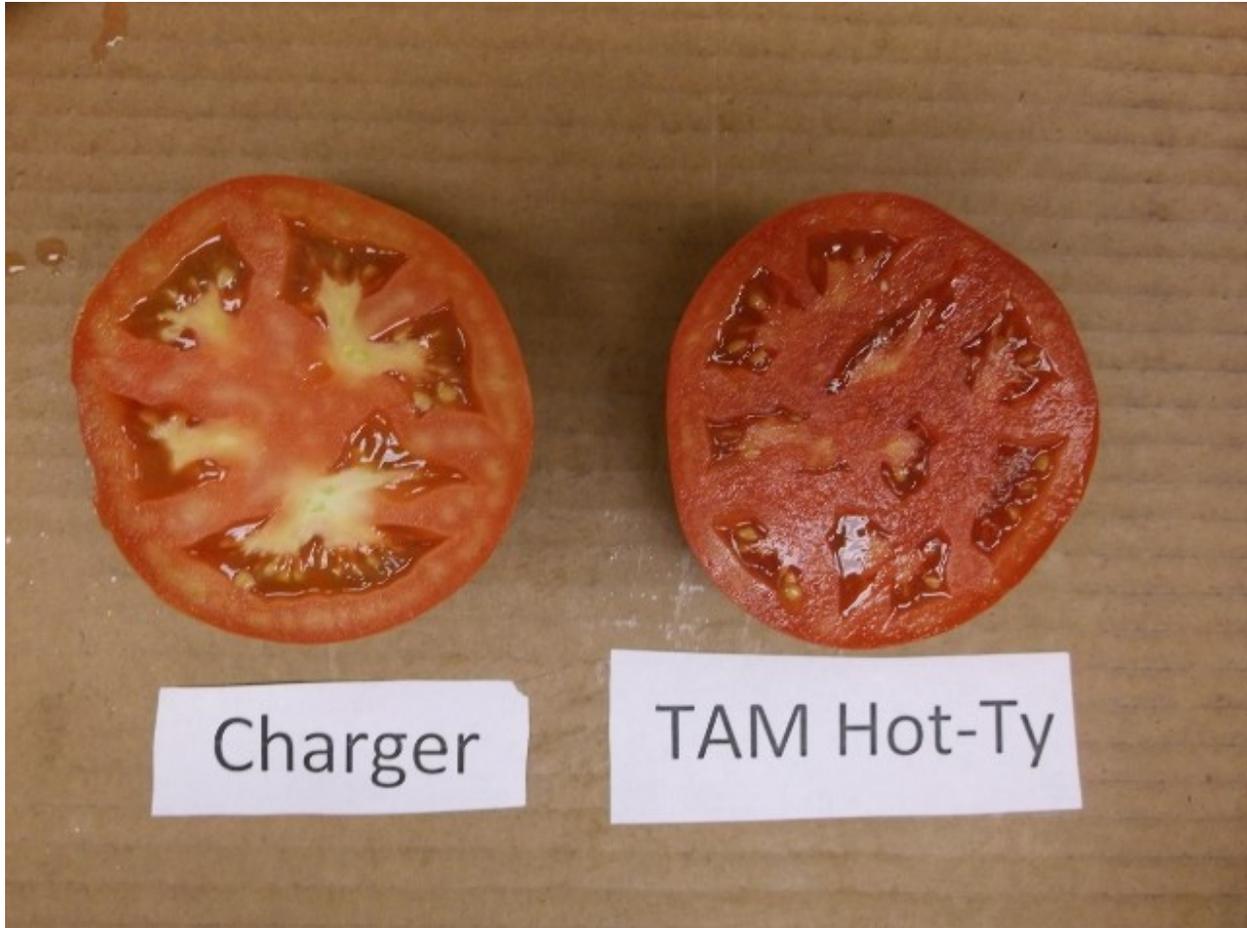
Another lesson learned was that hybrids tomato seed production on a commercial scale is very difficult in the humid climates of south and central Texas. More extensive collaborations with seed companies or small seed production experts in drier regions will be required to expedite large field trials with multiple growers of pre-commercial cultivars.

The final lesson learned was that convening a field day that attracts many growers is difficult in Texas due to the large area of the state where tomatoes are produced and the long distance travel required. An alternative may be multiple smaller field days in several locations, but will require direct participation by growers rather than at the Texas A&M AgriLife center.

Additional Information

The following publication on a new TAMU cultivar was from a poster presentation at the annual meeting of the American Society for Horticultural Sciences in Orlando:

Crosby, K., Jifon, J.L., Haralson, J., and D.I. Leskovar. 2014. 'TAM Hot-Ty'- a new, heat-tolerant tomato cultivar for Texas. HortScience 49(9): S350.



The field day at Texas A&M AgriLife Research and Extension Center at Uvalde



PROJECT 6: WATER SMART RESOURCE MANAGEMENT CAMPAIGN TO ENSURE SPECIALTY CROP SALES

Partner Organization: Texas Nursery & Landscape Association (TNLA); TNLA Education & Research Foundation; Texas Water Smart Advisory Group; Texas Department of Agriculture, Texas Retailers Association

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Type of Report: Final

Date Submitted: October 17, 2016

Project Summary

The Texas Water Smart (TWS) program is a public education program designed to promote conservation for the benefit of the green industry. The project's purpose was to educate homeowners and businesses about how to implement water-saving techniques and products in their green spaces, eliminating water scarcity and watering restrictions as barriers to the purchase of green industry products and services. Conservation of water is the key to the sustainability of the green industry in Texas. Educating Texans about the nexus between green spaces and natural resources conservation helps establish demand for Specialty Crop products and supports a healthy environment and community.

The years 2010 to 2015 marked a time of extreme drought for the entire State of Texas. Year-round, the state experienced unusually warm seasons and very small amounts of precipitation. Pair these weather patterns with a growing population and thriving business activity/production that increased demands for water, and a battle for scarce water was unavoidable.

The green industry developed concerns about how the drought and related water use restrictions would impact consumer behavior in terms of specialty crop product purchases. Outdoor water use comprises about 60 percent of a household's consumption. So, with limited water supplies, municipalities (which own and manage water resources for the public in Texas) across the state moved to restrict or eliminate outdoor water use. Knowing outdoor watering would be restricted, especially during the hottest and driest months of the summer and fall, consumers became concerned plant investments in their landscapes would be lost, and therefore they were discouraged from buying specialty crop products.

TWS was created by the producers and retailers of specialty crop products in an effort to promote voluntary water conservation. In light of an impending drought crisis, the Texas Water Smart program was a tool supported and delivered by green industry professionals to help local governments maintain water supplies, thereby circumventing the need for implementation of draconian outdoor watering restrictions. With a long-term perspective in mind, TWS was designed to evoke a behavior change in consumers. The strategy -- by learning simple and inexpensive conservation techniques endorsed and taught by industry experts, consumers should adopt a behavior to conserve and become more likely to continue purchasing landscape plants and products knowing they have the capability to maintain their investments no matter the weather conditions.

With the state in extreme drought stages, the Texas Water Smart program was originally focused on mass consumer education during its first years of operation. The drought was widespread, spanning the entire state, making a mass communications effort effective. As the TWS program developed and drought conditions lessened, TNLA began to explore more direct outreach venues through consumer workshops and engagement, and development of a Texas Water Smart Certification program for industry professionals.

Project Approach

TNLA has operated the Texas Water Smart program with support from the Specialty Crop Block Grant Program for multiple funding cycles. Initial grant awards were focused on a mass media campaign facilitated through radio buys and press conferences with elected officials who helped promote a public message of voluntary conservation.

Surveys were completed for both commercial and residential water usage from the North Texas Municipal Water District (NTMWD), City of Austin Utilities and San Antonio Water Systems (SAWS) to identify the impact of the messaging and how much water was saved. TNLA found mid to substantial drops in water use in these three parts of the state.

NTMWD Water Saved:	May	2013 v 2014	735,000,000 gallons
	June	2013 v 2014	539,000,000 gallons
	July	2013 v 2014	1,700,000,000 gallons
	August	Not Available	

City of Austin Water Saved:	May	2013 v 2014	20,000,000 gallons
	June	2013 v 2014	12,000,000 gallons
	July	2013 v 2014	40,000,000 gallons
	August	2013 v 2014	20,000,000 gallons

SAWS Water Saved:	May	2013 v 2014	514,000,000 gallons (INCREASE)
	June	2013 v 2014	76,000,000 gallons
	July	2013 v 2014	137,000,000 gallons
	August	2013 v 2014	302,000,000 gallons

Texas Water Smart depends on North Texas Municipal Water District, the City of Austin, and the San Antonio Water Systems to obtain water usage data. To date, TNLA and Texas Water Smart staff have been unable to obtain relevant 2012 data from the third parties.

While comparisons of water saved may be a useful measure, city-wide water usage may not be the most accurate gauge for tracking project messaging impacts because a large number of variables may affect water consumption. For example, city water statistics often include residential and commercial consumption as well as indoor and outdoor use. Thus, city water use statistics may not fully capture the impact of the TWS messaging on consumer attitudes and behaviors.

In 2015, TWS was able to conduct a much more robust educational campaign. Measuring and tracking consumers' willingness to invest in green industry products, as well as their awareness

about water use in the lawn and garden, provides an additional measure of this program's success. By focusing on an individual's water conservation education, homeowners can be equipped with the knowledge and confidence that they can adapt to periods of drought and manage healthy outdoor spaces. All of the TWS efforts are intended to counter the increasingly negative economic impacts associated with limited water supplies throughout the state of Texas, including the effects on nursery and landscape producers, retailers and ultimately, consumers.

In 2015, with the use of this grant and funding and resources obtained from other public and private entities, over \$1 million was invested on water conservation education efforts for end-users through a variety of methods including: youth curriculum, homeowner workshops, community demonstration projects, and a statewide, multimedia public awareness campaign.

The \$50,000 Specialty Crop Block Grant (SCBG) allocation available for use in 2015 was specifically expended to assist in consumer engagement and market surveys (~\$16,000), the development of radio and video spots used in a statewide public education program (~\$8,000), and the purchase of radio ads in major metropolitan markets across the state (~\$20,000).

Radio ads were purchased in the Dallas-Fort Worth, San Antonio and Austin media markets. These ads educated listeners about easy and inexpensive changes they can make to save water in their lawns and gardens. The messages are universal and encourage consumers to purchase green industry products by addressing two obstacles to plant purchases – the time and cost of maintaining the plants. TWS ads are designed to educate consumers about time saving and cost saving landscape management for current and future generations, messages that the market research found resonates with the audience.

TNLA originally proposed \$25,000 for consumer market surveys and \$25,000 for creative development. Due to contributions by TNLA, TWS coalition members, and the Texas Water Development Board, TNLA was able to exceed original budget expectations and stretch the SCBG funds to cover three areas – surveys, creative development, and the purchase of radio airtime to broadcast the creative – and remain under budget for the year.

For the final phase of this grant, the extremes of the drought had begun to subside, and TNLA purchased radio time in the Dallas-Fort Worth area with partner funds and shifted its approach with Specialty Crop Block Grant funds to focus on industry and direct consumer engagement. TNLA's rationale for a shift from a public awareness campaign utilizing mass media to a more direct approach was based on a recognition that the media and elected officials who previously played a strong roll in education efforts may redirect their focus from conservation to other issues as milder weather ensued. With the changing environment, engaging specialty crop industry professionals and implementing direct consumer education has a meaningful and lasting impact on consumer behavior.

In the final funding cycle, Specialty Crop Block Grant funds were used to develop a video series to educate industry professionals about the Texas Water Smart Certification program. These videos address the value of marketing a specialty crop business as water smart, provide education about water smart principles, and discuss how water smart plant products and techniques can be demonstrated to consumers. Over the course of the TWS program

implementation, participants have requested direct consumer education material – brochures and printed educational materials, signage that can be used in stores to alert consumers to water smart plants, and TWS branded promotional items that can be given to consumers as a take-home reminder of the conservation techniques. TNLA engaged the Texas Department of Agriculture to assist in production of the industry videos; partners like the North Texas Municipal Water District have offered financial support making radio ad purchases possible. Also, TNLA and the Texas Water Smart Foundation have established partnerships with private sector retailers and product manufacturers to help with direct consumer engagement.

TNLA finds success in the Texas Water Smart program as it has been utilized to demonstrate the value of industry-sponsored conservation programs and has staved efforts to curb outdoor water use. The TWS program has empowered businesses and local governments alike to persuade the public to voluntarily conserve rather than to conserve because of regulation.

TNLA recognizes the success of the TWS program and its ability to continue in the future is dependent on a strong network of industry and municipal supporters. Partnerships established over the past four years are a noteworthy accomplishment. The SCBG grants were paired with approximately \$375,000 from a Texas Water Development Grant, as well as approximately \$700,000 in combined cash and in-kind donations from program participants, including Texas Nursery and Landscape Association members; Texas Retailers Association; Junior Master Gardeners; Texas A&M AgriLife Extension Service; Kroger food stores; SuddenLink communications; Texas Water Smart Foundation members; and the cities of Fort Worth, Round Rock, Corpus Christi and San Antonio.

Participants who directly and significantly contributed to SCBG-funded portions of the project include:

- Texas Water Smart Foundation members dedicated approximately \$12,000 to assist in creative development.
- TNLA dedicated more than \$35,000 in staff resources and educational development.
- Funding from SCBG was coupled with \$258,000 in state grant funds for media buys which generated bonus, in-kind spots valued at \$130,000.
- Texas Water Smart Coalition members, the City of Corpus Christi and the City of Fort Worth utilized the creative developed with SCBG funding on their public access channels.
- Fort Worth, San Antonio, and Austin hosted press conferences highlighting the TWS creative, generating in-kind media impressions valued at \$78,000.
- Texas Water Smart Coalition members engaged with the public awareness program in a variety of ways. One of the largest investments was from Kroger who played the TWS creative over its intercom system reaching millions of Texans with a media value of \$35,000.
- SuddenLink aired TWS videos across their network generating a value of \$100,000 for the public education initiative.

Goals and Outcomes Achieved

Over the course of multiple phases, the TWS program generated almost 70 million media impressions. This metric is important because it demonstrates consumer exposure to the conservation message. While there are limitations to using citywide water consumption data in the program evaluation, the data indicates a three-billion-gallons water savings from 2013 to 2014 in areas surveyed. No matter the limitations, this savings is significant and an indication of project success.

TNLA's 2015 and 2016 goals remained the same as 2014 -- to reduce the wasteful use of water by Texas homeowners. However, over the past year, focus has shifted to include direct consumer and industry education. Surveys were conducted to evaluate the likelihood that a consumer educated with Texas Water Smart curriculum would adopt water-conserving techniques, plants, and tools in their green spaces.

Survey results:

- Approximately 35 percent of respondents surveyed through the statewide public education campaign reported they used less water in June through early September 2015 than in the same period in 2014.
- Approximately 44 percent of respondents surveyed through the statewide public education campaign reported they would have a more favorable opinion of businesses that promote water conservation techniques and messages.
- Approximately 92 percent of participants in the homeowner education program reported an expectation to reduce annual water use by at least 10-24 percent as a result of participation in the program; approximately 33 percent of participants in the homeowner education program expected their water usage to be reduced by 25–49 percent because of techniques learned.
- More than 98 percent of participants in the TWS homeowner education program reported they would use landscape design strategies that facilitate water conservation.
- More than 97 percent of participants in the TWS homeowner education program reported they would select plants based on their water requirements.
- Approximately 90 percent of TWS homeowner education participants reported they would adopt drip irrigation in their home landscapes.
- Approximately 55 percent of TWS homeowner education program participants indicated they are more likely to allocate home budgets toward purchasing plant materials.

* It is important to note Texas also received record rainfall in Spring 2015, which resulted in alleviation of drought conditions. The wet weather and milder temperatures lessened focus on water availability at both a local and statewide level. Therefore, TNLA assumed most Texans would be less interested in or compelled to conserve. The high level of consumer engagement reflected in the surveys signifies program success.

Green Industry Sales

Green industry sales in 2014 recorded a 2.05% increase from 2013; retail sales increased 5.6% and landscaping sales slightly increased by 1.16% (Palma and Hall, 2015). In 2015, green industry sales did not significantly change, decreasing overall by 1%; retail sales were slightly down 1.8%, while landscaping sales increased 3.2% (Palma and Hall, 2016). Horticultural services sales recorded an increase of 3.2% which represents a record high for Texas totaling

\$4.76 billion (Palma and Hall, 2016). The total green industry sales provided below were provided by a report compiled by Marco Palma and Charles Hall of Texas A&M AgriLife Extension Service:

Total Green Industry Sales 2009-2015

	GROWER	LANDSCAPE	RETAIL (Gross)	RETAIL (Net)	TOTAL
2015	\$1,983,586,654	\$4,764,483,805	\$12,135,946,293	\$3,675,090,499	\$10,423,160,958
2014	\$2,051,121,448	\$4,612,211,522	\$12,363,568,401	\$3,744,020,587	\$10,407,353,556
2013	\$2,100,242,682	\$4,550,424,995	\$11,721,100,798	\$3,549,464,140	\$10,200,131,818
2012	\$1,804,926,582	\$4,054,303,568	\$10,857,786,292	\$3,288,029,320	\$9,147,259,470
2011	\$1,918,432,053	\$3,538,719,690	\$10,374,997,040	\$3,141,827,767	\$8,598,979,510
2010	\$1,537,061,928	\$3,390,016,982	\$9,351,749,314	\$2,831,960,872	\$7,759,039,782
2009	\$1,336,866,584	\$3,414,177,793	\$9,039,697,678	\$2,737,463,255	\$7,488,507,632

Sales increases in particular sectors of the green industry mentioned above represent the effects of many contributing factors including the alleviation of drought but certainly do not exclude impacts of the core TWS activities accomplished through this project. TNLA proposes increased sales during times of drought demonstrate the green industry’s success in effectively communicating the conservation message and boosting consumer confidence.

Summary of activities (2015) include:

- Developed and purchased radio advertisements to implement a mass media campaign;
- Hosted press conferences in cities across the state to increase awareness about the nexus of water conservation and the specialty crop industry;
- Conducted market research to ensure education efforts resonate with consumers; and
- Partnered with stakeholders to host consumer workshops and community green space improvement projects.

Through more focused consumer engagement in 2015 and consistent messaging, homeowners could confidently conserve water while enhancing their lawn and gardens with Texas green industry products.

In 2016, the goal again shifted to a narrower focus while still promoting the broad message to homeowners to encourage water conservation strategies.

Summary of activities (2016) include:

- TNLA established partnerships with nurseries and a major supplier to participate in direct consumer education;
- Developed a series of videos designed for in-store education about conservation in the landscape and for educating green industry professionals about the value of the Texas Water Smart Certification program;
- Procured and distributed educational materials like brochures, in-store signage that highlights water saving specialty crop products, and other promotional materials that drive consumers to the Texas Water Smart website; and

- Developed new content and updated Texas Water Smart website.

TNLA originally estimated six to eight nursery partners across the state would engage in the consumer education program. During the grant period four entities committed to participating. Additional nurseries will engage as spring approaches, meaning industry participation will exceed the goal. Also, a Texas Water Smart member business with a national footprint has committed to participation, meaning TWS education events will be hosted in large retail venues across the state.

Through these partnerships, TNLA anticipates an increase in sales. Additionally, the high visibility of the TWS educational outreach materials provided through these partnerships will help exceed the total impressions targeted for this allocation. This data is unfortunately not currently available as the effects have not been realized. Partnerships and outreach materials will generate more notable behavior changes in the spring and summer of 2017, during peak purchase season for green products.

Outcomes and measures indicate the TWS project produced short-term results; however, TNLA believes changing behaviors and increasing consumer awareness about the nexus of specialty crop products, healthy outdoor landscape spaces, and water conservation is a long-term endeavor. As noted above, consumers directly engaged through TWS-focused workshops indicate they will conserve and report a willingness to purchase more specialty crop products in the future. This is indicative of on-going efforts and successes as Texans make conservation a part of their daily lifestyles.

Beneficiaries

Members of the Texas Nursery and Landscape Association benefit from this project. Further, members of the Texas Water Smart foundation benefit. The most direct beneficiaries are specialty crop product suppliers and retailers participating in direct consumer education outreach. In terms of total beneficiaries, we can conservatively state that 1 million people benefited from the implementation of this project.

Lessons Learned

The Texas Water Smart project has been a successful endeavor and learning experience. During the course of the program, TNLA learned the TWS program is attractive to regulators who are interested in promoting voluntary water conservation. Additionally, TNLA found industry has embraced the TWS program as a way to market their business and improve services and sales to consumers.

TNLA learned a broad public awareness program works well during perceived crisis conditions, as were experienced 2010 to 2015. When the crisis passes, it is important for industry stakeholders to continue education efforts in a sustainable manner. The promotional and educational materials TNLA is providing to retailers is valuable in obtaining their support and engagement into the future.

The Texas Water Smart education initiative continues to be successful in helping preserve our natural resource and promote specialty crop products. Building a strong network of program

partners and TWS coalition members and reaching individual Texans through educational workshops and the media is key to ensuring homeowners, businesses, and policy makers understand that the green industry and the specialty crop products they provide and service are complementary to current natural resource conservation goals.

Works Cited

Palma, Marco A. and Hall, Charles R. "Economic Contributions of the Green Industry to the Texas Economy" Texas A&M AgriLife Extension Service, Texas A&M University 2015 and 2016

PROJECT 7: EDUCATING THE SPECIALTY CROP INDUSTRY ON BEST PRACTICES FOR WATER CONSERVATION IN BUSINESS AND WITH CONSUMERS

Partner Organization: Texas Nursery & Landscape Association (TNLA)

Project Manager: Marisol Ybarra

Contact Information: marisol@tnlaonline.org 512-579-3866

Type of Report: Final

Date Submitted: March 2015

Project Summary

Over the course of this grant the Texas Nursery and Landscape Association (TNLA) was able to educate professionals of the Texas green industry (horticulture) on the importance and methods of water conservation. These professionals are now able to pass this knowledge along to customers (general public) and other green industry professionals they come in contact with. Not only were we able to educate professionals, but also provide a certification that is a reflection of the knowledge they have obtained.

Project Approach

Several opportunities we were able to take advantage of providing these education modules available in a face-to-face setting, online, through study material and online exams. This was a chance for hundreds of green industry professionals to learn from expert speakers, online learning and the online TNLA Texas Water Smart exam platform. Materials covered topics such as irrigation installation, management, and maintenance, water reclamation, low impact plant material and turfgrass, new and upcoming technologies to enhance water efficiency, understanding water restrictions, and sustainable irrigation, drainage, landscape installation, management and maintenance.

The education modules were promoted through different avenues such as electronic communications, the bi-monthly publication *TNLA GREEN Magazine* and hard copy brochures that were mailed to TNLA members and prospects and handed out at different green industry events.

Throughout the year, TNLA was able to reach out to hundreds of professionals, individuals, and companies about water conservation methods and implementations that can be used to achieve this. TNLA created a water smart study manual that will be used as the backbone for the TNLA Water Smart Certification Exam.

TNLA held events such as the Growers' Summit held in conjunction with Business Management Workshop and the Expo Education Conference where speakers were secured who presented to more than 400 attendees on topics such as the future of water in Texas, irrigation, sustainability and profitability, smart irrigation, and water reclamation. Both of these events required funds and staff time to research each speaker to ensure their message would be beneficial to the attendees as well as furthered the horticulture industry.

TNLA promoted the new certification by purchasing ad space in the *TNLA GREEN Magazine*. The *TNLA Green Magazine* is viewed by more than 2,500 green industry professionals. TNLA employees also had the opportunity to travel throughout Texas to the TRAPS Conference, FFA Conference and ISA Conference to interact face-to-face with over 300 horticulture industry professionals as well as distribute information about the importance of water conservation and promote the TNLA Texas Water Smart Certification.

Project Motivation

The Texas Green Industry faces an uncertain future in the light of current drought conditions, explosive population growth, and the uncertainty of an adequate long range water plan. Municipalities are enforcing water restrictions, and when the water is turned off, businesses that grow, sell, install and maintain nursery and landscape crops suffer too. It is no secret that businesses thrive on the availability of water. What is not as obvious is their symbolic relationship with their customers. If both businesses and consumers were to use less water, fewer restrictions would be needed and more water would be available. TNLA represents specialty crop businesses in the nursery and landscape sector and is well positioned to deliver water conservation education throughout Texas. Grant funds would be used to provide both face-to-face education and online training on water saving strategies for both businesses and consumers. A Texas Water Smart certificate would be created for professionals wanting to learn strategies to conserve water. At the conclusion of this project, a large number of those in the nursery and landscape sector will be educated on how water conservation is vital to their future. Through online training and live educational opportunities, businesses in the Green Industry will learn how to promote and support principles that save valuable water resources.

Goals and Outcomes Achieved

The initial goal was to *‘Educate a large percentage of those who grow, sell, install and maintain specialty crops on water conservation to ensure they have the water they need to advance the specialty crop industry in the future.’* More than 500 specialty crop related business owners and employees attended and were educated during the offerings outlined above. Project staff was able to contract with Texas A&M University and Masuen Consulting LLC to get the TNLA Texas Water Smart exam and study material written. Through previous Specialty Crop Grants, TNLA was able to create an online education and training website as well as an online professional certification website. Water Smart Certification exams are now live on the TNLA exam site and individuals have begun to take and pass the exam while others continue to study. Exams are live on the TNLA exam site and individuals have begun to take and pass the exam while others continue to study. Of those receiving the training, TNLA anticipated 50 Texas Water Smart certificates will be awarded to specialty crop businesses professionals that pass an online exam. To date we have had 7 people take the exam and pass. There are an additional 26 that have bought the manual and are currently studying for the exam.

Beneficiaries

TNLA was able to reach out to specialty crop related business owners and employees during the 2014 and 2015 TNLA Business Management workshop which had over 100 attendees each, educated 31 growers with the Grower Summit in 2014, the EXPO Education Conference which had over 300 attendees and online education opportunities which had over 100 participants. Staff was also able to interact with green industry professionals at industry events such as the

Texas Recreation and Parks Society Conference, the International Society of Arboriculture Trade Show, and the FFA Conference which combined staff interacted with over 300 attendees to make them aware of the TNLA Texas Water Smart Certification and TNLA. This is more than 800 professionals that received information through outreach or education modules.

Lessons Learned

There is still a tremendous amount of water conservation education that needs to take place. The lack of water and how it affects our industry is far from over. The more professionals we can educate the more impactful we will be.

Additional Information

Since we did experience some delay securing a writer for the TNLA Texas Water Smart curriculum we took advantage of the 2015 TNLA Winter Showcase and Business Management Workshop. We were able to promote the new certification to over 100 attendees. TNLA has experienced the turn-over of the original project manager of the grant, as well as encountered issues in securing the appropriate writer for the TNLA Water Smart curriculum. A new project manager was established from existing staff at TNLA and expect no further delays from that turn-over.

PROJECT 8: TEXAS RIO STAR GRAPEFRUIT - BIG DIFFERENCE, BIG REWARDS

Partner Organization: TexaSweat Citrus Marketing

Project Manager: Eleisha Ensign

Contact Information: (956) 580-8004; eleisha@texasweet.com

Type of Report: Final

Date Submitted: May 2015

Project Summary

TexaSweat conducted an educational program for children and families, empowering them with the nutritional benefits of Texas grapefruit and how to incorporate it into healthy dishes. Through an engaging, expanded classroom outreach program, TexaSweat partnered with teachers to share nutrition education, skills for selecting and preparing Texas grapefruit, and the grove-to-table story. TexaSweat reinforced messages shared in schools with a blogger ambassador program and media outreach that includes hands-on cooking workshops, grapefruit deliveries and ongoing pitching. This multi-faceted approach will better inform consumers about Rio Star grapefruit's unique benefits, driving long-term interest and consumption of Texas' state fruit. TexaSweat contracted with Fleishman-Hillard (FH) a PR firm to conduct this program.

Oftentimes, grapefruit is considered to be sour tasting and not a kid-friendly or easy to eat piece of fruit. Texas grapefruit is actually very sweet and can be easy to eat if prepared correctly. Offering opportunities for children and trendsetters to taste and experience this fruit in a positive way while learning about its nutritional value and economic value in Texas is key in overcoming these challenges.

Past SCBGP-funded projects for Texas Grapefruit, such as Rio Star Round Up-Spreading the Sweet Life Across Texas, was a project that was also geared toward educating children and adults about the sweet flavor and versatility of Texas Rio Star Grapefruit. This current program built upon the past program and focused upon its successes to guide and formulate its programming. For example, after the prior program was completed and surveys were sent out to participants, we found that when children learned about the state fruit of Texas through watching videos and lesson plans, they greatly desired the opportunity to actually taste the fruit at the same time. In this current program, we focused on this need and created more opportunities for students to have the ability to taste the fruit while learning about it.

Project Approach

Classroom Outreach

FH and TexaSweat developed and updated lessons plans and prepared outreach resources created in previous years, including a grove-to-table DVD, for the program. FH and TexaSweat brainstormed and prepared the details for the school outreach program. TexaSweat designed and printed a postcard to mail out to Texas educators to invite them to participate in the program.

The program details are:

The teacher must visit www.texasweet.com/prizepack and fill out their contact information. We will then mail them a package containing a \$10 gift card to purchase grapefruit to sample with their students during the program, as well as a DVD, 4 lesson plans and quizzes for the students.

NOTE: Only the first 120 responders received a gift card to purchase Texas Grapefruit. All entrants after that did not receive the gift card, but did receive all other materials.

The teacher was then asked to have each student take the pre-quiz, then watch the video, then take the post quiz, to evaluate how much they learned. A sheet was included in the packet giving exaction directions as to how to do this.

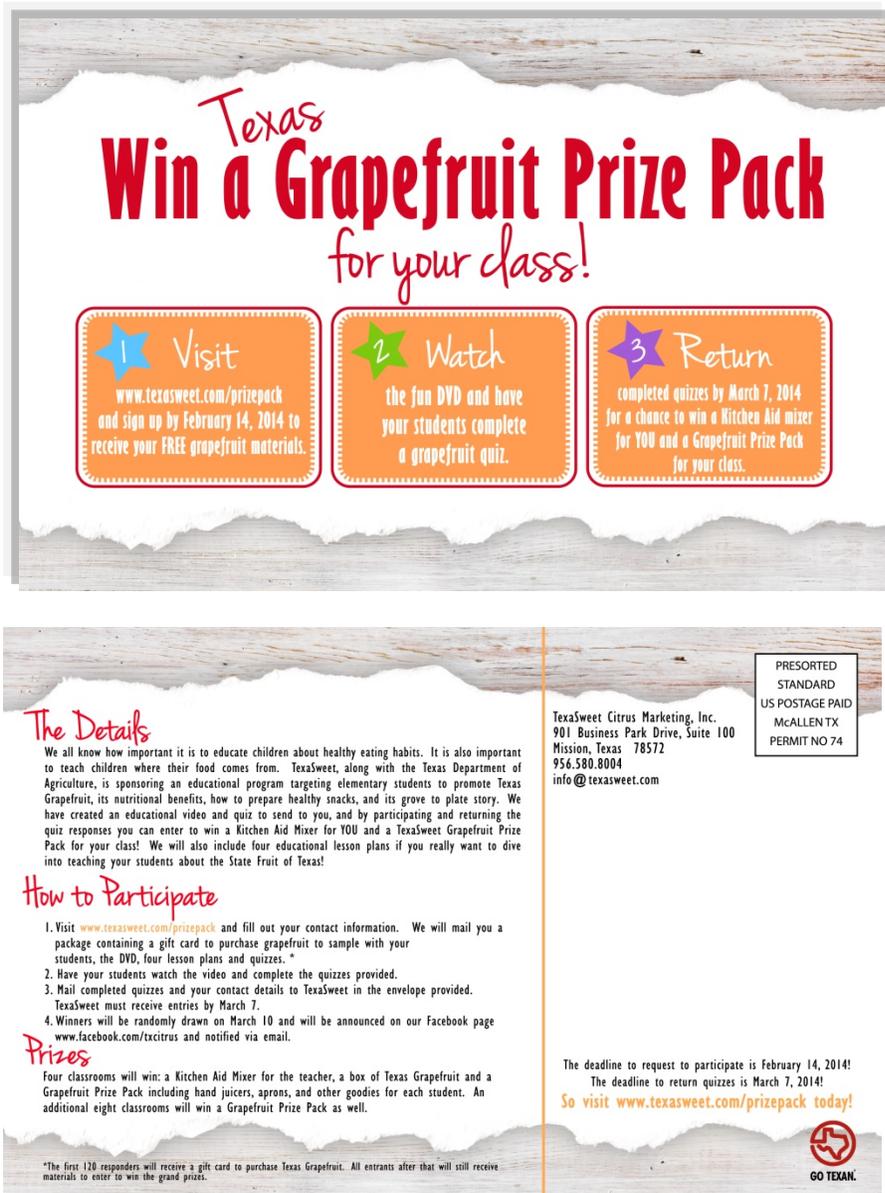
The Teacher was to then take the quizzes and mail them back to TexaSweeet in the enclosed postage-paid envelope. The entries were due by March 7th.

Winners would be selected the week of March 10th and the winning classes would be notified by email.

The prizes are: Four classrooms will win a Kitchen Aid Mixer and Juicer attachment for the Teacher, a box of Texas Grapefruit and a Grapefruit Prize Pack including a hand juicer, aprons and other goodies for each student. An eight additional classes will win the Grapefruit Prize Pack including a hand juicer, aprons and other goodies for each student.

TexasSweet updated the program at this point to respond back to every teacher that sent in their classes' entry. In the past, staff did not respond to let the teachers know who the winners were and based on previous teacher surveys, it was found that this notification was very important. We Each entrant received a box containing a thank you note for participating, a list of the winning teachers, pencils and juicers for each student in the class.

Below are the postcards that were sent out.



And at the beginning of the 2014-2015 season, an email was sent to TexaSweeT's teacher list (consisting of 496 emails obtained from the previous outreach effort) to announce the new citrus season and encourage lesson plans being incorporated into their classroom lessons.

Blogger Ambassador Program

FH created a target list of parenting-focused bloggers with a goal of 4 participants each in the Dallas, Houston, Austin and San Antonio regions. FH and TexaSweat developed requirements for the blogger ambassadors program.

Below are the details:

TexaSweat Citrus is planning a fun and educational “Grapefruit 101” workshop in early February and we would be thrilled if you join us.

Texas Citrus is sweet, juicy, delicious and, most importantly, at the peak of the season! We are excited to invite you to gather with TexaSweat and hear from the experts on all of the grapefruit essentials, from selecting the perfect grapefruit to cutting it. We’ll even share measuring tips. We will also discuss how to incorporate fruits and vegetables like Rio Star into family staples.

So here’s the deal. TexaSweat will:

- Host a hands-on cooking class at Central Market on [date] to talk all things Texas Citrus.
- Share a \$75 gift card to cover the costs of a family-friendly gathering, including peak-season Texas grapefruit and recipe ingredients.

In exchange, you will:

- Host a dinner inspired by TexaSweat workshop recipe ideas.
- Write a blog post that includes key facts about Texas citrus and showcases your grapefruit-centered meal.
- Share the blog post on social channels tagging TexaSweat.

After the workshop, we will give you two weeks to plan and enjoy your TexaSweat dinner. We would ask that you post to your blog and social channels by [date].

In October, TexaSweat and FH planned to provide family bloggers and media with additional sample shipments of grapefruit as well as materials to promote the new Texas citrus season and encourage additional coverage.

In November, 36 shipments of grapefruit and materials were sent to 8 reporters and 28 bloggers. By market, we sent shipments to:

- Austin – 7 bloggers & 3 reporters
- Dallas – 6 bloggers & 2 reporters
- Houston – 8 bloggers & 1 reporter
- San Antonio – 7 bloggers & 2 reporters



Media Relations

February is National Grapefruit Month and in order to raise awareness about this holiday and delicious fruit, TexaSweat Citrus Marketing hosted media cooking classes in four key Texas markets, San Antonio, Austin, Houston and Dallas-Fort Worth. TexaSweat brought together local media and influencers to highlight the versatility of grapefruit beyond breakfast, and showcased six delicious recipes, including the Grapefruit Sunriser Smoothie, Rio Star Ramen & Spinach Salad, Grapefruit Marinated Shrimp, Rio Star & Quinoa Salad, Warm Citrus Bake, Rio Star Grapefruit Ice Cream and Riomosa.

In each market, media received a hands-on experience as they learned everything from how to supreme a grapefruit to prepping and cooking each recipe. The class's informal setting allowed media to ask questions of TexaSweat employees throughout the class. Media attendees, including the Austin-American Statesman and the Dallas Morning News, were provided with robust information to assist with current stories. Bloggers left feeling inspired and were very excited to use their \$75 gift card toward the grapefruit.

Below are some photos of the workshops:



Market highlights:

San Antonio

- Attendance: 5 bloggers
- The class was very interactive and participants were supreming, mixing, cooking throughout the 1.5 hours
- Media was very active on social media and posted several great pictures using #TexasCitrus
- Class ran for 2 hours

Austin

- Attendance: 4 bloggers, 1 media, including the Austin American Statesman
- The classroom layout limited some engagement, but attendees provided positive feedback about the format, content and recipes. Riomosa was included for the Austin-American Statesman Drink Reporter and attendees loved it.
- Class ran for 2 hours

Houston

- Attendance: 1 blogger, 2 long-lead media
- Due to weather, some participants were unable to attend the class. However, they received the information and materials from the class separately.
- All attendees enjoyed the recipes and learned to supreme a grapefruit for the first time.
- 002's creative director attended and took recipe and interactive classroom stills throughout the class

Dallas

- Attendance: 3 bloggers, 1 media, including the Dallas Morning News
- The attendees were very engaged. Those unable to attend the class due to scheduling conflicts received the materials and information separately.

Other:

- Nine bloggers were unable to attend the cooking classes in their respective markets, but showed great interest in the program.
- Each of these bloggers received a \$75 gift card to complete the Blogger Dinner Party portion of the program.

Goals and Outcomes Achieved

Goal: Increase awareness and preference for Texas grapefruit among school-age children and their families by providing educational tools.

Target: Increase knowledge and awareness among students and teachers by 25 percent.

Benchmark: The benchmark will be established by the prequiz given to teachers prior to classroom event.

Performance Measure: Awareness will be measured by the total number of participating classrooms exposed to the content over the grant term, which will be monitored through the

number of worksheet submissions from teachers. We will also provide teachers with before and after quizzes to give to their students to evaluate knowledge gained. The overall effectiveness of TexaSweeT's messages and nutrition education among school age children will be evaluated through a survey to participating teachers, which will be distributed a few weeks after grapefruit shipments are delivered in March 2014.

Classroom Outreach Outcomes

In January, TexaSweeT mailed out 7,200 postcards to educators in Texas. In addition, TexaSweeT emailed over 500 teachers and posted the program on its Facebook page many times, which reaches 7,818 followers. 210 teachers responded and requested the materials to participate in the program. The deadline to submit entries was March 7, 2014; 121 classrooms returned their packets and 2,940 students participated in the program.

Teachers returned the pre and post quizzes to be entered to win the prizes. The pre-quiz asked questions about Texas citrus before the students watched the informational video. The post quiz included the same questions as well as a few additional ones and was given to the students after they watched the video. Staff evaluated the student's increase in knowledge by grading the pre and post quizzes and averaging the scores. The average test scores for the pre quiz was 59. The average test scores for the post quiz was 89. This shows a 30 point increase or a 66 percent increase in knowledge about Texas citrus.

After the deadline of March 7, 2014, all teachers that submitted a packet received a box with a thank you note for participating, a list of the winning teachers, pencils and juicers for each student in the class. This photo shows the packed boxes going out to participating classes.



The winners for the program were randomly selected. 12 classrooms were selected to win the prize packs and four of those winners were selected to win a Kitchen Aid Mixer for the teacher. The winning classes were notified via email and the winning classes were also posted on TexaSweeT's Facebook page. All 12 winning classes received: a box of Texas Grapefruit and a Grapefruit Prize Pack including a hand juicer, aprons and other goodies for each student.

The winning classrooms were:

Ms. Anzaldua, Harry Shimotsu Elementary, Mission TX

Ms. Barron, W.T. Hanes Elementary, Irving TX

Ms. Contreras & Mrs. Roberson-Huffpower, Green Valley Elementary, Houston TX

Ms. Garza, Bryan Elementary, Mission TX

Ms. Garza, Seguin Elementary, Houston TX

Ms. Graham, Dorie Miller Elementary, San Antonio TX

Ms. Jimenez, Treasure Hills Elementary, Harlingen TX

Ms. Locascio, Schell Elementary, Richardson TX

Mc. McMillan, Charles Patterson Middle School, Killeen TX

Ms. Montelongo, Central Elementary, Angleton TX

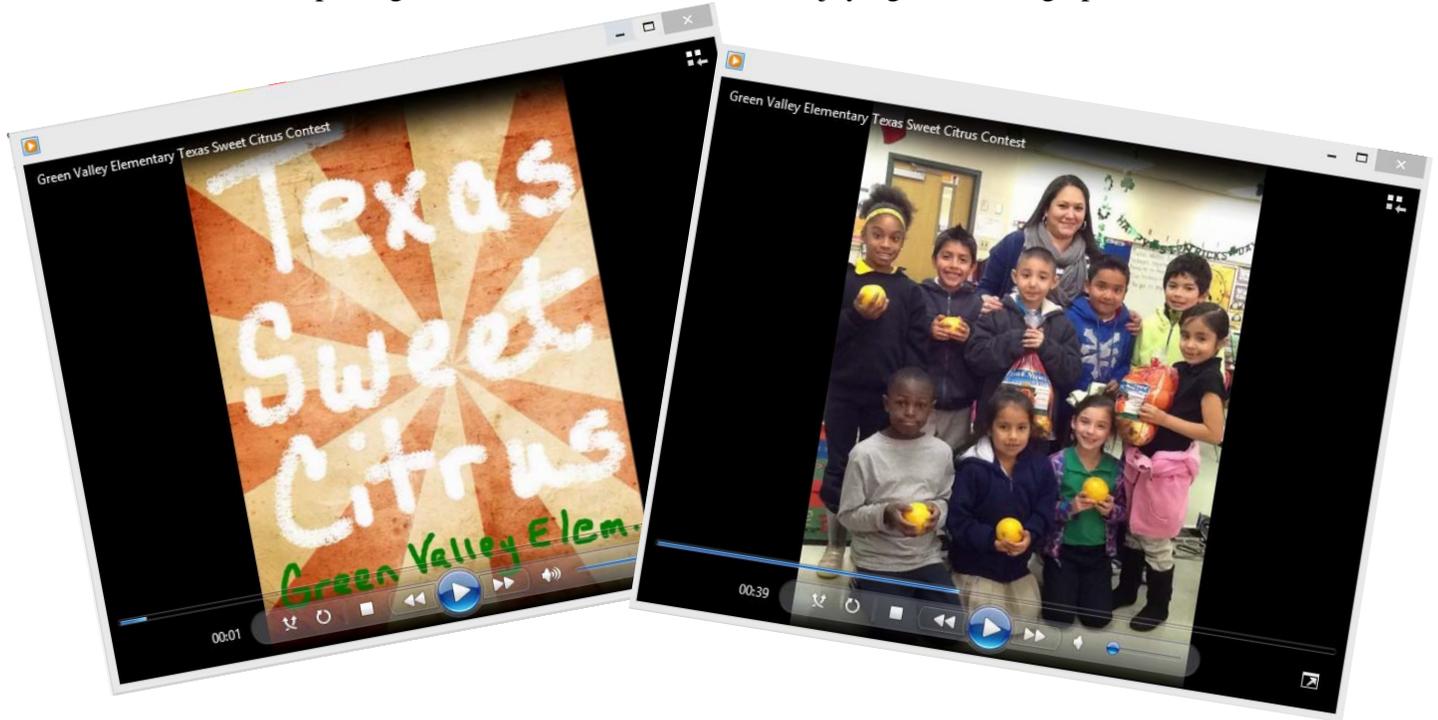
Ms. Monteros, Bond Elementary, El Paso TX

Ms. Veazey, Silvercrest Elementary, Pearland TX

Below are some photos from the winning classrooms:



And one classroom put together a video of their students enjoying the Texas grapefruit.



Beneficiaries

This educational and promotional program generated awareness that will translate into increased sales and consumption of Texas grapefruit, benefitting the entire Texas grapefruit industry including 190 growers and 27 shippers. The program will help extend the economic impact of the Texas citrus industry on the Texas economy, which can reach \$200 million a year.

Lessons Learned

The teachers loved the program but would like to see more fruit and prizes provided to more classrooms in future programs.

Additional Information

A survey was sent out to the participating teachers and 83 of the 121 teachers responded. 100 percent of the respondents said that they would participate in the program again. Below are a few highlights from the teacher's comments. There were also some constructive suggestions on how to improve the program.

10	I enjoy the lesson it fits in with our Social Studies and Science Units.	4/16/2014 2:48 PM
11	user friendly, prompt with delivery and deadlines	4/16/2014 2:44 PM
12	good way to get kids eat fruit with lots of vitamins.	4/16/2014 2:17 PM
13	I really like that companies are interested in education and promote student learning	4/16/2014 11:31 AM
14	It was a great idea and the kids really like it.	4/16/2014 11:30 AM
15	very educational	4/16/2014 9:25 AM
16	Good and educational.	4/16/2014 6:57 AM
17	Great educational program	4/15/2014 10:19 PM
18	It was refreshing to talk about produce of Texas. It goes along with social studies and science.	4/15/2014 9:38 PM
19	Great way to have students learn about healthy food.	4/15/2014 8:20 PM
20	I love it!	4/15/2014 5:48 PM
21	I went out and bought Rio Star Grapefruit! YUM!	4/15/2014 5:37 PM
22	My students were very excited participating in your program. They loved eating the Rio Star Grapefruit :)	4/15/2014 4:58 PM
23	The children loved the juicers that they got after we sent in our quizzes.	4/15/2014 3:50 PM
24	It was an okay program	4/15/2014 3:32 PM
25	It is really great. The kids learned something new. They loved it!	4/15/2014 3:27 PM
26	I LOVE this program and will do it every year with my students!!!	4/15/2014 3:17 PM
27	Wonderful, informative, healthy snack choice for children, local natural resource from Texas	4/15/2014 3:14 PM
28	I think it is a great program.	4/15/2014 2:47 PM

Combined Blogger And Media Results

To date, the following coverage has been obtained from this outreach effort.

- Blog posts to date: 5
- Media articles to date: 4
- Blog & Media UVM's total: 4,636,994
- Social media posts to date: 33
- Social media Impressions total: 70,114

Media and Blog Posts can be found here:

- <http://www.dallasnews.com/lifestyles/food-wine/food-wine-headlines/20141118-summer-gone-but-fall-and-winter-fare-abounds-at-farmers-markets.ece>
- <http://www.atthefirehydrant.com/2014/11/20/grapefruit-cactus-pico-de-gallo/>
- <http://www.ericastartwalking.com/2014/11/share-grapefruit-with-me-from-texasweet.html>
- <http://www.expressnews.com/food/recipes-cooking/article/Grapefruit-goes-in-cocktails-desserts-and-glazes-5919614.php>
- <http://midnitechef.wordpress.com/2014/11/23/texasweet-ruby-red-mojito/>

PROJECT 9: STRATEGIES TO ENHANCE QUALITY, TASTE, AND PRODUCTION OF SPECIALTY MELONS AND ARTICHOKE

Partner Organization: National Center for Appropriate Technology (NCAT)

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Type of Report: Final

Date Submitted: May2015

Project Summary

The purpose of this project was to expand commercial production of specialty melons and globe artichokes in Texas. Increased production of fresh, locally grown, healthy, high quality specialty melons and artichokes with superior flavor will directly benefit consumers and producers, expanding opportunities to diversify Texas agricultural products. Specialty melons—including honeydew, casaba, canary, and Tuscan types—have gained substantial market share in the U.S. in the past 10 years because of their consistently high sugars and diverse and appealing textures and flavors. Flesh colors range from creamy white or pale green to dark orange. Artichoke production in the U.S. has likewise grown, more than doubling in the last three decades. Production takes place almost exclusively in California, with preferred heads being globe types with red, mixed green-red or green color.

Earlier research by Texas A&M AgriLife, funded through a 2012 Specialty Crop Block Grant, established hybrid and open-pollinated melon lines with enhanced quality and disease resistance at several locations around Texas, and also studied consumer attitudes about melons and artichokes. Complementing and continuing that earlier effort, the current project refined crop management systems for artichoke and melons in growers' fields and experimental settings. Texas A&M AgriLife Research carried out the research while the National Center for Appropriate Technology (NCAT) led the educational effort. Research focused on improving quality and production seasonality for Texas markets, and also investigated stand establishment systems, deficit irrigation, season extension strategies, and organic production. The project included a strong emphasis on education, highlighting applied information for diverse audiences including emerging farmers, small-scale farmers, organic farmers, and large commercial growers. Workshops, field days, product demonstrations, a publication, and a video transferred experimental results to growers and consumers.

Project Approach

The project had four objectives: (1) Expand specialty melon and artichoke production sites in selected agro-ecological regions in south, central and west Texas; (2) Evaluate commercial and improved varieties of specialty melons and artichokes in conjunction with growers; (3) Compare quality, taste and productivity of these commodities under conventional and organic production systems using TDA certified organic land; and (4) Organize workshops, field days, and product demonstrations to transfer results from these experiments to growers and consumers.

Artichoke performance

Multilocation field trials took place at commercial sites extending from extreme south to southwest and central Texas: Rancho Viejo in the Lower Rio Grande Valley, My Father's Farm in Seguin, Oak Hill Farms in Poteet (Fig. 1), and a number of small or emerging farmers in Stonewall and San Antonio. Experimental sites were located in the Wintergarden and College Station. Fields were planted during fall 2013 and harvests performed during spring 2014. The first artichoke harvests occurred for cv. Imperial Star at the Rancho Viejo farm near Edinburg, Texas. This grower had an excellent pack out with 18-24 head count boxes that were marketed in Austin and surrounding areas. The second grower, an organic farm in Seguin, also had a successful crop, marketing heads at farmers' markets in San Antonio and Austin. Subsequent harvests took place in Uvalde, Poteet, San Antonio, and Stonewall. Plants in the College Station trial were lost due to heavy rains.

Among the traditional cultivars, the early Imperial Star and the late Green Globe and Green Globe Improved continue to be best performers in terms of yield. Four new varieties recently developed by Big Heart Seed Company in Brawley, California, were also tested. From those, the best cultivars were Lulu (Fig. 2) and Exp. #176 (Fig. 1). Both had superior yield and head quality (Tables 1, 2). These cultivars also exhibited high vigor and some level of winter freeze tolerance.



Fig. 1. Commercial artichoke production in Poteet (left) and trial in Stonewall under plastic mulch (right) (var. Exp. 176).

Artichoke screening and irrigation management

One acre of artichokes was planted with cultivars Imperial Star and Green Globe Improved (GGI) in order to screen best individuals for increased seed production. Improved genotypes were selected for seeding in the fall of 2014. In addition, a portion of the field planted with GGI had an in-ground lysimeter to measure crop evapotranspiration rates for specific crop phenological stages (Fig. 2). Data on water lost by soil evaporation and plant transpiration was taken daily. Values obtained from this test will be used for calibrations and future validations to determine crop water use. Additional artichoke screenings for best agronomic and quality traits were performed at Big Seed Heart in California (Fig. 3). These materials were selected for future trials in Texas.



Fig. 2. Screening red head types, e.g. Lulu (left). Texas cultivar screening and field lysimeter calibrations (right).



Fig. 3. Screening California artichoke varieties (Big Heart Seed) for Texas markets.

Table 1. Yield and head quality measurements of artichoke cultivars in 2014 at Uvalde.

Cultivar	Head measurements					
	Yield (t/ha)	Length (mm)	Width (mm)	Whole (g)	Heart (g)	Heart: head ratio
Experimental 176	13.22 bc	99 a	112 a	427.4 a	44.2 a	0.10 b
Green globe	19.31 a	83 c	99 b	309.3 c	32.9 cd	0.11 b
Green globe improved	16.24 ab	84 c	107 ab	339.0 bc	31.2 cd	0.09 bcd
Imperial Condor	15.79 ab	105 ab	102 b	362.0 bc	28.6 d	0.08 d
Imperial star	14.05 abc	98 b	106 ab	369.4 abc	32.4 cd	0.09 cd
Lulu	16.98 ab	87 c	107 ab	375.2 ab	36.6 bc	0.10 bc
PR	9.93 c	107 a	99 b	339.3 bc	42.0 ab	0.12 a
LSD	5.84	7.95	8.63	65.5	7.74	0.014
<i>p</i>	0.07	<0.0001	0.06	0.08	0.003	<0.0001

Table 2. Plant height and width, leaf number, and chlorophyll content index (SPAD) of artichoke plants at Uvalde, measured March, 31, 2014.

Cultivar	Leaf number	Plant		SPAD
		Height (cm)	Width (cm)	
Experimental 176	12 a	28.9	118.3 ab	51.38 ab
Green globe	11 abc	30.0	130.4 a	52.33 ab
Green globe improved	12 abc	28.1	105.3 bc	50.24 b
Imperial Condor	10 bc	34.2	101.3 c	50.01 b
Imperial star	11 abc	22.2	104.3 bc	51.18 ab
Lulu	12 ab	24.1	123.2 a	55.31 a
PR	10 c	23.3	102.2 c	49.88 b
LSD	1.54	14.54	14.2	4.3
<i>P</i>	0.1	0.6	0.001	0.17

During the fall of 2014, 11 cultivars were planted in a conventional field and seven cultivars in an organic field in order to screen best varieties for yield, head quality, and nutritive value. Additionally, a half-acre of the field was planted with Green Globe Improved to assess the impact of irrigation system (overhead, surface, and subsurface) on yield and head quality. Soil moisture was recorded daily using soil moisture sensors and plant morpho-physiological measurements measured monthly. Results from these experiments will be used to determine the best irrigation system for artichoke production in southwest Texas. Improved genotypes were selected for seeding during late fall 2014 and are currently being evaluated in organic and conventional field production.



Fig. 4. Conventional field (left) and organic field (right) showing different artichoke varieties.

Melon screening and performance

From the TAMU melon breeding program, new seed from 15 elite hybrids generated in the greenhouse was planted by commercial growers near Edinburg (early February), and at Uvalde AgriLife Center (mid-March). Seed was also distributed to three growers for trials near Poteet, Austin (organic), and Seguin (organic). These trials were designed to assess the quality of these specialty melons and cantaloupes compared to commercial cultivars. Larger quantities of the new TAMU orange casaba melon were distributed to a grower near Seguin for his spring planting. Seed for field increase was planted in Amarillo at the AgriLife Bushland research farm.

During May, the first (Edinburg) melon trial was evaluated. Sixteen TAMU cantaloupe hybrids and multiple commercial hybrids were assessed for maturity, yield, fruit size, disease resistance, and fruit quality attributes. Two TAMU hybrids and one commercial hybrid from Takii seeds had high brix (13 percent) and large fruits. Severe powdery mildew and *Monosporascus* root rot and vine decline were evident in the trial. Only one of the TAMU hybrids showed susceptibility to vine decline, and all were resistant to powdery mildew. The field cultivar exhibited susceptibility to both diseases.

The TAMU melon breeding lines and hybrids at Uvalde began to mature in mid-June, and were harvested through mid-July for quality analyses. Severe powdery mildew and some fusarium wilt were observed in this trial. Earliness was observed in six TAMU hybrids and multiple breeding lines, but none were as early as commercial cultivar Olympic Express. However, this cultivar had severe fruit rot issues so produced no marketable fruit. Fruit quality analyses found several TAMU hybrids and breeding lines had higher brix and firmer fruit than Mission (see Table 3). Seed of four hybrids was increased by controlled pollinations in the greenhouse at Texas A&M. In addition, an isolation plot of a vine decline-resistant parent, TAM 24, was grown at Amarillo and about one pound of seed was collected.

Table 3. Melon screening and performance results.

Entry	Size	Firmness	Brix %	Color
Mission	12	4	10.6	Med orange
Oro Duro	9	2	9.5	Dark orange
TAM 6	6	4	11.0	Med orange
TAM 11	12	4	11.1	Dark orange
TAM 13	12	4	12.5	Med orange
TAM 15	12	3	10.4	Dark orange
TAM 23	9	4	11.0	Dark orange
TAM 25	6	5	11.2	Dark orange
BL 5	12	5	13.1	Med orange

Another trial evaluated six melon cultivars under field conditions for yield and leaf physiology (gas exchange) under deficit irrigation. The experiment was carried out at two sites: Uvalde in the Wintergarden and Amarillo in the High Plains. Melon cultivars were grown at three irrigation levels: 100%, 75%, and 50% of crop evapotranspiration (ET_c) requirement. At both sites and across cultivars, the 50% ET_c treatment significantly reduced yield. However, no significant yield was found at the Uvalde site under 75% ET_c treatments (Table 4). The most stable and high quality cultivars were TAMU 1405, Oro Duro, and the special Tuscan melon ‘Da Vinci’.

Table 4. Yield of melon cultivars growing under different levels of water deficit in Uvalde and Amarillo TX, in 2014.

		Yield (ton/ha)	
		Uvalde	Amarillo
Cultivar	DaVinci	19.91	16.0
	F39	9.04	10.5
	Mission	21.94	8.9
	OC164	21.54	12.9
	OroDuro	26.84	19.0
	1405	19.05	20.3
LSD		8.40	8.5
ET	1.00	22.80	23.9
	0.75	23.71	11.9
	0.50	15.50	8.0
LSD		5.90	6.0
CV		0.004	0.056
ET		0.03	<0.0001
CV*ET		0.99	0.110

Educational programs on production and marketing

Education was a major component of this project, and included programs for growers, retailers, and consumers. Personnel from NCAT were instrumental in accomplishing this objective.

Team members (Maggiani, Leskovar, and Crosby) spoke at Texas Organic Farmers & Gardeners’ Conference in two consecutive years, in Houston (2014) and San Antonio (2015), educating growers about the project and recruiting growers to participate in field trials. About 55 participants attended both conferences. In June 2014 Maggiani made a trip to the Alice Farmers Market to talk to farmers about artichokes and conduct an artichoke demonstration for customers at the market. NCAT staff also presented information about the project at the Fort Bend County Vegetable Conference, Texas Certified Farmers Market Association, Houston Urban Food Production Conference, and other events. About 100 total participants attended at those conferences.

A field day was conducted at the Texas A&M AgriLife Research and Extension Center in Uvalde on May 23, 2014, presenting melon and artichoke crop management strategies to more than 30 growers who toured artichoke and melon research plots. Growers were provided new information about stand establishment, irrigation management, variety selection, crop rotations, and pest and disease control.

In early 2015 NCAT completed a new 16-page full-color publication, *Specialty Melon Production for Small and Direct-Market Growers*, and began distributing it at meetings, events, and by free download from the ATTRA website (www.attra.ncat.org). Also known as the National Sustainable Agriculture Information Service, ATTRA is a program of NCAT and reaches a large national audience. The publication covers cultural information, marketing, types of specialty melons, current research, and major insect pests and diseases and highlights the TAMU melon research program. NCAT also created a new video and posted it to the ATTRA YouTube channel (www.youtube.com/user/NCATATTRA): *Make More Money with Specialty Melons*. The video features TAMU researchers, explains marketing opportunities for Texas growers, and showcases varieties tested in this project. It was viewed over 200 times within the first month after posting.

The project was publicized in numerous press releases and newsletters from both TAMU and NCAT. The project attracted a recognized expert in artichokes (from the University of Tuscia) to look at our field research and discuss approaches including germplasm exchange to improve productivity and quality. The Co-PI of the project (Dr. Leskovar) is co-organizing the international symposium of artichoke, which will be held in Argentina in September 2015. Results from this project, including marketing opportunities, will be presented at that symposium by two members of the team (Leskovar and Palma). In addition, a post-doctoral researcher from Argentina came for a 3-month stay (with funds provided by Fulbright) to join the project and perform genomic characterization of artichoke germplasm.

Goals and Outcomes Achieved

We completed the three major activities set out in our plan of work: We established multiple location trials with artichokes and melons in key regions of Texas (Objective 1), evaluating seven artichoke varieties and over 20 melon varieties. We then selected improved varieties, growing with diverse cropping strategies based on the location and grower, such as drip or furrow irrigation, bare soil, or plasticulture systems using black or white mulch (Objective 2). In conjunction with NCAT personnel, we offered several educational events (Objective 3). These included field days, grower visits, seminar presentations to growers' associations and community-based organizations, and a publication and a video on specialty melon production that will be available electronically and distributed free of charge. Research results and new knowledge developed through the project were also transferred to the agricultural community and the general public who visited the project site at Uvalde in the Wintergarden. The project helped a number of small growers supply artichokes and specialty melons at farmers markets, while introducing these attractive products to many consumers. We estimate 50 growers adopted some of the techniques tested in the project.

Long-term goals of this project were to increase the number of Texas growers adopting improved varieties and production strategies for specialty melons and artichokes, increase the number of

acres grown, increase seed availability of TAMU specialty melon cultivars, and enhance consumer awareness of these products. We set targets of 100 acres and 10 growers committed to specialty melons and/or artichokes, as well as increased awareness and more favorable preferences on the part of 30-50 consumers. We approached or exceeded the acreage target, as two of the largest conventional melon producers in Texas—one in Edinburg and another in Carrizo Springs, with a total of 500 acres—are highly interested in growing specialty melons. We came close to the grower recruitment target, as at least seven growers (two of them USDA certified organic) grew specialty melons, artichokes, or both. The consumer awareness goal was achieved and exceeded, as farmers' market demonstrations and conference presentations reached hundreds of consumers.

Beneficiaries

This project benefitted not just small-to-large commercial growers, but also emerging growers (conventional and organic) interested in specialty crops. We estimate 10 Texas growers benefitted from the project on high value specialty melons and globe artichokes. The new open-pollinated cultivars developed by Texas A&M, such as 'Pacal' orange casaba, will benefit Texas growers due to their resistance to local disease and climate stresses, and their high quality. Consumers, especially in Texas, also benefit from the availability of fresh, safe, and healthy products. Results from this project were also presented to grower associations such as the Texas Organic Farmers and Gardeners Association (TOFGA).

Lessons Learned

Demand for high quality and flavorful melons and artichokes continues to be high. Channels include upscale restaurants, farmers' markets, community-supported agriculture (CSA) subscription programs, and large retailers such as Walmart, Whole Foods, and H-E-B. The limited availability of highly adapted varieties of artichokes and specialty melons—including seed production—continues to be a limiting factor for delivery of these products in the Texas markets. Locating growers who are interested in producing these commodities and have access to stable markets is also a consideration for expanding these crops. Cropping systems for melons and artichokes developed at Texas AgriLife have resulted in enhanced quality and yield, but adoption by growers has been slow due to low prices or undeveloped marketing strategies.

PROJECT 10: OUTREACH AND EDUCATION OF IRRIGATION CONSERVATION METHODOLOGIES FOR TEXAS FRUIT & VEGETABLE GROWERS

Partner Organization: Texas International Produce Association (TIPA)

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Type of Report: Final

Date Submitted: December 2014

Project Summary

Texas is currently experiencing rapid population growth due to its business friendly policies and natural resources. Large corporations are moving their businesses and their employees here at an unprecedented pace. Thus, Texas is currently reevaluating its ability to feed this explosive growth with the population expected to double from 25 million in 2010 to almost 50 million in 2050. Although this economic prosperity is welcomed after the Great Recession, it produces new challenges. The most glaring challenge is how to sustain the population's water needs; both agricultural and municipal.

Agriculture is the second largest industry in the State of Texas, with an estimated economic impact of \$100 billion. Living in a state constantly threatened by drought, water conservation is a high priority. According to the Texas Farm Bureau, the 2011 drought cost the State of Texas approximately \$7.6 billion. Even though areas of Texas have returned to a wetter weather pattern, serious water relief has yet to fall and impact important reservoirs and aquifers. Specifically concerning South Texas residents and growers, issues continue to arise between the U.S. and Mexico with regard to the water sharing treaty. Mexico continues to build a series of dams that will further restrict water flow into the Rio Grande River in future years. All things considered, everyone in the state of Texas is having to reprioritize their efforts in conserving water.

With the agricultural industry being one of the largest consumers of water, growers that rely on irrigation for their crops (especially specialty crop growers) stand to gain the most from changing their current irrigation practices. This project was intended to exhibit the benefits of implementing various options of on-farm water conservation. With Texas experiencing a historical drought, the project was very relevant to the grower community thus increasing its reach and impact.

Through this project, Texas International Produce Association (TIPA) was able to collaborate with Texas A&M AgriLife Extension to provide onion and watermelon growers real time water saving statistics and analysis, measure the economic impact of implementing sub surface drip on the farm, and hold two different half day programs for the South Texas growing community to be educated on the most current water conservation techniques available.

Project Approach

The overall goal for this project was to capitalize on the impact the drought was having on the growers. Most growers tend to acknowledge the importance of water conservation only when they are in the midst of a drought, so the strategy was to utilize every venue and opportunity

possible to promote established and new irrigation conservation methods. This was accomplished by hiring an industry coordinator, through experimental field work, hosting a field day and a half day workshop, and sending out digital service kits to TIPA and Texas Vegetable Association (TVA) members.

Industry coordinator

TIPA believes that industry work such as this project needs to be collaborative and incorporate growers, research, and extension, and private allied industry. A problem that exists today between applied research and the commercial grower is the fact that they are not engaged with one another like they have historically. In order to reconcile this problem, the Industry Coordinator focused on creating an environment where the grower, researcher/extension, and private industry all had opportunities to provide input for the success of this project and to work collaboratively. The Coordinator orchestrated meetings and sought out potential project partners. For example, the Coordinator convinced Netafim Irrigation USA, the leading drip irrigation manufacturer in the U.S., to provide the drip irrigation tape that was used in the onion/watermelon experiment and to provide consultations to Extension Specialists to ensure the tape was being used appropriately and reflective of how it is used by commercial onion/watermelon growers. The Coordinator also had Crop Production Services, an agricultural retail company, donate the fertilizer required to grow the crops. Overall, the goal for the Industry Coordinator was to serve as a bridge between the different parties involved in the project to insure its success. Positive feedback provided by the growers and involved allied industry partners confirm that they saw an increased level of commitment and cooperation between all parties.

Field work/ Field day

The crop experiments were conducted with the help of Texas AgriLife Extension at their research station in Weslaco, Texas. The premise of the experiment was to recreate, on farm irrigation schedules, the disparity between flood irrigation and sub-surface drip irrigation in practice. Extension specialists made sure to incorporate commodity specific irrigation methodologies such as onion and watermelon growth stages and water demand curves to maintain the projects focus on the chosen specialty crops.

Onion Experiment

The onions responded favorably to the drip irrigation system. The total onion yield obtained with drip irrigation systems was more than 219 percent higher than the yield obtained with furrow irrigation systems. The large and colossal onion sizes have generally higher price. Drip irrigation systems resulted in higher yields for large and colossal onions than the furrow systems, with the large onion size being 287 percent higher for the drip system than the furrow system. The average furrow length for this region is approximately 1200 ft. Vegetable producers have reduced the furrow length to 650 ft. to conserve water and improve irrigation efficiencies. The experiment conducted in this field had a furrow length of 320 ft. and the average irrigation depth applied was 2.5 in. Irrigation Use Efficiency (IUE) was calculated by dividing the total pounds of produce by the amount of water (in inches applied) to have a numerical representation of what was seen in the field. The drip IUE was 4141 lbs/in, the furrow irrigation based on ETC was 1437 lbs/in, and the furrow irrigation based on grower input had an 1303 lbs/in IEU. It is

concluded that drip irrigation systems more than double the yields and increased onion size while using less water.

Watermelon Experiment

The watermelons responded favorably to the drip irrigation system. Furrow irrigation used 135 percent more water than drip with plastic, and 86 percent more water than drip-bare soil. Drip irrigation with plastic used 26 percent less water than drip without plastic, and yields of drip with plastic were 8 percent higher than furrow irrigation, but the number of fruits was very similar. Highest water use efficiencies were observed with drip irrigation systems. Irrigation Use Efficiency (IUE) was calculated by dividing the total pounds of produce by the amount of water (in inches applied) to have a numerical representation of what was seen in the field. Furrow irrigated melons had an IUE of 5370, drip irrigated melons without plastic had an IUE of 10143, and drip irrigation melons with plastic had an IUE of 13609.

In order to disseminate the project data collected by Texas A&M AgriLife Extension specialists, TIPa held a field day at the Weslaco research station for South Texas vegetable growers. Approximately 40 growers were in attendance. Representatives from some of the largest growing operations in the area were also in attendance, like Val Verde Vegetable, J&D Produce, and Paramount Citrus. The field day consisted of a presentation time where the Extension Specialists discussed the experiment in full detail and shared their economic analysis. Growers were also given ample time to walk the experiment fields and engage with Extension Specialists. Overall, the field day was very successful and very helpful to the growers that were in attendance based on feedback provided through questionnaires submitted at the conclusion of the event. The event received a “positive” experience rating from 80 percent of the event participants.

Water conservation workshop

TIPa organized a half day water conservation workshop that included topics such as:

- 1) Organic acids and their role in moisture management
- 2) Soil moisture management with cover crops
- 3) Weather update and current status of the drought
- 4) The Rio Grande Water Authority’s efforts in securing funds for South Texas agriculture
- 5) Irrigation districts open forum

The workshop was attended by 60 individuals ranging from growers, agricultural researchers, crop consultants, and other various allied industry representatives. Surveys were administered to learn more about growers’ feelings toward implementing some of the conservation methods discussed at the workshop. Survey questions included were:

- *Given the recent drought and water restrictions, have you made any changes in your method of irrigation in the past 3 years?*
- *Please rank the following reasons for not implementing drip irrigation.*
- *Do you feel that applied research on water saving methods should continue?*
- *What commodities do you grow and how are they irrigated?*
- *What information would you need to convince you to implement conservation practices?*

The information provided has been crucial in helping TIPa officials gauge where growers are in their adoption of water conservation techniques and how to provide technical assistance to them in the transition to best practices in farm irrigation efficiency.

Digital service kits

In order to increase the reach and impact of the project's efforts, digital service kits were created to be mailed to growers across the state. The kits included DVD's of the presentations made at the water conservation workshop and information on how to contact TIPA representatives if any additional information was desired. In total, the service kits were mailed to 288 TIPA and TVA (Texas Vegetable Association) members.

Goals and Outcomes Achieved

The goals that were listed in the approved proposal include:

1. Set up co-operator farms to replicate the extension watermelon and onion experiments
2. Have 40 growers attend the field day and water conservation workshop
3. Have 30 percent of attendees adopt at least 1 conservation technique
4. Increase overall education and awareness to conservation techniques
5. Send out media kits to a state wide audience that could not attend the field day and workshop
6. Share the data collected at the Texas Produce Convention

One of the major goals for this project was to be able to get relations between AgriLife Extension and growers back in similar standing that was common during the 1950's. Extension was viewed to be of vital importance and the ultimate resource for local growers. Somewhere along the way it changed and there now exists a "disconnect" between the two parties. By having co-operator farms, TIPA believed that the experience would prove positive and begin to mend the relations and cultivate a renewed commitment to both sides. Unfortunately, after multiple attempts, finding willing growers was extremely difficult and did not come to fruition. Fortunately though, the efforts made by this project made great strides in getting growers to engage with Extension and hopefully allow for potential cooperation in the future.

Knowing that growers are typically slow to adopt new practices on their farms, TIPA understood the importance of having a tangible example of water conservation techniques for growers to experience. Through the onion and watermelon trials, over 40 growers were able to walk the fields and witness the benefits of adopting conservation practices. They were able to see the increased yield response and plant health benefits of using sub-surface drip irrigation. They also could see the agronomic benefits of how using less water in a more efficient manner helps them reduce total water volume used and experience a superior germination that flood irrigation cannot provide. Those same growers came back to the conservation workshop to increase their understanding of where their irrigation water comes from and about municipal usage and the amounts required to sustain population growth. They also learned that soil chemistry is important in maximizing soil moisture, and that there are people and programs in place to help them implement water conservation methods on their farms.

One of the most feasible conservation practices that growers could broadly implement is decreasing the total length of their beds to prevent deep percolation and reduce unutilized irrigation water. The average bed length for specialty crops like onions and watermelons often range in 800-1200 ft. The experiment bed size was 360 ft. and exhibited a higher IUE (1431 lbs/in) than the grower standard (1303 lbs/in). The post workshop and field day surveys

exhibited that the majority (greater than 50 percent) acknowledged the benefit of shortening their rows and would seriously consider implementing this strategy in their next growing season.

A primary goal for this project was to promote it through as many venues as possible to increase its reach and impact. The Texas Produce Convention (TPC) is a gathering of many of the top Texas specialty crop growers, packinghouses, and allied industry where 200 attendees per convention are common. It is hosted by TVA and TIPA and unfortunately it was decided that there would not be a 2014 TPC. Although it is unfortunate that it was a missed opportunity to share the project with that particular audience in the excellent setting that the TPC always provides, TIPA was able to achieve its purpose by sending out the digital service kits to the same individuals that are invited to TPC every year. Approximately 288 digital service kits were mailed.

Overall, this project was successful in many facets. It provided an opportunity to bring growers, applied researchers, and allied industry together to remind the industry that challenges as difficult as water conservation require a dedicated effort by all parties involved. Easily adopted conservation methods were exhibited to growers to show them how they can conserve water immediately on their farm. Long term conservation methods like sub-surface drip irrigation were studied and analyzed and shown that the economics of the system make it a viable option for most specialty crop growers. Industry leaders in soil science educated growers on how to reprioritize soil organic matter to help the soil increase its natural water holding capacity in order to maximize rain water that is collected. South Texas growers were educated by state officials on where their irrigation water comes from, that it is never guaranteed, and that every effort of theirs to conserve water on the farm helps make sure there is water for the next season. All efforts combined, over 40 of South Texas' leading specialty crop growers and 288 state wide growers and crop consultants were shown the different options they have to conserve water on the farm.

Beneficiaries

Originally, it was expected that the beneficiaries of this project would be just growers and the municipalities receiving more water allotments from reduced agricultural use. However, as the project progressed the demographics that would benefit from this project increased.

The Growers

Specialty crop growers were expected to be the primary beneficiaries of this project that include the 40 plus growers that attended the field day and workshop and the 288 individuals that received the digital service kit. TIPA officials expect this number to increase by having the crop consultants that were in attendance at the events disseminate the information to their various growers. Feedback provided by the crop consultants concluded that they will increase their efforts to consult with their growers on the various ways to conserve on-farm irrigation water.

Water Districts

Water district directors were invited to participate in a question and answer forum during the water conservation workshop. It was a time where growers could voice their concerns, present ideas, and convey their opinion of how the districts could better facilitate their needs. The growers conveyed that the districts should do more to help them transition to sub-surface irrigation, such as offer cost share opportunities to help build on farm reservoirs. Overall, the

district directors were given an opportunity to educate growers on some of the key challenges they face and how they plan on helping facilitate the needs of the growers. TIPA believes that the experiences gained from this project will play a vital role in helping motivate serious change at the water district level.

Consumers

The Food and Agriculture Organization (FAO) estimates that the global demand for food, feed, and fiber will increase by 70 percent in the first half of the 21st century. In order to meet these demands, the agricultural community will have to more than double its current production, potentially having to double its water usage. These are alarming statistics, but as demonstrated in this project, there are gains to be made through water use efficiency. Consumers will benefit as more growers adopt more efficient irrigation methods conserving vital agricultural water.

TIPA, AgriLife Extension, & Allied Industry

TIPA seeks to engage with all agricultural stakeholders and this project was a great opportunity to engage with growers, AgriLife extension and research specialists, and allied industry. This project helped create strong bonds between the different parties and fortify an industry-wide unity that will lead to successful projects in the future.

Lessons Learned

This project was insightful by encouraging important discussion amongst growers, research/extension, and allied industry. Major lessons learned are as follows:

- A majority of growers are looking for financial assistance in adopting on-farm water conservation methods.
- Co-operator farms were difficult in the execution of this experiment. Most growers were concerned about exposing trade secrets and/or confidentiality.
- Even though the drought has severely impacted growers, it will have to continue to worsen to get greater adherence to on-farm conservation methods.
- Specialty crop growers are moving their growing operations to more heavily populated water districts in order to access larger shares of agricultural water.
- The average price of irrigation water in the RGV is still too inexpensive to motivate all growers to adopt the use of sub surface drip irrigation.
- Growers respond favorably when organizations like TIPA engage with them about important topics like on-farm water conservation.

PROJECT 11: CONSERVING WATER IN RURAL AND URBAN VEGETABLE FARMING

Organization: Uvalde County Underground Water Conservation District

Partner: Texas A&M AgriLife Research

Project Manager: Vic Hilderbran, Co-PI Dr. Daniel Leskovar,

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Type of Report: Final

Date Submitted: June 2015

Project Summary

Vegetable crop production in southwest Texas is limited due to environmental conditions, especially high temperatures and drought during the growing season. In addition, due to strict water restrictions for surface and underground water resources, the vegetable industry is increasingly interested in maximizing water use efficiency (WUE) when growing high value leafy vegetables. The project is aimed at the feasibility of growing high-value leafy greens for urban and rural communities and to improve water use and conservation in the production of locally grown, healthy, and high quality leafy green products. Studies were performed to determine crop water requirement, WUE and final product quality of various leafy greens with emphasis on lettuce under re-circulating hydroponic culture (urban farming) and field conditions with drip and center Pivot irrigation (rural farming). The data has shown the high WUE, product quality and productivity of lettuce cultivars when growing in hydroponics using the nutrient film technique (NFT) hydroponic recirculating system as compared to field production under drip and center Pivot. The results foster hydroponic leafy vegetables business in southwest and central Texas by providing recommendations about best lettuce cultivars for commercial production, the technology of the production system, as well as the design support for the greenhouse NFT system. This project complemented a previously funded SCBGP in refining practices and the production system for the different lettuce types. The project also provided educational programs, highlighting results to diverse audiences, including emerging and small-scale farmers in Texas.

Project Approach

The following tasks were achieved during the grant period: screening leafy greens under the hydroponic NFT culture, screening lettuce types under the NFT system, comparison of hydroponics with field-grown systems (drip, pivot), consumer preference for leafy greens and educational programs.

Screening leafy green crops

Five crops and 22 cultivars were initially screened for lettuce, collard, kale, mustard and Swiss chard. Seeds were sown in propagation trays (Fig. 1) until they were transplanted in the hydroponic tables. Water usage, pH and electrical conductivity were monitored throughout the growth cycle. Growth and quality parameters were measured at harvest. The best crop performance by cultivar was as follows: collard ('Georgia Southern'), kale ('Vates Blue Curled Scotch'), mustard ('Tendergreen'), swiss chard ('Ford Hook' and 'Lucullus'), and lettuce ('Bibb', 'Butter Crunch', 'Salad Bowl Green', 'Kremlin Red Leaf', 'Progreen-76' and 'Sunbelt').



Fig. 1. Seedling growth at the nursery stage prior to transplanting in the hydroponic system.



Screening and selection of lettuce types

The chemical compositions of the nutrient solution used in the NFT recirculating system nutrition solution were nitrogen (N) total-3%, available phosphorus (P_2O_5)-2%, soluble potash (K_2O)-4%, calcium (Ca)-2.8%, magnesium (Mg)-0.5%, sulfur (S)-1.1%, manganese (Mn)-0.05%, molybdenum (Mo)-0.0005%. Plants were grown during three cycles, October 2014, December 2014 and February 2015, for 57, 46, and 46 days from seeding to harvest, respectively. Tables 1, 2 and 3 summarize the lettuce yield productivity and quality

characteristics, as well as WUE by cultivars. For the Bibb lettuce, greatest fresh weight, leaf length, leaf number, Brix index and WUE (0.22-0.58 L/g DW) were recorded for Buttercrunch. For Romaine lettuce, greatest fresh weight, leaf length, leaf chlorophyll content index (SPAD) and WUE (0.28-0.70 L/g DW) was recorded for Sunbelt. Conversely, these cultivars expressed moderate leaf tipburn injury during the first cycle. For the Loose-leaf lettuce group highest growth and WUE (0.37-0.95, 0.50-1.00, 0.40-1.04 and 0.34-0.73 L/g DW) were recorded for Ezatrix, Caipira, Kremlin Red Leaf and Pearl Gem, respectively. Brix index of the lettuce sap was variable ranging from 1.70-4.43 for Bibb, 1.48-2.52 for Loose-leaf and 1.75-3.45 for Romaine types. After three cycles the average WUE (L/g dry weight) for Bibb lettuce type (Buttercrunch) was 0.37, for Romaine lettuce (Sunbelt) 0.43 and for Loose-leaf lettuce types (Ezatrix, Caipira, Kremlin Red Leaf, Pearl Gem) 0.59, 0.68, 0.64 and 0.51 L/g DW, respectively. The lettuce cultivars: Chabi, Bibb, Buttercrunch and Sunbelt showed moderate tip burn (Fig. 3) during the first cycle.



Fig. 3. Tip burn in Bibb type lettuce (left). Discussing leafy quality attributes with project partners (right).

Table 1. Lettuce cultivar yield and leaf quality in the NFT recirculating system during first cycle (October 21, 2014 – December 18, 2014).

Bibb Lettuce							
Cultivars	Leaf Fresh Weight, g	Leaf Dry Weight, g	Leaf Length, cm	Leaf Number	SPAD index	BRIX index	Stem Diameter, mm
Bibb	70.50a	2.95a	27.4a	13a	28.9a	2.45a	15.3a
Buttercrunch	144.6a	5.88a	34.2a	20b	29.4a	2.90a	21.4a
LSD (.05)	75.7	3.1	7.7	5.3	7.4	0.78	7.2

Loose-leaf Lettuce							
Bellatrix	59.2cb	2.65cb	19.8d	13cb	23.7b	2.52a	12.5bac
Ezatrix	121.9a	4.70a	24.0c	20a	23.8b	2.07ba	15.7ba
Caipira	89.70b	3.50b	21.2d	12cb	18.4c	2.12ba	14.6bac
Kremlin Red	76.8cb	3.55b	26.1bc	13cb	27.8ba	2.60a	15.4ba
Progreen 76	76.1cb	2.85cb	29.7a	13b	30.2a	2.20a	15.7a
Ezfrill	61.8cb	2.55cb	19.8d	14b	16.6c	1.83b	11.2bc
Ezfilan	56.40c	2.27c	19.3d	13cb	17.0c	1.88b	10.6c
Pearl Gem	65.30cb	2.87cb	28.3ba	9.0c	11.4d	2.50a	13.5bac
LSD (.05)	32.05	1.09	2.45	3.69	4.89	0.6	4.48
Romaine Lettuce							
Sunbelt	120.8a	4.58a	33a	14b	32.75a	3.45a	18.48a
Chabi	94.5b	4.23a	26.4b	17a	31.95a	2.9a	17.2a
LSD (.05)	22.54	0.69	1.37	1.4	0.92	2.14	6.92

Table 2. Lettuce cultivar yield and leaf quality in the NFT recirculating system during the second cycle (December 26, 2014 – February 10, 2015).

Bibb Lettuce							
Cultivars	Leaf Fresh Weight, g	Leaf Dry Weight, g	Leaf Length, cm	Leaf Numbers	SPAD	BRIX	Stem Diameter, mm
Bibb	176.4b	3.13b	27.7b	21b	32.0a	1.70b	14.78a
Buttercrunch	301.4a	5.93a	38.9a	32a	29.9a	4.43a	16.53a
LSD (.05)	97.2	1.09	8.66	6.68	3.12	0.8	2.96
Loose-leaf Lettuce							
Bellatrix	84.70d	1.65d	18.88d	19.0c	18.85c	1.90bac	8.93c
Ezatrix	186.4b	3.63bc	27.93bc	32.75a	31.18ba	1.80bc	11.68b
Caipira	185.9b	3.45c	25.25c	24.75b	26.08b	2.25bac	11.13bc
Kremlin Red	163.7b	3.80bc	27.1bc	20.5c	32.0a	2.83a	14.80a
Progreen 76	182.5b	4.30ba	28.58b	20.25c	31.85a	2.68ba	11.13bc

Ezfrill	125.3c	2.38d	20.23d	18.5dc	15.0dc	1.53c	11.75b
Ezfilan	81.0d	1.78d	21.0d	16.0d	11.15d	2.08bac	10.40bc
Pearl Gem	240.7a	4.70a	32.48a	18.75c	14.78dc	1.93bac	12.50ba
LSD (.05)	28.5	0.75	3.13	2.75	5.36	0.99	2.48
Romaine Lettuce							
Sunbelt	255.3a	4.90a	35.1a	26a	35.95a	2.18a	15.1a
Chabi	202.1b	3.78b	28.9b	23a	31.65b	1.75a	12.3a
LSD (.05)	43.2	0.78	2.54	3.7	3.96	0.73	3.23

Table 3. Lettuce cultivar yield and leaf quality in the NFT recirculating system during the third cycle (February 1, 2015 – March 19, 2015).

Bibb Lettuce							
Cultivars	Leaf Fresh Weight, g	Leaf Dry Weight, g	Leaf Length, cm	Leaf Numbers	SPAD	BRIX	Stem Diameter, mm
Bibb	211.7b	5.98a	27.05b	21.75a	28.28a	1.75a	17.85a
Buttercrunch	273.7a	8.90a	35.25a	24.50a	30.48a	2.50a	19.75a
LSD (.05)	59.5	3.96	7.11	2.98	3.42	1.5	7.92
Loose-leaf Lettuce							
Bellatrix	91.80fe	3.35ed	18.10c	17.25c	25.18b	2.18ba	11.28c
Ezatrix	200.7cb	6.28b	24.63b	29.25a	30.68a	1.80bc	15.73b
Caipira	175.5cd	5.30c	20.35c	20.25b	22.08b	1.90bc	14.05cb
Kremlin Red	159.7d	5.85cb	26.08b	17.0c	30.25a	1.70bc	19.60a
Progreen 76	208.9b	8.35a	30.0a	18.25cb	31.35a	2.43a	14.30cb
Ezfrill	121.1e	4.0d	18.35c	18.50cb	15.38c	1.48c	12.40cb
Ezfilan	84.10f	3.10e	20.45c	13.50d	9.80d	1.88bc	12.83cb
Pearl Gem	245.8a	8.10a	31.33a	16.0cd	14.85c	2.10a	12.85cb
LSD (.05)	29.48	0.86	2.77	2.99	4.89	0.48	3.65

Romaine Lettuce							
Sunbelt	256.6a	8.67a	33.63a	24a	36.45a	2.32a	15.35a
Chabi	233.4a	7.10b	26.90b	21a	35.78a	2.23a	14.38a
LSD (.05)	25.77	0.89	1.5	3.37	4.14	1.31	3.11

Comparison of hydroponic, drip and LEPA systems

During 2014, a study was conducted to determine the impact of irrigation systems (drip vs. linear irrigation or LEPA) and irrigation rates (100% vs. 70% ETC) on four leafy crops and a total of ten cultivars: collard ('Georgia Southern' and 'Vates'), kale ('Vates Blue Curled Scotch' and 'Dwarf Siberian Improved'), lettuce ('Bibb', 'Salad Bowl Green', 'Butter Crunch', and 'Simpson Black Seeded') and spinach ('Ashley' and 'Carmel'). Overall, deficit irrigation (70% ETC) slightly reduced yield and WUE in spinach under the LEPA system, while the opposite occurred with lettuce which exhibited an increase of WUE with 70% ETC under LEPA. In kale and collard, 70% ETC caused a slight reduction in yield under SDI as compared to LEPA.

In lettuce, yield, quality and water use parameters were evaluated and compared to those obtained in the hydroponic NFT production system (Fig. 4). When comparing lettuce grown hydroponically vs. open field, three major findings were found: 1) total productivity of lettuce was much higher under hydroponic than open field; 2) hydroponic lettuce had 8-fold greater water use efficiency, and 3) the cycle of production was reduced by 40% in hydroponics. Similar trends were measured for kale and collards under the hydroponic NFT system (Fig.4).



Fig. 4. Comparing leafy greens in hydroponics (left) and open field - LEPA system (right).

These studies suggest that the effects of deficit irrigation on yield and WUE of leafy greens grown are highly dependent on the type of crop, cultivars and irrigation systems when grown in the Wintergarden region. Water savings in the hydroponic production system were >90% as compared to growing them in open fields with drip or Center pivot. Best lettuce types were 'Bibb', 'Buttercrunch' and Romaine cultivars 'Sunbelt', 'Pro Green 76' and 'Kremlin Red leaf'. Spring trials showed several plants of the Romaine and Bibb types were affected by "tip burn" a physiological disorder associated with calcium deficiency and mobility (Fig. 3).

These results highlighted the importance of continuous screening and selection of lettuce cultivars for reduced leaf tip burn, high WUE and leaf quality in the hydroponic culture. This is

also important to improve water productivity, extend the production season, and improve the final product quality with minimum pesticides and nitrate leaching to the environment.

Consumer preference for leafy greens

Hydroponic lettuce types were used in a consumer preference study carried out at TAMU College Station during February 2014. Consumer preferences for green and red hydroponic lettuce were compared to those grown as organic and conventional. A total of 201 individuals from the Bryan/College Station area bid on several vegetable products: conventional green lettuce, conventional red lettuce, organic green lettuce, organic red lettuce, hydroponic green lettuce, hydroponic red lettuce, hydroponic mixed (red and green) lettuce, and spinach (control). Across all sessions on average, organic and hydroponic varieties were valued more than conventional varieties. Out of all of the products, on average, hydroponic mixed and organic green varieties received the largest premiums across treatments. In addition, different econometric analyses were performed to identify the significant factors that affect willingness to pay (WTP). The results of this study served as the basis for a Master of Science degree to Meghan Ness who published the thesis entitled: *Evaluating the external validity of experimental auctions: the case of hydroponic lettuce*.

Educational programs

Urban and rural educational programs were conducted covering all aspects of production, water saving technologies and marketing of specialty leafy greens. The project was promoted to current and potential growers interested for establishment hydroponic systems in Texas as well as members of water agencies especially the Uvalde County Underground Water Conservation District, rural appraisers, and potential industry interested in investing in these technologies in Texas. The hydroponic program was also presented as part of a field day program in Uvalde during April. <http://today.agrilife.org/2014/04/25/uvalde-wheat-vegetable-field-day-interest-among-area-producers/>. Thirty six participants attended the field day. A workshop entitled 'Aquaponics: principles and practices' was also delivered in May 2014 at Texas A&M, College Station. Sixty five participants representing current and potential small to large hydroponic growers actively engaged in the seminar and Q&A interactive sessions. The seminar entitled *Hydroponics for leafy greens: Comparing quality, production, and water use efficiency* included topics on the concepts of hydroponics, types of NFT's, applications, crops, as well as advantages and disadvantages. This research was also presented at the American Society of Horticultural Science in Orlando during July. Thirty participants attended the oral session. The paper was entitled: *Water saving strategies for leafy greens in Southwest Texas*. Another presentation was given regionally to 30 participants of the Texas Chapter of the American Society of Farm managers and Rural Appraisers (ASFMRA) in Uvalde during October 2014. The general theme of the conference was 'New factors Affecting Rural Land' with the specific presentation that highlighted this project 'Water conservation for drought mitigation: Approaches for Agriculture and Landscape Uses'.

Goals and Outcomes Achieved

The long-term goals of this project are to produce high-value leafy greens following efficient and water conserving strategies for urban and rural communities and to expand the production of

high value locally grown leafy greens. In order to achieve the long-term goals, significant progress has been made through the annual plan of activities set initially for 2014. The project screened leafy greens under the hydroponic NFT culture, compared leafy greens grown in hydroponics with field grown under drip and linear system irrigation, evaluated the consumer preference and willingness to pay for leafy green products and conducted numerous educational programs to diverse audiences. These results have served as the basis to establish new research and technology development in conjunction with inputs received from the two major hydroponic growers located in Seguin-San Antonio area. Additional information generated by the project was used to attract a multi-million hydroponic system. Currently there are four main commercial hydroponic operations in Texas, with the newest established in Rockdale in 2015. This operation serves the markets of the Round Rock area. The project more recently attracted a new initiative for the establishment of another large scale hydroponic system in the metropolitan areas of Houston and San Antonio. Therefore, the visibility of this project is attracting large commercial operations to produce hydroponically Texas grown products with higher economic impact, as compared to the establishment of small-scale farmers as initially envisioned on the project. These operations are reaching far more consumers which are seeing the value of consuming locally grown leafy green products. We estimate that the project reached out over 500 people through integrated activities such as field days, seminars and visits (on-line and in-person).

The results in water conservation continue to be impressive for recirculating hydroponic systems with more than 90 percent of water savings as compared to those grown under field conditions. The NFT recirculating system used for lettuce production can be implemented not only in semi-arid rural environments, but also in urban areas, as well as areas where the soil type or other plant growth and development factors are not ideal for the desired lettuce commercial production. The direct advantages of the NFT recycling system technology of lettuce production are: no crop limitations due to soil type; plant nutrition solution can be recycled; minimum to no waste because leaching is significantly reduced; quick growth, uniform quality and stable yields because there is no competition for nutrients and water; less frequent occurrence of soil borne diseases; local production with less labor needs as compared to open field cultivation that requires soil tilling, more pest control (weed, pest and diseases), irrigation and cultivation. Hydroponic production of leafy greens will allow for an extended production season with a more continuous supply of high quality and fresh products as compared to open field production.

Beneficiaries

The project is benefiting small-scale emerging farmers as well as current and future large commercial farmers. For example, the project reached over 350 individuals through educational programs, consumer panels and field days. The project in conjunction with the local partner organization also created awareness and provided hydroponic-grown lettuce varieties to hundreds of disadvantaged people served at the local Uvalde Nutrition Center. In addition the project has delivered findings on the production, system design and management to over 100 participants attending regional seminars and workshops related to water conservation technologies and the production of high-value leafy crops.

Lessons Learned

Growing lettuce varieties during spring and summer continues to be challenging for growers, especially under high temperatures and humidity experienced in southwest and central Texas

environments. Locating growers interested in the production of these commodities has been very important to refine objectives and redirect activities to serve their needs. The demand for high quality and tasteful leafy greens is quite high in Texas markets and the potential opportunities to expand this market through upscale restaurants, farmers' markets, and large retailers such as Walmart, Whole Foods and HEB is very promising.

PROJECT 12: PAIRING TEXAS VEGETABLES WITH DAIRY TO INCREASE BRAND AWARENESS & SALES

Partner Organizations: Texas Vegetable Association

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Type of Report: Final

Date Submitted: February 2015

Project Summary

To increase awareness and sales of Texas vegetables, the Texas Vegetable Association (TVA) partnered with Southwest Dairy Farmers (SWDF) and executed a marketing campaign focused in Austin and San Antonio over two, three-week flights during the spring and fall.

The motivation for this project is to enhance the competitiveness of Texas grown vegetables by providing education to consumers about the health benefits of fresh Texas vegetables and promoting locally grown produce. Many consumers lack the knowledge of pairing compatible foods with one another. The motivation for implementing a campaign to creatively market Texas grown vegetables with dairy products is for a few reasons: 1) People may have a stronger interest in purchasing Texas grown veggies if they are aware of the great health benefits they provide; 2) Consumers may be more likely to support Texas grown veggies if they know that they exist and what they taste like; and 3) Consumers may be more likely to purchase Texas veggies if they can creatively pair them with other healthy and delicious foods. Many folks just lack the creative knowledge of what foods pair well with and nutritiously complement one another. This marketing campaign ventured to bridge that gap through an array of marketing and advertising with the intention that this would enhance targeted specialty crops. By getting right in front of the consumers during in-store demonstrations, TVA was able to have a direct impact on the market and instill that message. Moreover, by partnering with the SWDF, TVA was able to expand the reach of the program and appeal to a completely different population.

It is important to expand a market for Texas vegetables for the same reason it is important to increase opportunities for any locally grown or produced product, because it creates a stronger local economy and relieves dependence on outside sources for healthy fresh vegetables. Furthermore, it ensures a larger market for locally produced fresh; key word being fresh, vegetables for a rapidly growing Texas population. Availability of fresh food is never ideal and by partnering with SWDF, TVA is able to expand the reach for targeted specialty crops providing more opportunities for consumers to buy and producers a sustainable market.

Cost-sharing was utilized as indicated in the approved project proposal. SWDF provided support with a value in excess of \$65,000. To ensure Specialty Crop Grant Program funds were used solely to enhance the competitiveness of specialty crops TVA promoted only specialty crops with program funds. Cost-sharing project activities occurred when there was overlap between promotion of vegetables and non-specialty crop foods.

The campaign included some of the same valuable methods used in previous marketing campaigns, but also several new tactics. TVA expanded on previous efforts to educate consumers about the health benefits of fresh Texas vegetables. TVA utilized proven tactics such

as, television commercials, and in-store demonstrations, and also included a new consumer-facing website, video pre-roll, online ads and home page takeovers.

By partnering with SWDF, TVA was able to increase campaign reach and add more marketing tactics including a billboard campaign involving vegetables and dairy paired together. TVA was able to share in SWDF’s media campaign expanding program messages. TVA’s in-store demonstrations mirrored the Texas Department of Agriculture’s (TDA) efforts to promote GO TEXAN and increase point of purchase sales.

These tactics increased sales, grew brand awareness and educated consumers on the health benefits, availability and freshness of GO TEXAN vegetables and the benefits of pairing vegetables and dairy together to make a tasty and healthy meal.

Project Approach

TVA utilized the following tactics to engage consumers:

Online Advertising in Austin and San Antonio

TVA identified top media websites in each market (KVUE, the ABC affiliate in Austin and KSAT, the ABC affiliate in San Antonio) and created animated banner ads to run in April, May, September and October. Additionally, online video pre-roll ran by utilizing television spots. All creative messaging featured TVA’s “Dip, Dunk and Drizzle” campaign, which promoted pairing vegetables with dairy as a healthy option for snacks and sides. This resulted in 1,153,500 impressions from the banner ads and 300,000 impressions from pre-roll video.



TV Ads in San Antonio and Austin

TVA identified television stations in each market that performed best with the target demographic. These stations were KVUE, the ABC affiliate in Austin and KSAT, the ABC affiliate in San Antonio. TVA ran 287 30, 15, and 10 second commercials featuring the “Dip, Dunk and Drizzle” campaign promoting how Texas vegetables combined with dairy not only taste great,

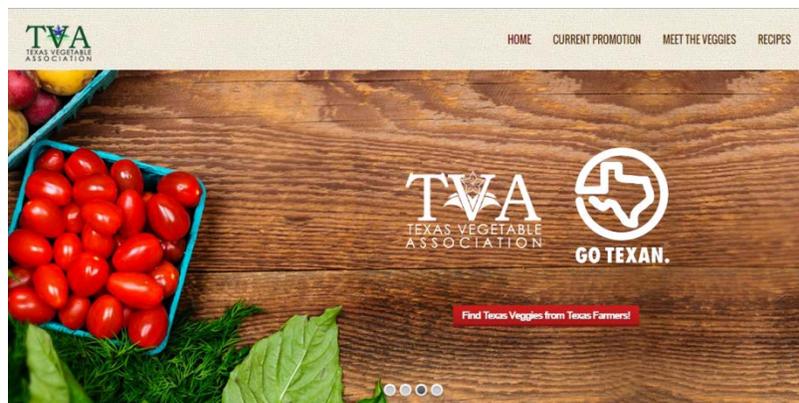


but they're healthy and fresh. The two flights corresponded with the digital campaign, and ran in April, May, September and October.



Dedicated Texas Vegetable Association Consumer Website

TVA designed and developed a new website to provide consumers with more information about Texas vegetables. Elements of the site include how to select vegetables at the store, proper storage, recipes and a page featuring the current “Dip, Dunk and Drizzle” campaign. The site is responsive, allowing it to be clearly viewed on all mobile and tablet devices. It also has a user-friendly content management system for quick and easy updates and edits. After the site launched, 220 unique users engaged in 227 sessions with 323 page views. The full site can be viewed at www.txvegetables.com.



Billboards

To supplement the media campaign, six billboard locations were secured in Austin and San Antonio during April and May, Two billboards from June through September, and six again during September and October. This was provided by SWDF at no cost to TVA.





VEGGIES Y'ALL!

We Texans take pride in everything we do – and growing delicious, nutritious vegetables is no exception.

Take a moment to explore the site and learn how to **Choose, Store** and **Cook** with these important dietary staples. And by going local, you'll not only be getting your family the nutrients they need, you'll also be supporting Texas agricultural growth. With a wide variety of vegetables produced in Texas – including Texas Sweet Onions (the official state vegetable) – you'll enjoy top notch quality. Plus, the confidence in knowing that you're supporting your local economy.

The **Texas Vegetable Association** serves growers and producers by addressing important industry concerns



BETTER TOGETHER - TVA & SOUTHWEST DAIRY FARMERS

*The Texas Vegetable Association is proud to partner with Southwest Dairy Farmers; promoting various ways to **DIP, DUNK or DRIZZLE** your vegetables for delicious flavor variations.*

Who are the **Southwest Dairy Farmers**? They are the men and women who help to bring your favorite dairy products into your home. This alliance of dairy farmers works hard to educate consumers on dairy nutrition and promote dairy consumption. They also keep up-to-date with research and information about milk, cheese, ice cream, and all other dairy products we love.



GO TEXAN DISTRIBUTION

*Check out a **List of Restaurants and Farmers Markets** that proudly serve and sell Texas Vegetables — and always look for the **GO TEXAN** sign, when selecting your produce.*

GO TEXAN celebrates, promotes, and supports Texas agriculture by representing Texas Agri-businesses — building awareness and recognition of Texas produce at local, national and international levels.

The site is also a helpful tool to find restaurants, wineries, and shops that sell locally grown produce. Show your Lone Star pride when you go to your local grocery store or farmers' market and look for the **GO TEXAN** signature

In-Store Demonstrations

TVA partnered with TDA and HEB to perform in-store demonstrations and taste tests at 390 locations during the campaign. For greater impact, the demonstrations were scheduled to coincide with an existing event.

Goals and Outcomes Achieved

The goal of this campaign was to increase consumer awareness of the quality of taste and nutrition of Texas Vegetables in order to enhance the competitiveness of these crops. TVA encouraged consumers to visit restaurants that purchase/serve local produce/vegetables, and promoted the health benefits of individual vegetables as well as replacing unhealthy foods with vegetables at home, work or at restaurants. Based on the number of impressions and reach achieved by the media plan (see section above for break down by medium), awareness increased among the target audience.

Produce demonstrations resulted in an average of 12,000 pounds of Texas vegetables sold during the promotional period at participating retailers. Campaign tactics resulted in an average increase in sales of 46.5 percent from the previous year. Consumer comments from surveys included: “We were happy with the foods we sampled; that it got us out of our “food” comfort zone.” Other comments included: “It was great to learn about the growing seasons of Texas produce and when fresh produce is available.”

Due to product availability there were issues with the demos. While marketing efforts did drive traffic to the retail outlets which was beneficial to them, there was a greater demand than there was product for sampling.

Beneficiaries

This campaign benefitted 400 growers and producers of Texas vegetables across the state of Texas as well as dairy farmers across Texas, New Mexico, Kansas, Missouri and Oklahoma. Campaign promotions impacted sales at more than 3,500 retail grocery stores and 150 Texas restaurants.

The biggest competitor for Texas producers is Mexico. With Country Of Origin Labeling laws it was easy to see and hear consumer reaction to purchasing imported products. Staff conducting the samplings and cooking demonstrations reported that consumers stated they would purchase Texas or even US products before purchasing imported. Increasing desirability can be quantified by the increase in sales. If a consumer desires a product over another they will purchase the desired product.

Lessons Learned

There was difficulty setting up the in-store demos in a timeframe for the product to be readily available. This illustrated how important marketing and advertising efforts are to support the demos and increase sales. Based on experiences with grocers this year, TVA understands all of the steps involved in scheduling and executing the demos, and does not foresee this issue repeating itself in the future. Specifically, TVA was not aware that there was an issue with product availability. Contact with the grocers much sooner could have helped determine the best time for scheduling demos. TVA will be contacting grocers much sooner regarding product availability in the future.

In store demonstrations remain the best way to determine consumer preference and possibly increase sales of any product. Demo staff recorded consumer comments during sampling. Possibly a better way to improve this is to go high-tech and perhaps, surveying consumers electronically to streamline the evaluation process. TVA also needs to determine how to conduct demonstrations on a scale that would affect the entire states sales results.

Taking a look at USDA reports for 2012, 2013 and 2014 overall sales of some Texas produce did not increase. However, data of the individual demonstrations did show an increase in sales for that particular period. Consumers sampling products at the retail grocery store and participating restaurants did result in sales increases at the time of the promotion but with the size of the market in Texas, the projects did not affect the overall sales of Texas produce.

Additional Information

The media campaign was further supported by a two-page spread in Texas Produce Magazine. It featured information about the partnership with the SWDF and encouraged producers and retailers to participate by using Texas vegetables and the Go Texan® sticker.

VEGGIES GONE LOCAL

Going Local Means Fresh Vegetables and Healthy Meals for Texas Consumers

Texas Grows a Wide Variety of Vegetables

Texas produces more than 60 different fruits and vegetables including its top vegetable commodities: onions, cabbage, carrots and mixed greens. Texas onions are the state's official vegetable and are referred to as "Texas Sweet Onions" as the Texas variety tends to be sweeter. About 15,000 acres of onions are grown in-state each year, making them Texas' leading vegetable crop.



Texas Vegetables Partner with Southwest Dairy Farmers

Through discussions with the Texas Department of Agriculture (TDA), TVA and Southwest Dairy Farmers (SWDF), Austin-based advertising agency Marketing Matters developed a creative concept that focused on the strengths of pairing Texas vegetables and dairy. The messaging focused on the different ways to eat vegetables and dairy together, and the concept was "Eating your Vegetables in 3 O's - Dip, Dunk and Dizzle".

The 2012 media campaign for TVA and SWDF was executed in two different flights, spring and fall. The "Dip, Dunk and Dizzle" campaign included a mix of television commercials, billboards, print advertising, targeted online ads, point-of-sale and event marketing to reach the four major markets in Texas: Houston, Dallas, San Antonio and Austin.

The strategic marketing partnership between Southwest Dairy Farmers and the Texas Vegetable Association allowed the two associations to combine marketing dollars to reach greater numbers of consumers while creating a powerful media presence that could be achieved by marketing separately.

2014 Campaign will Reach Out to Families

Based on the success of the 2012 campaign, TVA is again partnering with SWDF to re-introduce the campaign in Austin and San Antonio. Existing ads will once again encourage families to "Dip, Dunk or Dizzle" Texas vegetables with dairy products in an effort to increase sales for both organizations.



In addition to television, online ads, in-store demonstrations and billboards, TVA will launch its first ever consumer-facing website:

www.txvegetables.com. The site will provide consumers with valuable resources including nutrition information, how to choose and store each vegetable, recipes and a listing of businesses that source Texas vegetables. Additionally, a page within the site will be dedicated to reiterating messaging from the current marketing campaign (this year, "Dip, Dunk or Dizzle"). The overall tone of the site will be casual and friendly, and over time, it will become a major marketing tool benefitting all growers and producers in the state.

The Texas Vegetable Association was formed to improve vegetable production and to increase consumer awareness, consumption and sales of Texas-grown vegetables. The TVA also serves the industry by supporting key agencies and legislative bodies on food safety and labor issues. The TVA is a proud member of the Texas Department of Agriculture's GO TEXAN® program.



WAYS TO GO TEXAN:

- 1 Offer GO TEXAN® vegetables in your store and apply the GO TEXAN® mark.
- 2 Encourage consumers to visit GoTEXAN.org to find recipes of tasty new ways to enjoy veggies.
- 3 Offer GO TEXAN® vegetable dishes at your restaurant.

Texas Grown Vegetables. Now That's Fresh!

VISIT GOTEXAN.ORG AND TXVEGETABLES.COM
BECOME A MEMBER OF BOTH GO TEXAN® & TVA AND ENJOY EVEN MORE BENEFITS!



PROJECT 14: CHECKING THE SPREAD OF HLB IN TEXAS: A COMPREHENSIVE PLAN OF ACTION

Partner Organization: Texas Citrus Mutual

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Type of Report: Final

Date Submitted: December 2015

Project Summary

Introduction of the Asian Citrus Psyllid (ACP) in Texas has brought with it the detrimental phloem disease Huanglongbing, also known as Citrus Greening (CG). Citrus greening is a bacterial infection of citrus trees that reproduces in the plant phloem. This bacterium (*Candidatus liberibacter asiaticus*) will eventually clog the phloem elements and infect the citrus tree by producing small, lopsided, bitter fruit and eventually succumbing to the disease. There is not a known cure at this time for citrus greening.

The Asian Citrus Psyllid is the vector of CG. Once a citrus tree has become infected with CG it becomes a reservoir for the inoculum. Foraging psyllids obtain the inoculum and can spread the bacterium both short and long distances.

Citrus Greening was detected in Texas on January 13, 2012. Since the initial finding there have been several positive detections. It is estimated that the Texas Industry supports approximately \$250 million economically and widespread detections of CG could possibly devastate the industry and impact its economic activity by causing losses that exceed 50 percent, affecting income, jobs and production areas. Additionally, loss of mature citrus trees and replacement would be financially straining as well. It is estimated that the replacement value of all grapefruit and orange trees would approximately cost the industry \$538 million. If 60 percent of the mature fruit bearing grapefruit required replacement, the industry would lose approximately \$256 million. Replacement of oranges would cost the industry approximately \$67 million. As a result of the detection of CG, the Texas Citrus Pest and Disease Management Corporation has provided positive, proactive steps to decelerate the spread of CG and possibly save the Texas Citrus Industry.

Texas Citrus Mutual built on the existing foundation of knowledge related to controlling the disease in Texas by employing advanced, proactive measures in: early detection surveying, coordination/grower outreach and public outreach. The ultimate objective for all of these measures is to slow the spread of HLB within Texas' only commercially viable citrus production zone, the Lower Rio Grande Valley (LRGV). A multi-faceted strategy was necessary to meet the HLB challenge on terms imposed by local geography and patterns in landuse; which is to say that the future of commercial citrus production is reliant on engaging both growers and the public.

The goals set forth in this program were to determine where HLB infection currently exists in commercial citrus groves throughout the Lower Rio Grande Valley in an effort to help contain

the disease and neutralize the threat posed to commercial groves by high populations of ACP in nearby abandoned groves.

Project Approach

The surveys of the commercial groves were carried out by a contracted HLB survey specialist from Florida and the TCM staff. Approximately 5600 acres in the Rio Grande Valley were surveyed in all three counties of commercial production. Training of TCM staff allowed for whole grove surveys while the contract from Florida provided perimeter surveys.

Abandoned groves were also identified within the commercial production area. Groves were removed to reduce the population of ACP.

A centralized HLB Command Center was developed in Weslaco, TX to provide a centralized location for growers and government agencies to meet and discuss the HLB threat.

A unified database was also created to house all of the known positive detections of HLB and provide an outline of ACP activity.

Goals and Outcomes Achieved

Goal 1: Determine where HLB infection currently exists in commercial citrus groves throughout the Lower Rio Grande Valley in an effort to help contain the disease.

To achieve this goal an operational HLB command center was developed and located in Weslaco, TX. for day to day activities. This is a central location throughout the Lower Rio Grande Valley. At the command center, development of a unified database was achieved. The database houses all of the known HLB positive trees that have been detected to date. It also provides information on the location of commercial citrus groves, known owners and grove managers and the approximate acreage of each commercial grove. Stakeholders are provided updates every 2 weeks of ACP populations within their area. HLB updates are provided monthly.

Throughout this program, approximately 503 residential trees and 1420 commercial trees of citrus were found to be infected with HLB. The confirmation of infection was provided through qPCR laboratory testing. The spread of HLB was found in all three counties of the lower Rio Grande Valley.

Surveying has resulted in identification of approximately 90 percent of HLB-infected trees in the 5,000 acre target; this is based on at least 2 and in many cases up to 4 individual passes into each grove that encompasses the 5,000 ac. target since the start of the grant period; each pass has been made at minimum 6-month intervals and diagnosis of individual tree infection is confirmed via PCR testing

Goal 2: Neutralizing the threat posed to commercial groves by high populations of ACP nearby abandoned groves.

Approximately 3718 infected trees and abandoned commercial trees were removed throughout the duration of this program. This aided in the reduction of ACP populations around commercial groves.

Commercial groves in immediate (e.g., <1/4 mi.) proximity to treated abandoned groves experienced on average about 50 percent reduction in ACP levels within a 4-week window post-treatment; monitoring of treatment efficacy beyond that window was found to be problematic as regular treatment at 4-8 week intervals (current TX industry standard) in the commercial groves themselves confounds results (industry standard has gone from 8-12 week treatment intervals to 4-8 week intervals since the time of grant inception (2013).

In general, growers within the 1/4 to 1/2 mi. interval out from abandoned groves treated through this program reported reduced pressure for the 1-2 week interval post-treatment; beyond that time, treatment efficacy was reduced, especially in the growing season (mid-February to mid-November) when localized rain events and/or irrigations induce more flushing in all groves and thus lead to more frequent spikes in ACP population levels.

To aid in the voluntary removal of residential citrus, vouchers were provided as repayment of removal. The vouchers were only for non-citrus trees. Approximately 61 vouchers were redeemed throughout the program.

To ensure grower satisfaction of the program, Texas Citrus Mutual engages approximately 200 small growers within the commercial growing area to become part of an area-wide management program. Levels of ACP within the commercial citrus area have diminished with the incorporation of these growers.

Beneficiaries

Approximately 400 commercial citrus growers within the Lower Rio Grande Valley have benefited from this program. The benefits include knowledge of HLB infection, ACP levels around their specific groves and removal of abandoned groves. All of these factors have reduced the spread of HLB and ACP populations. Stakeholders including state and federal agencies now have a better understanding of the spread of the disease and how to better control the spread.

Lessons Learned

This program allowed the commercial citrus industry to identify the areas that are highly infected with HLB. The spread of the disease reached further than expected. This has led to the re-writing of the industry's best management practices for the suppression of HLB and ACP levels. This program has also provided the needed ability to remove high-risk situations from the suppression area.

PROJECT 15: INCREASING SALES OF TEXAS SPECIALTY CROPS BY BUILDING BRAND AWARENESS

Partner Organization: Texas Department of Agriculture (TDA)

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Type of Report: Final

Date Submitted: December 2016

Project Summary

The purpose of this project was to increase sales of Texas specialty crops by building brand awareness through educating Texas producers, buyers and the end user in order to develop and strengthen the specialty crop industry. The Texas Department of Agriculture's Marketing and International Trade Division (TDA-Marketing) worked with produce and horticulture commodity and trade associations to develop targeted marketing campaigns, produce demonstrations, events and other outreach activities. TDA's Marketing Coordinator, whose primary purpose is to develop and maintain relationships with the industry sectors and expand the GO TEXAN Specialty Crop awareness campaign, served as a liaison and resource for the industry, coordinating program activities and administering the sub-grants. Additional staff contributed to the projects including assistance with media buys, retail promotions and social media. TDA was able to ensure funds were spent solely to enhance the competitiveness of specialty crops through a few avenues of program administration. The marketing projects contributed to the future growth of the Texas specialty crop industry and local economy by expanding produce, tree nuts and horticulture visibility and awareness through targeted marketing campaigns.

Project Approach

TDA's marketing coordinators worked to expand the visibility and sales of Texas specialty crops by following a precise marketing approach:

- TDA conducted the Healthy Living with Texas Produce project in which TDA awarded eight TDA certified farmers markets with funding to conduct four events each for a total of 32 Healthy Living with Texas Produce events. During these events, the markets partnered with local hospitals and/or clinics to educate attendees on how to cook healthy meals with Texas produce.
- Created and developed retail signage for produce and Texas grown plants.
- Retail Initiatives – TDA awarded a retail nursery grant to Buchanan's Nursery to conduct promotions on Texas grown plants.
- Created a marketing campaign driving consumers to their local retailers to purchase GO TEXAN produce, tree nuts, floral and horticulture products.
- TDA created in-store promotions which included product demonstrations, signage, coupons (from our partners), recipe cards and more to increase consumer awareness and purchases of Texas grown produce and Texas plants. The GO TEXAN horticulture retail promotion included advertisements on digital, printed, and radio advertisements as well as educational workshops on vegetable gardens and growing urban orchards.

- Floral Promotions for Retail Florists – As part of an overall retail promotion TDA worked with the Texas State Florists’ Association to conduct a Texas cut flower promotion promoting the use of Texas cut flowers for wedding arrangements. Arrangements were available through Texas retail florists. A GO TEXAN Specialty Crop Awareness campaign was designed by TDA to support Texas florists by designing floral tags to raise awareness among Texas brides about Texas flowers available for use in their floral arrangements. This promotion was conducted at the David Tutera Wedding Experience in front of more than 400 brides in the Houston area. In addition, more than 200 local florists including the Texas State Florists Association were on hand to showcase the Texas products available to the brides for their floral arrangements.
- TDA partnered with the Lubbock Restaurant Association to work with restaurants to develop an educational program to educate the consumers on restaurants using Texas produce as well as to educate the restaurants on Texas produce that is in season.
- TDA also worked with Texas restaurants to conduct the Texas Restaurant Roundup. Although no Specialty crop funds were used to promote the event, Specialty crop staff took this opportunity to promote Texas produce in restaurants by developing online banner ads encouraging consumers to enjoy locally-grown items at neighborhood restaurants.

TDA-Marketing staff also created specialty crop marketing materials to be dispersed at events, festivals, conventions and conferences. These materials were approved by TDA’s Grants office to ensure all funds solely benefited specialty crops. A program specialist was tasked with promoting specialty crop producers and operations on social media (Facebook, Instagram and Twitter) and our GO TEXAN event pages. Projects were also supported by a Marketing Communication Specialist who focuses on copy and design development as well as electronic communication and editing to advance project activities. Vendor communication, purchasing and administrative work on the program was provided by the TDA-Marketing Financial Analyst and an Administrative Assistant.

The Specialty Crop Program Coordinator and other regional staff attended the Texas Pecan Growers Association Conference and Trade Show, Texas Nursery and Landscape Association EXPO, Produce Marketing Association Conference, Viva Fresh Expo and the Ellison Chair for International Floriculture Annual Meetings to inform producers and retailers of the opportunities available to increase sales of Texas specialty crops by building brand awareness.

Goals and Outcomes Achieved

Goal: The goal was to increase consumers’ knowledge of GO TEXAN produce, tree nuts, horticulture and floriculture products and increase demand of these products locally through increased product visibility and awareness.

Outcome: The target TDA-Marketing set was to increase sales of GO TEXAN specialty crops at participating retailers by 50 percent. According to the National Agriculture Statistics Service valued sales of Texas produce at \$400 million in 2014 and at \$448 million in 2015. Although statewide numbers do not indicate a 50 percent increase in sales of Texas produce, targeted retailers did indicate an increase of sales of 50 percent as expected. Reports indicate that the produce demos only resulted in an average of 10 percent increase in sales. Retail promotions of

Texas Superstar plants were also successful. Over 309,000 plants were sold at a value of \$1,257,973.25. This, however, was only a 10 percent increase over last year.

Beneficiaries

Texas producers including 124 GO TEXAN specialty crop producers and 2,296 farms benefited from this brand awareness marketing campaign. This represents more than 130,000 harvested acres of Texas fruits and vegetables. More than 3000 consumers learned about using Texas grown flowers in their wedding bouquets at two David Tutera’s Wedding Experience events in Houston. Thirty-two producers of Texas Superstars also benefited from the local retail promotions. During the GO TEXAN Restaurant Roundup, 405 restaurants participated in the promotion. The GO TEXAN program gained more than 6,000 likes due to GO TEXAN Restaurant Round Up event. If you include the paid impressions, 3,233,991 consumers saw and read about Texas produce.

Lessons Learned

Staffing and scheduling of the retail educational events continues to be a struggle. Each year TDA staff need to re-evaluate how to improve these. TDA staff have tried working directly with retailers, directly with producers and commodity organizations. No matter which direction, staffing and scheduling continue to be difficult. Staff has learned that it needs to be an all-inclusive project in which all three methods are done at the same time. Not only does this help with conducting the events, it also helps in collecting the data for reporting.

Additional Information

Retail Initiatives



HEB in South Texas



At Produce Marketing Association promoting Retail Opportunities to Retailers



Pallet wraps were created to showcase and promote Texas grown plants.



Ad directing consumers traveling via RV to pick up vegetables at their local grocery store before camping. RV Life and Trip Advisor.



Retail pumpkin promotions



Front of Floral Tag



Back of Floral Tag



Floral bouguett with tag at Wedding Experience

Healthy Living with Texas Produce



Stuffed Cabbage Rolls

Ingredients

1 lb. lean ground beef or ground turkey
1 onion, grated
1 cup brown rice, cooked
1 carrot, grated
1 teaspoon salt
fresh ground pepper
6 slices bacon, minced
12 wilted cabbage leaves, thick veins trimmed to thin

Yields: 12 cabbage rolls



Sauce

1/2 cup brown sugar
1/4 cup lemon juice
1 cup tomato sauce

Directions

Brown ground meat over medium heat; add onions and sauté together. Combine cooked rice, carrots, salt, pepper and bacon to cooked meat and onions. Spoon mixture into the center of each of the 12 cabbage leaves. Roll up, tucking in sides to completely enfold meat. Place folded side down in a greased baking dish. Mix together brown sugar, lemon juice and tomato sauce. Pour over rolls, cover tightly and bake at 375°F for 30-40 minutes.

Nutrition Info

Serving Size: 1
Calories 172
Calories from Fat 71 g
Total Fat 8 g
Saturated Fat 3 g
Cholesterol 43.9 mg
Sodium 375.8 mg
Total Carbohydrate 16.3 g
Dietary Fiber 1.2 g
Sugars 11.3 g
Protein 9 g



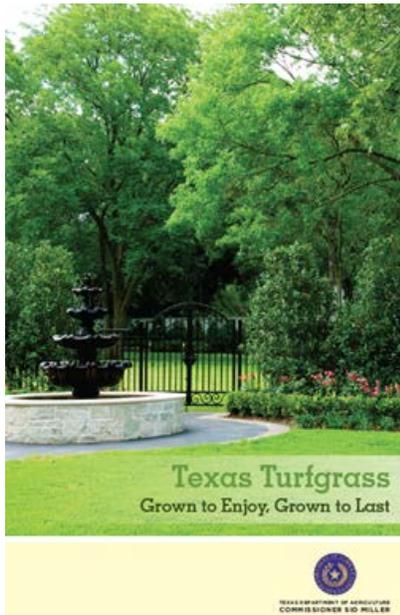
Educational programs of the Texas A&M AgriLife Extension Service are open to all people without regard to race, color, religion, sex, national origin, age, disability, genetic information or veteran status.

The Texas A&M University System, U.S. Department of Agriculture, and the County Commissioners Courts of Texas Cooperating

Restaurant Initiatives



Specialty Crop Marketing Materials



Turfgrass



Texas Superstar



Landscape Guide



Produce availability brochure



Farmers Market Brochure