

# Wyoming Department of Agriculture

Specialty Crop Block Grant Program – Farm Bill

Agreement No. 12-25-B-1707

Final Performance Report

Due: December 28, 2016

**Contact:** Ted Craig  
(307) 777-6651  
[Ted.craig@wyo.gov](mailto:Ted.craig@wyo.gov)

<b>GOOD AGRICULTURAL PRACTICES (GAPS) WYOMING PRODUCER TRAINING AND COMPLIANCE</b> .....	<b>6</b>
Project Summary .....	6
Project Approach .....	6
Goals and Outcomes Achieved .....	10
Beneficiaries .....	13
Lessons Learned.....	13
Contact Information .....	13
 <b>WYOMING SPECIALTY CROP PRODUCTION AND DISTANCE DIAGNOSTICS NETWORK</b> .....	 <b>15</b>
Project Summary .....	15
Project Approach .....	15
Goals and Outcomes Achieved .....	15
Beneficiaries .....	16
Lessons Learned.....	16
Contact Information .....	17
 <b>SPECIALTY CROP SEASON EXTENSION/EXPANSION PRODUCER SMALL GRANT PROGRAM</b> .....	 <b>19</b>
Project Summary .....	19
Project Approach .....	19
Goals and Outcomes Achieved .....	28
Beneficiaries .....	31
Lessons Learned.....	31
Contact Information .....	31

<b>WYOMING SPECIALTY CROP NONPROFIT ORGANIZATION SMALL GRANT EDUCATIONAL PROGRAM .....</b>	<b>32</b>
Project Summary .....	32
Project approach .....	32
Goals and outcomes Achieved .....	41
Beneficiaries .....	45
Lessons Learned .....	46
Contact Information .....	46
 <b>STRAWBERRY PRODUCTION USING VERTICAL GROWING SYSTEM IN HIGH TUNNELS .....</b>	 <b>47</b>
Project Summary .....	47
Project Approach .....	47
Goals and Outcomes Achieved .....	48
Beneficiaries .....	53
Lessons Learned.....	53
Contact Information .....	53
 <b>PRESERVING WYOMING’S SPECIALTY CROPS SAFELY.....</b>	 <b>54</b>
Project Summary .....	54
Project Approach .....	54
Goals and Outcomes Achieved .....	54
Beneficiaries .....	56
Lessons Learned.....	56
Contact Information .....	56
 <b>EVALUATION OF KINWA (QUINOA) AS A LEAFY GREEN CROP FOR ADAPTION TO WYOMING.....</b>	 <b>57</b>

<b>Project Summary .....</b>	<b>57</b>
<b>Project Approach .....</b>	<b>57</b>
<b>Goals and Outcomes Achieved .....</b>	<b>58</b>
<b>Beneficiaries .....</b>	<b>63</b>
<b>Lessons Learned.....</b>	<b>63</b>
<b>Contact Information .....</b>	<b>63</b>
<b>ALLEVIATING GRAPEVINE COLD DAMAGE IN WYOMING VINEYARDS.....</b>	<b>64</b>
<b>Project Summary .....</b>	<b>64</b>
<b>Project Approach .....</b>	<b>64</b>
<b>Goals and Outcomes Achieved .....</b>	<b>66</b>
<b>Beneficiaries .....</b>	<b>70</b>
<b>Lessons Learned.....</b>	<b>70</b>
<b>Contact information .....</b>	<b>71</b>
<b>FOOD PRODUCTION: HIGH TUNNELS FOR VEGGIES AND HERBS .....</b>	<b>72</b>
<b>Project Summary .....</b>	<b>72</b>
<b>Project Approach .....</b>	<b>72</b>
<b>Goals and Outcomes Achieved .....</b>	<b>73</b>
<b>Beneficiaries .....</b>	<b>74</b>
<b>Lessons Learned.....</b>	<b>75</b>
<b>Contact Information.....</b>	<b>78</b>
<b>DETERMINING OPPORTUNITES FOR EXPANDED SPECIALTY CROPS IN WYOMING ....</b>	<b>79</b>
<b>Project Summary .....</b>	<b>79</b>
<b>Project Approach .....</b>	<b>79</b>
<b>Goals and Outcomes Achieved .....</b>	<b>80</b>

<b>Beneficiaries .....</b>	<b>87</b>
<b>Lessons Learned.....</b>	<b>87</b>
<b>Contact Information .....</b>	<b>88</b>
<b>WYOMING DEPARTMENT OF AGRICULTURE SPECIALTY CROP SUPPORT FOR EDUCATION, MARKETING AND PROMOTION .....</b>	<b>89</b>
<b>Project Summary .....</b>	<b>89</b>
<b>Project Approach .....</b>	<b>89</b>
<b>Goals and Outcomes Achieved .....</b>	<b>91</b>
<b>Beneficiaries .....</b>	<b>93</b>
<b>Lessons Learned.....</b>	<b>93</b>
<b>Contact Information .....</b>	<b>93</b>

# GOOD AGRICULTURAL PRACTICES (GAPS) WYOMING PRODUCER TRAINING AND COMPLIANCE

## PROJECT SUMMARY

The intention of this grant was to provide a means and opportunity for Wyoming producers to be trained on GAPs as proposed in the Federal Register. The overall purpose of this grant project was to educate producers on Good Agricultural Practices and the steps required to maintain compliance. This was accomplished by providing four (4) training opportunities (minimum of one, 8 hour session per location) to 30 producers per year (total of 60 producers) around the state of Wyoming on Good Agricultural Practices as they currently stand.

The success of this project will be measured in by the following:

**GOAL** – Increase participant understanding of GAPs.

**BENCHMARK:** Not available as no trainings have occurred previously.

**TARGET:** Anticipate that 75 percent of respondents will indicate that their knowledge has increased as a result of their participation in the training.

**PERFORMANCE MEASURE:** The number of growers who report an increase in knowledge, as measured by a participant survey, at the end of each training session.

## PROJECT APPROACH

Provide four (4) training opportunities (training session per location) to 30 producers per year (total of 60 producers) around the state of Wyoming. In order to achieve this goal the following have been completed:

- Reviewed GAPs training programs previously offered in neighboring states.
- Leveraged training Manual from NE
- Leveraged training Program and Instructors from NE
- Complete Session in Lingle, WY
- Complete Session in Casper, WY
- Plan Session in Powell, WY
- Plan Session in Cheyenne, WY

Press Releases

Lingle, WY – Released Jan. 6, 2015 by UW Extension and archived at

<http://www.wyomingextension.org/news/>

Good agricultural practices workshop

Food safety begins with sound practices on the farm

Food safety begins with sound practices on the farm, especially with fresh vegetable and fruit produce that is eaten raw. Recent outbreaks of food borne illnesses involving both fresh and

processed food products have heightened public concern about food safety. Many fresh produce retailers now require the producers who supply them to have third party audits to verify safe food production and handling practices on the farm. The recently signed bill on food safety underscores the growing emphasis on food safety and the need for fresh produce farmers to produce a safe product.

University of Wyoming Extension is teaming with University of Nebraska Extension and the Wyoming Department of Agriculture to offer “Good Agricultural Practices Workshop” on Tuesday, January 20 through Thursday the 22<sup>nd</sup> in the meeting room at UW’s SAREC research station outside of Lingle, Wyoming.

Workshop topics include:

- Produce safety risk factors & impacts
- Post-harvest produce handling
- Water quality and testing
- Creating a food safety plan
- Auditing farms for GAPs/food safety
- Soil management/manure management
- Worker health and hygiene
- Traceability, Recall, and Liability issues

This workshop had benefits for all producers, retailers and wholesalers in supermarkets, farmers’ markets, or for business owners in service industries. In particular, the GAPs workshop will equip producers with the knowledge to create a written food safety plan. By becoming food safety compliant, producers will stay competitive in the specialty produce business.

Participants learned the principles of Good Agricultural Practices on the first day and create their own food safety plan (required by GAP certifications) on the last day. Class days will begin at 9am and go until about 4:30. Lunch and snacks will be provided.

Registration is required for the workshop by January 15, 2015. Please register online at [www.eventbrite.com/e/good-agricultural-practices-workshop--tickets-14951537451](http://www.eventbrite.com/e/good-agricultural-practices-workshop--tickets-14951537451). For more information, please call Cole Ehmke at with UW Extension in Laramie at (307) 766-3782 or [cehmke@uwyo.edu](mailto:cehmke@uwyo.edu).

Other advertising for the Lingle, Wyo. workshop included the circulation of email notices directly to potential attendees by Cole Ehmke as well as via listserv (the Wyoming Farmer’s Marketing Association being a valuable one, but also three internal lists to UW Extension educators; the posting of posters; postings on event calendars (such that published by the Wyoming Livestock Roundup and the Prairie Star as well as online calendars like UW Extension), and paid advertising in local papers. Papers in the area in which advertisements were run for three weeks were The Business Farmer, the Torrington Telegram, the Lingle Guide, the Lusk Herald, the Guernsey Gazette, the Platte County Record Times (Wheatland). Two ads also appeared in the Scottsbluff Star Herald.

**Casper, Wyoming – released March 5, 2015 by UW Extension and archived at**

<http://www.wyomingextension.org/news/>

Fresh produce safety workshop in Casper

Fresh produce growers and buyers will learn appropriate agricultural practices to prevent food-borne illnesses as part of a two-day workshop in Casper.

“Good Agricultural Practices” is Thursday and Friday, April 9-10, at the Best Western Ramkota Hotel as part of the Wyoming Farmers Marketing Association’s annual conference.

“This workshop will benefit producers as well as those who buy and use local produce in inspected kitchens like schools, hospitals and restaurants,” said Cole Ehmke, University of Wyoming Extension specialist, who helped organize the sessions.

Recent outbreaks of foodborne illnesses involving fresh and processed food products heightened public concern about food safety, he said. Illness-causing pathogens, such as salmonella and listeria, come from a variety of sources. The most common source is fecal matter, Ehmke said, which can be spread by water, wildlife, waste and workers.

Producers will stay competitive in the specialty produce business by becoming food safety compliant.

“Many fresh produce retailers now require their suppliers to have third-party audits to verify safe food production and handling practices on the farm,” he said.

Participants will learn the principles of good agricultural practices (GAPs). Producers will then be able to create their own food safety plans (required by GAP certifications).

Workshop topics include:

- \* Produce safety risk factors and impacts
- \* Post-harvest produce handling
- \* Water quality and testing
- \* Creating a food safety plan
- \* Auditing farms for GAPs/food safety
- \* Soil management/manure management
- \* Worker health and hygiene
- \* Traceability, recall and liability issues

Sessions are 9 a.m. to about 4:45 p.m. each day. Snacks are provided, and lunch will be on your own. Early registration by April 1 is \$25 and \$30 after. Other information and registration is at <https://2015wfmaconference.eventbrite.com>.

Scholarships to offset costs are available for up to \$300 through the Wyoming Department of Agriculture’s Specialty Crops program. For more information, contact Ehmke at 307-766-3782 or [cehmke@uwyo.edu](mailto:cehmke@uwyo.edu).

Advertising for the Casper event includes the circulation of emails (to individuals and lists), posters, postings on event calendars, and direct mail to those having inspected kitchens that might be interested in the topic.

#### **Training Details:**

- The first of the four trainings was held in January 20<sup>th</sup> and 21<sup>st</sup> in Lingle, Wyoming. Participants received a three-ring binder with educational materials as well as a USB drive with complete copies of materials associated with the topic. A copy of the materials was also provided to an individual who was unable to attend the training but was interested in the topic. Certificates of completion to the workshop attendees were provided by Linda Stratton after the event.

The agenda was as follows:

#### **FARM FOOD SAFETY TRAINING OUTLINE**

##### **DAY 1**

- 9:00 A.M. OVERVIEW FARM FOOD SAFETY – WHY DO I NEED GAPS**
- Why is Farm Food Safety important?
  - Explain the “instruction” section and work through the “my farm assessment” section of the Cornell Food Safety Begins on the Farm Grower Self-Assessment book
- 10:15 A.M. Microbiology 101 For Producers**
- 11:30 A.M. Worker Health & Hygiene**
- 12:30 p.m. Lunch Break**
- 1:15 p.m. Water & Field Sanitation**
- 3:15 p.m. Field Harvest, Packing Facility Sanitation & Transportation**
- 4:15 p.m. Traceback, Documentation & The USDA Audit**
- 4:45 p.m. Wrap Up- Questions and Expectations For Day 2**  
(Farm Map, Mission Statement, Farm Description, Template Explanation)

##### **DAY 2**

- 9:00 a.m. Introduction**
- Review/complete grower self assessments
  - Explanation of Farm Food Safety Plan Template
- 9:30 a.m. Basics & Farm Description**
- Contact information
  - Farm & facility maps
- 10:00 a.m. Worker Health & Hygiene Guidelines**
- Workers
  - Visitors
  - Hand washing and toilet facilities

- Injury and illness policies
- 11:00 a.m. Water Quality Assessment**
  - Water sources
  - Testing facilities
  - Testing procedures
- Noon Lunch**
- 12:45 p.m. Field Sanitation**
  - Animals & manure lagoons
  - Fence & field inspections
  - Wildlife
  - Worker field sanitation
- 1:45 p.m. Manure Use & Management**
  - Soil assessment
  - Manure use
- 2:45 p.m. Harvest & Packing**
  - Produce flow maps
  - Harvest traceability – Lot Codes
  - Post-harvest water source & sanitation
  - Ice
  - Packing house sanitation
  - Pest control
  - Tool, bin & vehicle cleaning
- 4:00 p.m. Traceability & Mock Recall Procedures**
  - Product identification system
  - Traceability plan
  - Mock recall guidelines

#### **2015 & 2016**

- Establish training dates and locations (Edwards, Ehmke, Stratton)
- Promote events (Edwards, Ehmke, Stratton)
- Follow-up with participants to gain understanding of learning achieved (Edwards, Ehmke)

### **GOALS AND OUTCOMES ACHIEVED**

**GOAL** – Increase participant understanding of GAPs.

**BENCHMARK:** Not available as no trainings have occurred previously.

**TARGET:** Anticipate that 75 percent of respondents will indicate that their knowledge has increased as a result of their participation in the training.

**PERFORMANCE MEASURE:** The number of growers who report an increase in knowledge, as measured by a participant survey, at the end of each training session.

52 individuals participated in the Wyoming GAPs (86% of Target) training program in one of four locations. Participants were asked to complete a self-assessment of their understanding of the topics **pre** and **post** session. These data were used to estimate the perceived knowledge gained about GAPs and the FSMA. 47 individuals returned the survey.

Results-Target and Performance Measures

Participants were asked to complete a self-assessment of their understanding of the topics pre and post session.

Location	Producer Participants	Respondents Indicating their knowledge increased (Target 75%)	Average Perceived Knowledge gained (GAPs)	Average Perceived Knowledge gained (FSMA)	Total Overall Estimated Increase in Knowledge
Lingle (Jan 2015)	6	100%	48%	33%	55%
Casper (Apr 2015)	36	100%	33%	40%	50%
Riverton (May 2016)	10	100%	67%	51%	59%
Cheyenne (Dec 2016)	6	100%	44%	144%	102%
<b>All</b>	<b>52</b>	<b>100%</b>	<b>83%</b>	<b>104%</b>	<b>95%</b>

	Count	Total	Percent
<b>Worker Health &amp; Hygiene</b>			
· Workers	43	31	<b>72</b>
· Visitors	43	26	<b>60</b>
· Handwashing and toilet facilities	44	30	<b>68</b>
· Injury and illness policies	43	22	<b>51</b>
<b>Water</b>			
· Water sources	44	26	<b>59</b>
· Testing facilities	44	25	<b>57</b>
· Testing procedures	43	27	<b>63</b>
<b>Field Sanitation</b>			
· Animals & manure lagoons	38	15	<b>39</b>
· Fence & field inspections	42	18	<b>43</b>
· Wildlife	42	16	<b>38</b>
· Worker field sanitation	41	29	<b>71</b>
<b>Manure Use &amp; Management</b>			
· Soil assessment	43	26	<b>60</b>
· Manure use	42	23	<b>55</b>
<b>Harvest &amp; Packing</b>			
· Produce flow maps	42	24	<b>57</b>
· Harvest traceability – lot codes	42	23	<b>55</b>
· Post-harvest water source & sanitation	42	23	<b>55</b>
· Ice	39	18	<b>46</b>
· Packing house sanitation	36	15	<b>42</b>
· Pest control	43	23	<b>53</b>
· Tool, bin & vehicle cleaning	43	30	<b>70</b>
<b>Traceability</b>			
· Product identification system	43	27	<b>63</b>
· Traceability plan	43	30	<b>70</b>
<b>Create a farm food safety plan.</b>	43	40	<b>93</b>

Additional data collected included survey questions concerning the participant's likelihood of adopting GAPs methodology into their own operations. Individuals responded favorably to most of the questions and can be ranked in the following order: 93% indicated they would create a farm food safety plan; 72% indicated they would develop some controls for worker health and hygiene; 71% indicated they would implement worker field sanitation practices; 70% indicated they would develop a traceability plan and develop a tool, bin and vehicle cleaning policy. Some of the lower values (38% wildlife & 39% lagoons 42% packing house & 46% Ice) are reflective of individuals indicating that these topic were not applicable to their operations.

## BENEFICIARIES

There were 52 beneficiaries who by attending a GAP program gained knowledge on food safety. This will provide a safer product to the end consumer.



## LESSIONS LEARNED

The concepts behind Good Agricultural Practices (GAPs) and the Food Safety Modernization Act (FSMA) are relatively intuitive. Asking that small operations implement this regulation will be a financial and time burden for some. It is important for food producers to have some form of food safety handling education. Just because a producer is informed does not mean that these procedures will be implemented. Timing of workshops in northern Wyoming is weather dependent as winter is the best time for producers but worst time for incumbent weather travel by presenters.

## CONTACT INFORMATION

Jeff M. Edwards-Extension Educator  
University of Wyoming  
2753 State Highway 157  
Lingle, WY 82223-8543  
[307-837-2956](tel:307-837-2956)  
Jedward4@uwyo.edu

# ON-FARM FOOD SAFETY WORKSHOP

## Learn Good Agricultural Practices (GAPs)

This training will teach Good Agricultural Practices (GAPs) for small and large farm growers to help protect clients from foodborne illnesses and open market opportunities. Topics include:

- Record keeping
- Harvest activities
- Storage
- Transportation
- Hygiene
- Water testing
- Handling of manure

Learn GAPs to improve growing/handling practices and to build a food safety plan for certification. \$25. Questions? Call Cole Ehmke at (307)766-3782 or [cehmke@uwyo.edu](mailto:cehmke@uwyo.edu). Scholarships are available for up to \$300! Register at [2015wfmaconference.eventbrite.com](http://2015wfmaconference.eventbrite.com)



## Food Safety

It's your business.

April 9-10  
Ramkota in  
Casper, Wyo.



Organized by University of Wyoming Extension, the Wyoming Department of Agriculture and University of Nebraska Extension. Funded by USDA Specialty Crops.



# WYOMING SPECIALTY CROP PRODUCTION AND DISTANCE DIAGNOSTICS NETWORK

## PROJECT SUMMARY

The immediate purpose of this project is to utilize technology to build a support system for specialty crop producers, particularly to provide diagnostic help when dealing with insects, weeds, and plant diseases. Proper diagnosis is needed for pest management decisions. This project has not been submitted to any other grant program and will be managed by master gardener coordinator at University of Wyoming. Specialty crop producers will use this information to make crucial production and pest management decisions. They need timely information when dealing with pest populations, planting, watering, and harvesting.

## PROJECT APPROACH

1. Between grant and University funding 26 offices and 4 specialists were equipped with iPads and digital microscopes for diagnostics of specialty crop pests and diseases. Master Gardeners, Extension educators, and Extension specialists received training on how to handle specialty crop questions using technology to interact with specialists and other educators in the network.
2. Develop a diagnostic network of users encompassing diverse specialties to handle questions on fruit and vegetable diseases and pests.
3. Create and track a social media group to facilitate easy access and communication between all network users including the specialty crop diagnostic team, Extension secretaries, and specialty crop producers.

## GOALS AND OUTCOMES ACHIEVED

**Goal:** Equip 26 offices and 4 Extension Specialists with iPads and microscopes for diagnostics of specialty crops.

**Outcome:** Equipment was purchased and delivered to all extension offices across Wyoming. Master Gardeners, educators, and specialists received training on using the equipment.

**Goal:** Enhance the competitiveness of specialty crops through more sustainable, diverse, and resilient specialty crop systems by improving plant-pest diagnostics, and sound pest management practices.

**Outcome:** Since receiving the equipment, UW Extension has helped 23 specialty crop producers and home gardeners with weed and pest identification, weed and pest management recommendations, and crop production practices. Equipment was not received until August

2016, otherwise we would have gotten more use out of them. Most questions come in to the extension offices earlier in the growing season.

Survey Summary: specialty crop producers helped were surveyed

On a scale of 1-5 what was your knowledge of the problem prior to using the Wyoming Specialty Crop Diagnostic System?

10 responses

Average Response: 2.3

On a scale of 1-5 what was your knowledge of the problem after using the Wyoming Specialty Crop Diagnostic System?

10 responses

Average response: 4.2

How will you use the information you received using the Wyoming Specialty Crop Diagnostic System?

- Neem oil to treat mites, aphids, and powdery mildew in high tunnel
- I received help identifying diseases in my garden. Drip irrigation to reduce powdery mildew.
- I have a serious thistle problem. I will spray in the fall.
- Fertilize and compost to improve soil quality.
- Plant 'Sea Scape' strawberries in high tunnel.
- Try planting garlic in fall to get larger bulbs.
- Extend growing season by planting greens for fall harvest.

**Goal:** Create a social media group and network of users.

**Outcome:** We use facetime and zoom software programs to communicate using the iPads.

We surveyed 23 Extension employees at Extension offices to see if the iPad, microscopes and real time access to experts on campus increased their ability to help specialty crop producers diagnose plant problems? 100% indicated that it has helped with diagnosing weed and pest problems questions raised by specialty crop producers on yard calls and at the offices.

## BENEFICIARIES

UW Extension educators, Master Gardeners, and Wyoming specialty crop producers. Although due to the timing of getting the systems in place we only were able to impact 23 growers and 30 educators we expect to see a much greater impact in the future. In a separate survey by UWYO of over 450 small acre owners who grow some specialty crops whether for their own consumption or for sale indicated 250 were presently using a pest management strategy , 43 were planning on using pest management and 141 wanted more information on pest management strategies. We estimate that there are over 3000 small acre owners growing specialty crops who could benefit in the future from the distance diagnostic network.

## LESSONS LEARNED

This was a much needed system that has and will continue to help UW Extension provide timely service to Wyoming specialty crop producers. UW Extension offices have identified plant pest

problems as the number 1 question received throughout the growing season. Extension offices clients can now easily connect with appropriate educators and specialists across the state to gain the information and knowledge they seek.

## CONTACT INFORMATION

Chris Hilgert

Extension Horticulture Specialist and State Master Gardener Coordinator

Department 3354

1000 E University Ave

Laramie, WY 82071

[307.766.6870](tel:307.766.6870)

[www.uwyo.edu/mastergardener](http://www.uwyo.edu/mastergardener)

Here are some examples of the diagnostic samples received.

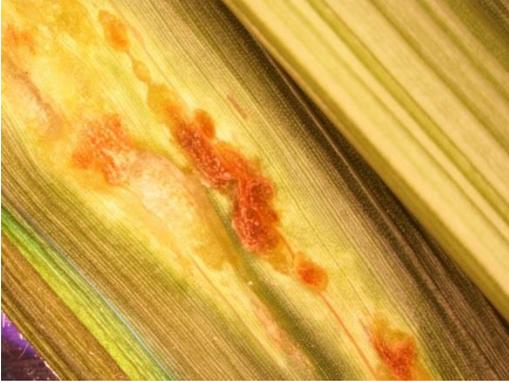
### Powdery Mildew



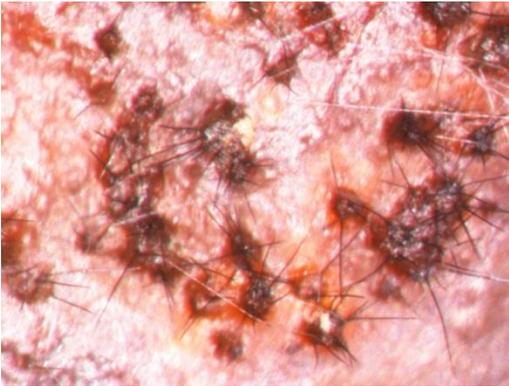
### Downy Mildew



### Corn Smut



**Anthracnose**



**Aphids**



## **SPECIALTY CROP SEASON EXTENSION/EXPANSION PRODUCER SMALL GRANT PROGRAM**

### **PROJECT SUMMARY**

Through previous USDA specialty crop grants, Wyoming has offered small grants to producers and to develop and promote methods that would extend or increase specialty crop production and consumption. The program has been very successful in enhancing the specialty crop program in the state. Since the inception of the program grants have been awarded for producer high tunnels, irrigation systems, and other season extension methods. Workshops have been held around the State to promote the use of hoop houses which have been shown to increase growing season, quality, and quantity of product. These tunnels are being built to withstand Wyoming wind, temperature, and hail. They also result in reduced water usage through drip irrigation and an increase in the variety of specialty crops available. This funding opportunity compliments the hoop house workshops coordinated by the UWYO Cooperative Extension Service by providing grant opportunities to participants of those workshops as well as other producers. Consumer and producer knowledge and awareness of this growing method were increased by farm days and student field trips that resulted from the grants.

### **PROJECT APPROACH**

The purpose of the project was to increase specialty crop education, production, and consumption through season extension techniques, water conservation and other approved educational projects by providing small grants (not to exceed \$3,500) to Wyoming producers. Grants included various season extension techniques that included high tunnels, low tunnels, row covers, high tunnel water conservation systems, and other means that extended or increased specialty crop production, processing, promotion, education, and consumption in Wyoming. Nine grants were awarded with the requested funds. This small grant program enabled small specialty crop producers to provide a greater range of produce for a longer period of time. The program was marketed to the producers attending UW Cooperative Extension high tunnel workshops that construct high tunnels, producers attending the Wyoming Farmers Marketing Association Conference and UWYO producer conferences. The application and guidelines were updated and posted on the Wyoming Department of Agriculture web site (<http://wyagric.state.wy.us/>) and marketed through media releases, at trade events meetings and conferences. Application process included submitting an application that included specific goals related to specialty crop production, impacts, outcomes, work plan, budget, and letter of support from a local entity that can vouch for an applicant's involvement in agriculture production. Expenses were limited to materials for hoop houses or other season extension techniques and submitted reimbursements receipts were reviewed to confirm that

the expenses are eligible and substantiated with proof of purchase. The Wyoming Community Network continued to manage the program and WDA continued to help review applications and requests for reimbursements and performed site visits to confirm work done. Applications were reviewed by WDA and Wyoming Community Network and successful applicants notified.

## WYOMING SPECIALTY CROP PRODUCERS SEASON EXTENSION HIGH TUNNEL SMALL GRANT PROGRAM

---

### **Application**

#### **PURPOSE**

Small grants will be awarded to specialty crop agribusiness operations to develop methods for season extension, increased productivity and native seed production. Eligible grants will also include water conservation methods.

#### **Eligibility Requirements**

Wyoming farmers/ranchers are eligible to apply for a Wyoming Specialty Crop Grant if they meet the following criteria:

1. Be a private-sector Wyoming-based agricultural producer as defined by USDA.
2. Demonstrate that producer is capable of capitalizing on methods that will enhance their specialty crop production through season extensions, water conservation, and native seed production.
3. Has received a recommendation from a local entity or individual that can vouch for their involvement in agricultural production.

**Eligible expenditures** are limited to materials necessary to erect a high tunnel, low tunnels, row covers, soil amendments, drip irrigation system and high tunnel solar fans and vents or other preapproved season extension methods.

**Ineligible expenditures** include travel such as lodging and meals and mileage, and expenditures directly related to the operation of the business, such as salaries.

#### **AWARD LIMITATIONS**

**This is a matching program:** The total grant award is limited to 75% to a maximum of \$3500 of the actual eligible expenditures per year. The minimum amount of a grant is \$500. Each Agribusiness is limited to no more than \$7000 over the life of the season extension program.

#### **Requirements of Agribusiness Participant**

**Documentation:** The Farmer/Rancher must complete and submit to the Wyoming Department of Agriculture the following forms for reimbursement: 1) *Request for Reimbursement*; 2) *Itemized Expenditure*; and, 3) a detailed *Final Report* on the grant by September 1, 2016. Copies of canceled checks (both sides), invoices, and other confirmation of payment must be submitted for reimbursement.

#### **APPLICATION PROCESS**

Potential participants of the Wyoming Specialty Crop Grant Program must complete and return the application and the required attachments **by August 1, 2016.**

**PLEASE NOTE:** Expenditures incurred without written or electronic confirmation from the Wyoming Department of Agriculture are not eligible for reimbursement. **The application process cannot be started after the company has purchased the materials or supplies for the project.**

#### **GENERAL GRANT INFORMATION**

The Wyoming Specialty Grant Program is a reimbursable grant; and as such, the applicant must pay all expenditures before the grant award can be disbursed. The business shall function independently in performing this activity and shall assume sole responsibility of any debts or liabilities that may be incurred in regard to this grant. The grant award cannot be assigned.

**Return application forms to:** Wyoming Department of Agriculture 2219 Carey Ave. Cheyenne, WY 82002

**\*\*\*This program has a limited amount of funds. Preference will be given to qualified first time applicants and the Wyoming Department of Agriculture reserves the right to deny applications that are not complete or otherwise deemed not eligible.**

1. The proposals should be typed, single spaced and in 12 point format.
2. Written proposals must be printed and legible or will not be accepted.
3. Each page should be numbered with applicant's name at the top of each page.
4. Application packets should not exceed 10 pages including supplemental documentation.
5. An electronic version of the application packet (in MS Word format) may be submitted to one of the email addresses listed in the contact information.
6. Submit ONE complete original application packet signed by the person authorized to receive funds and mail to Wyoming Department of Agriculture at the address below.

#### ***Submission of Application***

1. If an electronic grant application is submitted it must be emailed to the contacts below no later than **August 1, 2016. Applications must be received by the grant deadline.** Applications that do not adhere to this deadline will not be accepted.
2. A signed printed copy of the application must be mailed to the Wyoming Department of Agriculture at the address below no later than August 1<sup>th</sup> 2016.

**A signed hard copy must be mailed to:**

Wyoming Department of Agriculture  
Specialty Crop Producer Small Grants Program  
2219 Carey Avenue

Cheyenne, Wyoming 82002

**Contact Information**

Mary Randolph  
Wyoming Community Network  
(307) 777-6430  
Email: merliz@sisna.com

Ted Craig  
Wyoming Department of Agriculture  
(307) 777-6651  
FAX (307) 777-6593  
Email: [tcraig@state.wy.us](mailto:tcraig@state.wy.us)

**GENERAL INSTRUCTIONS**

- ◆ Application form must be completed in its entirety and required documentation attached.
- ◆ Please print or type.
- ◆ Incomplete applications will not be reviewed.

**Business information**

1. **NAME OF AGRIBUSINESS**
2. **FEDERAL TAX ID NUMBER OR SOCIAL SECURITY NUMBER**
3. **MAILING ADDRESS**
4. **CITY/ZIP**
5. **AGRIBUSINESS ENTITY (Corp, Partnership, Sole Proprietor, Other)**
6. **PRESIDENT (if Corporation)** **OR OWNER**
7. **MANAGER (If Different)**
8. **PHONE** **FAX #**
9. **YEARS IN BUSINESS** **NUMBER OF EMPLOYEES**
10. **E-MAIL ADDRESS** **WEB ADDRESS**
11. **AGRIBUSINESS DESCRIPTION.** Give a brief description and history of your operation
12. **SPECIALTY CROP EXPERIENCE.** Describe any experience you may have involving specialty crops.
13. **LETTER OF RECOMMENDATION.** Attach a letter of recommendation from your local extension office, County Commissioner, Farm Bureau etc. with regard to the farm/ranch and your involvement in agriculture production.

14. **BUSINESS/MARKETING PLAN.** Attach a one-page summary of your business plan, which addresses your marketing strategy and includes the previous year's sales figures.

**PROJECT INFORMATION**

1. **PROJECT NAME**
2. **LOCATION OF PROPOSED PROJECT**
3. **START AND COMPLETION DATES**
4. **PROJECT INFORMATION.** Describe the Project and how it will benefit your operation.
5. **GRANT HISTORY.**
  - A. Is this the first time you have applied for this grant?  No  Yes  
If no, what was the past project?
6. **PROJECT PURPOSE AND GOAL:** Clearly state the purpose of the project and explain why your project is important to your operation.
7. **POTENTIAL IMPACT:** Discuss the number of people or operations affected and the intended beneficiaries of the project. Any potential economic impact if such data is available and relevant to the project. Project must impact for more than your own operation. No more than one page.
8. **EXPECTED MEASURABLE OUTCOMES:** For the project, describe at least two things that are measurable outcomes that directly support the projects purpose.
9. **WORK PLAN:** For the project, explain briefly activities that will be performed and include a time line to accomplish the project and indicate who will do the work

**PROJECT BUDGET:** All items must be specific to this project.

ITEM	ITEMIZED EXPENSES	AMOUNT
1		
2		
3		
4		
5		
6		
7		
8		
TOT	TOTAL	

9. **GRANT AMOUNT REQUESTED** (not to exceed 75% of eligible expenditures)  
 \$ \_\_\_\_\_
10. **MAXIMUM GRANT AWARD** (not to exceed \$3,500)

*I certify that the information supplied herein (including all pages attached) is correct and that neither the applicant nor any person (or concern) in any connection with the applicant as a principal or officer are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction or by any Governmental agency of the State of Wyoming nor from federal financial or nonfinancial assistance by any federal department or agency in accordance with Executive Order 12549 (Debarment and Suspension) and CFR 44 Part 17, or are on the disbarred vendors list at [www.epls.gov](http://www.epls.gov). Further, applicant agrees to notify Agency by certified mail should it or any of its agents become debarred, suspended, or voluntarily excluded during the term of this agreement. If approved for the specialty crop grant, I agree that the business will assume sole responsibility of any and all debts or liabilities that may be incurred from this project; and will provide the required documentation to the Wyoming Department of Agriculture upon request.*

---

Signature	Title	Date
-----------	-------	------

**Return application forms to:**  
 Wyoming Department of Agriculture  
 Specialty Crop Producer Small Grants Program  
 2219 Carey Avenue  
 Cheyenne, Wyoming 82002

REQUEST FOR REIMBURSEMENT

---

Name  
 Grant Number  
 Contact Person  
 Phone Number  
 Mailing Address  
 City & Zip

The following documentation is required:  
MANDATORY FOR ALL GRANT PROJECTS

\_\_\_\_ Final Report/Hard Copy and Electronic Copy      \_\_\_\_ Copies of All Paid Invoices  
\_\_\_\_ Itemized Expenditure Report      \_\_\_\_ Copies of All Canceled Checks  
\_\_\_\_ Photographs of the project      or other method of confirm of payment

\*\*\*\*\*  
\*\*\*\*\*

**REQUEST OR REIMBURSEMENT**

Expenditures (Total from Itemized Expenditure Report)

\$ \_\_\_\_\_

Required match for grant 25% (Cash or In-kind)

\$ \_\_\_\_\_

Reimbursement Requested (not to exceed grant award of \$3,500 of eligible expenditures)

\$ \_\_\_\_\_

---

---

I hereby certify that this billing is correct and just and is based upon actual payment(s) of record; reimbursement for the above listed expenses have not been received from any state government source; and, the activities were conducted in accordance with the guidelines of the WDA Specialty Crop Small Grants Program.

---

Signature

Title

Date

**Final Report**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CITY/STATE/ZIP: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_ FAX NUMBER: \_\_\_\_\_

NAME OF NONPROFIT ORGANIZATION: \_\_\_\_\_

DATES OF EVENT: \_\_\_\_\_ LOCATION OF EVENT: \_\_\_\_\_

---

---

**PROJECT SUMMARY:** *Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by the community garden project.*

**PROJECT APPROACH:** *Briefly summarizes activities performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms.*

*Include any significant results, accomplishments, conclusions and recommendations. Present any significant contributions by any project partners in the project.*

**GOALS AND OUTCOMES ACHIEVED:** *Include the activities that were completed in order to achieve the goals and measurable outcomes for the project. Clearly convey completion of achieving outcomes by illustrating any baseline data that has been gathered to date and showing the progress toward achieving set targets.*

**Goal:**

**Benchmark:**

**Target:**

**Impact**

**Goal:**

**Benchmark:**

**Target:**

**Impact**

**OUTCOMES ACHIEVED:**

**BENEFICIARIES**

*Provide a description of the groups and other operations that benefited from the completion of the project accomplishments and how they were impacted by the project*

**LESSONS LEARNED**

*Offer any insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project. Provide unexpected outcomes or results that were an effect of implementing this project. If goals or outcome were not achieved, identify and share the lessons learned to help others.*

**ADDITIONAL INFORMATION**

*Provide additional information available (i.e. publications, websites, photographs)*

**BUDGET:** All items must be specific to this project.

ITEM	ITEMIZED EXPENSES	GRANT EXPENSES	IN-KIND EXPENSES	AMOUNT
1				
2				
3				

4				
5				
6				
7				
8				
TOT		TOTAL		

**DOCUMENTATION:** The grant recipient must complete and submit to the Wyoming Department of Agriculture the following forms for reimbursement: 1) *Request for Reimbursement*; 2) *Itemized Expenditure*; and, 3) a detailed *Final Report* on the grant by September 1, 2016. Copies of canceled checks (both sides), invoices and/or other confirmation of payment must be submitted for reimbursement.

*I certify that the information supplied herein (including all pages attached) is correct and that neither the applicant nor any person (or concern) in any connection with the applicant as a principal or officer are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction or by any Governmental agency of the State of Wyoming nor from federal financial or nonfinancial assistance by any federal department or agency in accordance with Executive Order 12549 (Debarment and Suspension) and CFR 44 Part 17, or are on the disbarred vendors list at [www.epls.gov](http://www.epls.gov). Further, applicant agrees to notify Agency by certified mail should it or any of its agents become debarred, suspended, or voluntarily excluded during the term of this agreement. If approved for the specialty crop grant, I agree that the business will assume sole responsibility of any and all debts or liabilities that may be incurred from this project; and will provide the required documentation to the Wyoming Department of Agriculture upon request.*

---

Signature

Title

Date

Applications were reviewed by WDA and WCN for multiple impacts before approval. If the project did not show benefits beyond the individual producers operation the projects were not accepted. Producers were given the option of revising their application to include ways that included multiple impacts and resubmitting it.

A power point was developed and updated after feedback from producers of a sample grant application to help producers develop projects that meet the need for multiple impacts.

The program was promoted at the following conferences:

February 2015/16 Westi Days

February 2015/16 Fremont County Farm and Ranch Days

March 2015/16 Wyoming Farmer Marketing Conference

March 2015 Laramie Conservation Expo

March 2015/16 Bee University

August 2015 Wyoming State Fair

October 2015 Lander Local fest

Wheatland Specialty Crop Conference

Schrall gardens
Malcolm Ranch
Abbatello
Metz LLC
Good to Grow
Planet Laramie
Patch Ranch
High Horse Farm

## GOALS AND OUTCOMES ACHIEVED

### Expected Measurable Outcomes

**Goal** – To increase specialty crop education, production, and consumption through season extension techniques, water conservation and other approved educational production projects by providing small grants to Wyoming producers.

**Benchmark** – Number of grants awarded in the past is 32 and the number of people who have increased their knowledge of season extension techniques hoop house building days, farm days and CSA participation averages 35 per grant for total of 1120.

**Target** – We expect the number of producers using season extension/increased crop productivity methods to increase by 20% and the number of people to increase their knowledge of season extension techniques, water conservation and other approved educational projects to be up to an additional 280. The number of individuals impacted at farmers markets is estimated to be double this amount.

**Performance Measure** – Recipients of the grant will be required to report on amount of increased production and the numbers of people who have increased their knowledge about

season extension techniques by attending a high tunnel build day, farm day or student field day. All records will be compiled and maintained by the WCN.

**Schrall Gardens Impact 10**, four teachers and six neighbors who were interested in the benefits of a hoop house production methods have been given tours. The production of greens, beets, cucumbers, tomatoes and peppers has doubled with the hoop house extended season.

**Malcolm Ranch Impact 15** neighbors have toured the hoop house and 4 have indicated they plan on building one as well. The hoop house extended by over sixty days and we were able to supply vegetable much earlier at the local farmers market.



**Abbatello Impact 32**. Tours included 23 neighbors and 9 individuals from the Shoshoni Rec center. This spring are planning on starting seedlings in March so that will be an additional 60 days over outside planting in the spring.

**Metz LLC Impact 24** individuals toured the hoop house that included neighbors, local growers and one nursery person. I am getting between 60 and 90 days of production time and we are in the process of installing vertical towers to expand the amount of usable space within the hoop house.



**Good to Grow Impact 201** This included 40 CSA families and 4 neighbors interested in building a hoop house. Two high school horticultural classes with 37 students also toured the farm. In addition over 120 preschoolers visited the farm and sampled the produce being grown. Our tomato and pepper production is has increased over 50% in the hoop house with bee hives incorporated. We have never been able to grow avocados out in the field at our elevation but were able to grow avocados in the hoop house and were able to supply them to our CSA members for two weeks.



**Planet Laramie Impact 66** that included farm tours and UWYO capstone student tours. - UW class visits spring/summer 2@ ~13 students per class, Open farm visit/tours ~28 community members, work days 2@ 6 people per day. We also had speaking engagements on our growing operation that included "Make your Business Mushroom." Producers Panel, Laramie Local Food Gathering, Laramie, 30 April 2016. "Gourmet Mushrooms and Fresh Veggies in Your Backyard."

PowerPoint Presentation, Laramie Garden Club, Laramie, 27 Sept. 2016. *Residential lot-turned-small-farm yields prized produce.* Barnyards & Backyards, Summer 2016.



Classes included: Microbiology Capstone Fall 2015 and Agroecology 2016. The season has been extended this fall already since there have been nights below freezing; the hoop house has saved 7-10 degrees during some cool September nights. With an improved growing environment, we have expanded our crop offerings. With the hoop house project we have increased our availability, ensured consistency and offered higher quality produce and mushrooms. We have increased and

improved space for seedling starts, which will also extend our growing season and diversity.

**Patch Ranch Impact 18** neighbors have come to see the hoop house and vertical grow towers. The towers have increased the amount of growing space and decreased the growing time for greens by almost 50%.

**High Horse Impact 49** Thirty four neighbors and producers have toured the hoop house and fifteen CSA members have benefited. The season was extended by over 60 days with first frost in August and fruiting until the end of October.



**Impact:** The total amount of hoop house space added was 4914 square feet and the value of the produce able to be grown was \$24,570. Over a 5 year usable life span for the hoop house this equates to approximately \$123,000.

## **BENEFICIARIES**

Eight producers and eight farmers markets benefited from the program. In addition, 415 producers, consumers, and students toured the hoop houses and increased their awareness of hoop house production.

## **LESSONS LEARNED**

Weather, specifically winds and snows, are an issue with construction of high tunnels, and we have no control over this other than to provide information on how to strengthen the design. Another issue that continued to surface was the lack of knowledge the first-time grant writers have in understanding the process and the need for multiple impact. When asked for information on the program, we also include a copy of a sample grant application publication. Numerous calls from backyard gardeners wanting information on the grant program were also fielded. They have heard about the program by word of mouth from friends or neighbors and were often not qualified. In cases where individuals were not qualified to participate in the program, we referred them to the UWYO hoop house website for inexpensive plans on how to build hoop houses to extend the season of their backyard garden.

## **CONTACT INFORMATION**

Mary Randolph  
Wyoming Community Network  
307-760-5727  
merliz@sisna.com

# WYOMING SPECIALTY CROP NONPROFIT ORGANIZATION SMALL GRANT EDUCATIONAL PROGRAM

## PROJECT SUMMARY

The Wyoming specialty crop program offered small grants to nonprofit organizations to develop and promote educational methods that extended or increased specialty crop production and consumption in Wyoming. The program was instrumental in expanding the knowledge of producers, consumers and students. Since the inception of the program grants have been awarded for promotion of specialty crops through construction of hoop houses/high tunnels or indoor and outdoor gardens for schools, communities, and other nonprofit organizations to provide production and educational opportunities in the climate challenged areas of Wyoming. The results of the community and educational hoop houses and gardens built in Wyoming have been an increase in knowledge, production, and consumption of specialty crops. Community gardens often incorporate hoop houses (high or low tunnels) to help extend the growing season, and protect crops from hail, wind, and cold. We are also seeing interest in heritage and educational gardens. This grant funding included these types of projects. Nine grants were awarded.

## PROJECT APPROACH

The application and guidelines were updated and marketed through media releases, at trade events meetings and conferences. The application was posted on the Wyoming Department of Agriculture's website. Applications were reviewed by WDA and successful applicants notified. Small grants were awarded to nonprofit organizations for the creation of community, school, heritage, or educational gardens, planting of fruit bush and tree garden/orchards, and or hoop house season extension projects that helped increase knowledge of and participation in specialty crop production. We received 12 applications of which nine were funded.

Application process included submitting an application, budget, and letter of support from a local entity that can vouch for an applicant's involvement in agriculture production.

### **NONPROFIT ORGANIZATIONS WYOMING SPECIALTY CROP GRANT PROGRAM**

#### **Guidelines**

##### **PURPOSE**

Small grants will be awarded to nonprofit organizations and educational institutions to promote Specialty Crop for approved projects.

##### **ELIGIBILITY REQUIREMENTS**

Wyoming nonprofit organizations are eligible to apply for a Wyoming Crop Specialty Grant if they meet the following criteria:

1. Be a registered Wyoming-based nonprofit organization or an educational institution in the State of Wyoming.

2. Demonstrate that the organization is capable of promoting the use of specialty crops.

**Eligible expenditures** are limited to materials for raised beds, high tunnels low tunnels, row covers, irrigation supplies, soil amendments, mulch, garden tools, specialty crop seeds, starter plants and other pre-approved costs necessary for the project.

**In-kind matching expenditures** may include cash, donated labor, rental equipment and other approved expenditures directly related to the project.

**Ineligible grant expenditures include but are not limited to shipping, salaries and administrative costs.**

#### **AWARD LIMITATIONS**

**This is a matching program.** Nonprofit organizations may receive a maximum of one specialty crop grant. The total grant award is limited to 75% of the actual eligible expenditures. The minimum amount of a grant is \$500. The maximum a grant is \$3500.

#### **REQUIREMENTS OF THE ORGANIZATION PARTICIPANT**

**Documentation:** The nonprofit organization must complete and submit to the Wyoming Department of Agriculture the following forms for reimbursement: 1) *Request for Reimbursement*, 2) *Itemized Expenditure* and, 3) a detailed hard copy and electronic copy of final report on the grant by September 1, 2016. Copies of canceled checks (both sides) or other confirmation of payment and invoices must be submitted for reimbursement.

#### **APPLICATION PROCESS**

Nonprofit organizations applying to the Wyoming Specialty Crop Grant Program must complete and return a signed hard copy and email an electronic copy of the application and the required attachments by August 1, 2016 to Attn: Wyoming Department of Agriculture, Community Garden Grant for Nonprofit Organizations, Wyoming Specialty Crop Program, 2219 Carey Ave. Cheyenne, WY 82002.

---

**PLEASE NOTE:** Expenditures incurred without written or electronic confirmation from the Wyoming Department of Agriculture are not eligible for reimbursement. **The application process cannot be started after the nonprofit organization has purchased materials being requested in the grant for the community garden.**

#### **GENERAL GRANT INFORMATION**

The Wyoming Specialty Grant Program is a reimbursable grant; and as such, the applicant must pay all expenditures before the grant award can be disbursed. The organization shall function independently in performing this activity and shall assume sole responsibility of any debts or liabilities that may be incurred in regard to this grant. The grant award cannot be assigned.

**\*\*\*This program has a limited amount of funds. Money will be dispersed on a first come, first serve basis and the Wyoming Department of Agriculture reserves the right to deny applications that are not complete or otherwise deemed not eligible.\*\*\***

**Application Format and Submission Requirements**

1. Proposals need to be typed, single spaced and in 12 point format.
2. Each page should be numbered, with applicant's name at the top of each page.
3. Application packets should not exceed 10 pages including any supplemental documentation.
4. An electronic version of the application packet (in MS Word format) must be submitted to the following email addresses [merliz@sisna.com](mailto:merliz@sisna.com) and [ted.craig@wyo.gov](mailto:ted.craig@wyo.gov)
5. Submit ONE complete original application packet signed by the person authorized to receive funds and mail to Wyoming Department of Agriculture at the address below.

***Submission of Application***

1. An electronic grant application must be emailed to the contacts below no later than **August 1, 2016**. **Applications must be received by the grant deadline.** Applications that do not adhere to this deadline may not be accepted.
2. A signed printed copy of the application must be mailed to the Wyoming Department of Agriculture at the address below no later than August 1, 2016

**Contact Information**

Ted Craig  
Wyoming Department of Agriculture  
(307) 777-6651  
FAX (307) 777-6593  
Email: [ted.craig@wyo.gov](mailto:ted.craig@wyo.gov)

Mary Randolph  
Wyoming Community Network  
(307) 777-6430  
Email: [merliz@sisna.com](mailto:merliz@sisna.com)

A signed hard copy must be mailed to:

Wyoming Department of Agriculture  
COMMUNITY GARDEN GRANT FOR NONPROFIT ORGANIZATIONS

---

Wyoming Specialty Crop Grant Program  
2219 Carey Avenue  
Cheyenne, Wyoming 82002

## Application

### GENERAL INSTRUCTIONS

- ◆ Application form must be completed in its entirety and required documentation attached.
- ◆ Incomplete applications will not be reviewed.

### Applicant Information

1. NONPROFIT ENTITY
2. FEDERAL TAX ID NUMBER
3. MAILING ADDRESS
4. CITY/ZIP
5. NAME OF APPLICANT
6. PHONE FAX #
7. E-MAIL ADDRESS WEB ADDRESS

### PROJECT INFORMATION

1. PROJECT
2. LOCATION OF PROPOSED PROJECT
3. START AND COMPLETION DATES

**ABSTRACT** *(In 150 words or less summarize what you want to accomplish)*

**PROJECT PURPOSE AND GOALS:** *Clearly state the purpose of the project and explain why your project is important to your organization and the community.*

**Goal:**

**Benchmark:**

**Target:**

**Goal:**

**Benchmark:**

**Target:**

**POTENTIAL IMPACT:** *Discuss the number of people or operations affected and the intended beneficiaries of the project. Provide potential impact if such data is available and relevant to the specialty crop project.*

**EXPECTED MEASURABLE OUTCOMES:** *For the project, describe at least two distinct and measurable outcomes that directly and meaningfully support the project's specialty crop purpose.*

**WORK PLAN:** *For the project, explain briefly activities that will be performed and include a time line to accomplish the project. Indicate who will do the work and manage the project.*

**Financial Feasibility** How do you intend to use the grant funds? Provide a breakdown of costs for the community garden project and where the grant funds fit into the project financing. Provide budget estimates for the total project cost.

**Eligible expenditures** are limited to materials for raised beds, low tunnels, soil amendments, garden tools, specialty crop seeds, starter plants and other pre-approved costs necessary to construct a community garden.

**In-kind matching expenditures** may include cash, donated labor, rental equipment and other approved expenditures directly related to the construction of the community garden.

**Remember, no labor, administrative costs or shipping may be included in the grant request. A 25% in-kind match is required. This may include in-kind donated labor, equipment rentals and other preapproved costs.**

**BUDGET**

Sample table format

Itemized Expenses	Grant Funds	Cash Match	In-Kind Match	Total

**BUDGET NARRATIVE:** Provide sufficient information in paragraph format about the budget categories listed for each line item to demonstrate that grant funds are being expended on eligible grant activities that meet the purpose of the program.

Total Eligible Grant Expenditures from Itemized Budget Table \$ \_\_\_\_\_  
 Required cash or in-kind match for grant (25% be at least 25%) \$ \_\_\_\_\_  
 Grant Requested (**not to exceed grant award of \$3,500 of eligible expenditures**) \$ \_\_\_\_\_

**PROJECT OVERSIGHT:** Describe the oversight practices that provide sufficient knowledge of grant management to ensure proper and efficient administration.

**PROJECT COMMITMENT:** Briefly describe the organization's commitment to and work toward the goals and outcome measures of the community garden project.

*I certify that the information supplied herein (including all pages attached) is correct and that neither the applicant nor any person (or concern) in any connection with the applicant as a principal or officer are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction or by any Governmental agency of the State of Wyoming nor from federal financial or nonfinancial assistance by any federal department or agency in accordance with Executive Order 12549 (Debarment and Suspension) and CFR 44 Part 17, or are on the disbarred vendors list at [www.epls.gov](http://www.epls.gov). Further, applicant agrees to notify Agency by certified mail should it or any of its agents become debarred, suspended, or voluntarily excluded during the term of this agreement. If approved for the specialty crop grant, I agree that the business will assume sole responsibility of any and all debts or liabilities that may be incurred from this project; and will provide the required documentation to the Wyoming Department of Agriculture upon request.*

---

Signature	Title	Date
-----------	-------	------

**REQUEST FOR REIMBURSEMENT**

---

Name  
Grant Number  
Contact Person  
Phone Number  
Mailing Address  
City & Zip

The following documentation is required:  
MANDATORY FOR ALL GRANT PROJECTS

\_\_\_\_ Final Report/Hard Copy and Electronic Copy                      \_\_\_\_ Copies of All Paid Invoices  
\_\_\_\_ Itemized Expenditure Report                      \_\_\_\_ Copies of All Canceled Checks  
\_\_\_\_ Photographs of the project                      or other method of confirm of payment

\*\*\*\*\*

\*\*\*\*\*

REQUEST OR REIMBURSEMENT

Expenditures (Total from Itemized Expenditure Report)

\$ \_\_\_\_\_

Required match for grant 25% (Cash or In-kind)

\$ \_\_\_\_\_

Reimbursement Requested (not to exceed grant award of \$3,500 of eligible expenditures)

\$ \_\_\_\_\_

---

---

I hereby certify that this billing is correct and just and is based upon actual payment(s) of record; reimbursement for the above listed expenses have not been received from any state government source; and, the activities were conducted in accordance with the guidelines of the WDA Specialty Crop Small Grants Program.

---

Signature

Title

Date

**Final Report**

NAME: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CITY/STATE/ZIP: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_ FAX NUMBER: \_\_\_\_\_

NAME OF NONPROFIT ORGANIZATION: \_\_\_\_\_

DATES OF EVENT: \_\_\_\_\_ LOCATION OF EVENT: \_\_\_\_\_

---

---

**PROJECT SUMMARY:** *Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by the community garden project.*

**PROJECT APPROACH:** *Briefly summarizes activities performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include any significant results, accomplishments, conclusions and recommendations. Present any significant contributions by any project partners in the project.*

**GOALS AND OUTCOMES ACHIEVED:** *Include the activities that were completed in order to achieve the goals and measurable outcomes for the project. Clearly convey completion of achieving outcomes by illustrating any baseline data that has been gathered to date and showing the progress toward achieving set targets.*

**Goal:**

**Benchmark:**

**Target:**

**Impact**

**Goal:**

**Benchmark:**

**Target:**

**Impact**

**OUTCOMES ACHIEVED:**

**BENEFICIARIES**

*Provide a description of the groups and other operations that benefited from the completion of the project accomplishments and how they were impacted by the project*

**LESSONS LEARNED**

*Offer any insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project. Provide unexpected outcomes or results that were an effect of implementing this project. If goals or outcome were not achieved, identify and share the lessons learned to help others.*

**ADDITIONAL INFORMATION**

*Provide additional information available (i.e. publications, websites, photographs)*

**BUDGET:** All items must be specific to this project.

ITEM	ITEMIZED EXPENSES	GRANT EXPENSES	IN-KIND EXPENSES	AMOUNT
1				
2				
3				
4				
5				
6				
7				
8				
TOT	TOTAL			

**DOCUMENTATION:** The grant recipient must complete and submit to the Wyoming Department of Agriculture the following forms for reimbursement: 1) *Request for Reimbursement*; 2) *Itemized Expenditure*; and, 3) a detailed *Final Report* on the grant by

September 1, 2016. Copies of canceled checks (both sides), invoices and/or other confirmation of payment must be submitted for reimbursement.

*I certify that the information supplied herein (including all pages attached) is correct and that neither the applicant nor any person (or concern) in any connection with the applicant as a principal or officer are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction or by any Governmental agency of the State of Wyoming nor from federal financial or nonfinancial assistance by any federal department or agency in accordance with Executive Order 12549 (Debarment and Suspension) and CFR 44 Part 17, or are on the disbarred vendors list at [www.epls.gov](http://www.epls.gov). Further, applicant agrees to notify Agency by certified mail should it or any of its agents become debarred, suspended, or voluntarily excluded during the term of this agreement. If approved for the specialty crop grant, I agree that the business will assume sole responsibility of any and all debts or liabilities that may be incurred from this project; and will provide the required documentation to the Wyoming Department of Agriculture upon request.*

---

Signature

Title

Date

*Submit completed forms to:*  
Wyoming Department of Agriculture  
Wyoming Specialty Crop Program  
Community Garden Grant for Nonprofit Organizations  
2219 Carey Avenue  
Cheyenne, Wyoming 8200

The program was promoted at the following conferences:

February 2015/16 Westi Days

February 2015/16 Fremont County Farm and Ranch Days

March 2015/16 Wyoming Farmer Marketing Conference

March 2015 Laramie Conservation Expo

March 2015/16 Bee University

August 2015 Wyoming State Fair

October 2015 Lander Local fest

Wheatland Specialty Crop Conference

## GOALS AND OUTCOMES ACHIEVED

**Goal** - The goal of the project is to increase the knowledge of specialty crop production, and consumption through community projects that include school and community gardens, community orchards, heritage and educational gardens, high tunnels, and high tunnel and community garden water conservation.

**Benchmark 1-** Number of communities, schools and nonprofits directly impacted by past grants is twenty three (23); directly increasing the knowledge of 25-65 people per project.

**Target** –To increase the knowledge of up to 520 gardeners, students or consumers on specialty crop production by providing grants for educational gardens, orchards or high tunnel projects by 7- 8; directly impacting between up to 520 individuals.

**Performance Measure** – Small grant recipients will track the number of individuals who have increased their knowledge of specialty crop production from participating in school/community heritage or educational gardens/orchard development, or hoop house construction and use. The small grants program final report will require the recipient organization to track the number of impacted individuals in the case of schools report increase in knowledge through testing. All records will be maintained by the WCN.

**Performance Measure** – The number of people who have increased their knowledge/awareness of specialty crop production by participating in community gardens/orchard development or hoop house construction were as follows:

### **4H Fort Washakie Hoop House: Impact 42**

Twelve individuals with no prior hoop house construction experience were involved in the hoop house building workshop. An additional 15 students from the local high school were recruited to help. The hoop house was built to house the projects of 15 4H club members.



**Saratoga Elementary School cold frame greenhouse Project: Impact: 154 Students** The students were impacted by increasing learning opportunities on soil, growing plants and nutrition. Saratoga Elementary School is a KG - 6<sup>th</sup> grade school with 154 students. The Paws test scores show that the percentage of students in the lowest performing category for science decreased by 11.76%. The community of Saratoga and surrounding areas has an estimated population of 1200 people. The green house provided provided activities and educational studies that related to agriculture, science, and environments.



**State Fair 4H hoop house: Impact 20 directly.** Eight individuals with no prior hoop house construction experience were taught how to build a hoop house in a workshop. An additional four people helped construct raised beds. There were eight 4H members who grew vegetables in the hoop house and showed them at the fair. The project was part of the horticultural display at Wyoming State Fair which attracts over 40,000 people a year. The library Young Gardener program was able to also use the hoop house in 2016.



**Ag in the Classroom/Wyoming Agriculture & Natural Resource Institute Impact 60** Fifty four of the 60 individuals were educators directly related to teaching in Wyoming. The workshop taught participants how to build vertical hydroponic grow towers that could be taken back to their schools for use in the classroom. A survey of participants as to how comfortable and ready to use vertical towers they were was taken and on a scale of 1-5 90% chose 5 and 8% chose 4 and 2% chose 3.

**CV Ranch Impact 41** - Students participated in the building and care of 500 square feet of new raised beds. CV ranch is a residential school and treatment facility for disabled and emotionally disturbed youth whose education needs aren't met in their local communities. Students had the opportunity to become producers and



consumers for seed to table. This was a bench mark season for the FLP. It was incorporated into the school curriculum. Produce was supplied to our food services program and incorporated in student meals.



**Food for Thought Impact 310** -Through a workshop 10 people including high school and college students, interns retirees and garden instructors gained the necessary skills to build a hoop house. Approximately 40 weekly volunteers, 200 children and 60 garden plot owners were exposed to the high tunnel through regular visits to our center. We also have 52<sup>nd</sup> graders helping with growing food in the hoop house. The mission of Food for Thought is to support a



self-reliant community of individuals empowered to produce and select nutritious and affordable local food.

**The objective of the following three projects was to provide students a micro-farm station that provided an entire year of hands on projects and lesson plans designed to plant, grow, care for, observe, and harvest different types of food, plants and herbs incorporated with lessons.**

**Lingle/Fort Laramie Schools Impact 36 4th grade students.** The Paws test scores show that the percentage of students in the lowest performing category for science decreased from 10.53% to 7.69%. We will be comparing the past Paws results

with these in the spring of 2017. The indoor micro-farms were provided to two 4<sup>th</sup> grade classrooms in the Lingle/Ft. Laramie Conservation District. The micro-farm growing experience provides opportunities to include outside community members (like 4-H, FFA, Cattlewomen, Conservation Planting Program) as enhancements to lesson plans. This project encourages community support for the classroom experience.



The microgreen growing project allowed students to discover how to prep soil, plant different types and sizes of seeds, learn firsthand how to adapt for multiple types of growth and light needs, and learn about harvesting and tasting requirements. The second project spring garden taught the students to accept the reality of a living system that takes time, care, patience and included some losses. Their enthusiasm for growing food they can consume, their desire to learn what vegetables really are and what their bodies need for energy, combined with studies about soil and water requirements are helping students gain essential real life skills for their future, exposing them to possible career options in farming and production.

**Trail Elementary Impact 80 4<sup>th</sup> grade students** The school has a total of 246 students. The Paws



4<sup>th</sup> grade test scores show that the percentage of students in the lowest performing category for science decreased from 18.06% to 7.89%. We will be comparing the Paws results with these in the spring of 2017. The indoor micro-farms were provided to six 4<sup>th</sup> grade classrooms in the North Platte Valley Conservation District. The micro-farm growing experience provided opportunity to include outside community members (like 4-H, FFA, Cattlewomen, Conservation Planting

Program) as enhancements to lesson plans. Project incorporated conservation district

education goals and outreach from other community leaders into the public classrooms to enhance their knowledge of where food comes from and how it is produced. This project encouraged community support for the classroom experience. Students explored how various seed types grow, determined water and light requirements for various types of plants, learned short and long-term care requirements, developed recipes and ate their produce, shared group discussions about flavor and products that can be made from each plant, and continue to decipher the connection between their need for food and their ability to produce it. Each student contributed both privately and in a group setting. Students learned about vegetable subgroups, how to classify a fruit or vegetable, and are participating in experiments to learn about soil layers, erosion, and water health. The indoor garden wagon experience will continue to bring to life the agricultural community they reside in, and will continue to provide real life farm lessons about care for themselves, their community lands, their water and air, and each other as a whole.

**Southeast/La Grange Schools Impact 41 4th grader students** The Paws test scores for 4<sup>th</sup> grade show that the percentage of students in the lowest performing category for science decreased from 11.1% to 5.88%. We will be comparing the Paws results with these in the spring of 2017.

The indoor micro-farms were provided to two 4<sup>th</sup> grade classrooms. We will be comparing the Paws results with these in the spring of 2017 grade classroom in the South Goshen School District. The micro-farm growing experience provided an opportunity to include outside community members (like 4-H, FFA, Cattlewomen, Conservation Planting Program)



as enhancements to lesson plans. This project will easily encourage community support for the classroom experience. To date students have planted a micro greens garden, held a joint classroom outdoor harvest day, planted a spring garden with tomato, peas, carrots, radishes, lettuces, kale, and peppers, and created multiple opportunities for fourth grade student consumption. They had opportunity to plant, to learn what microgreens are and what nutrition they provide, to record indoor growth results, and to harvest for public consumption, which included proper sanitary methods for harvesting, preservation methods for storing, desirable timetables for proper storage, and delivery for joint classroom consumption. Additional plantings will include cabbages, potatoes, cucumbers, beets, radishes, green onion bulbs, zucchini, edible flowers and herbs, alpine strawberries, and oyster mushrooms.

**Meeteetse K-12 school Impact 109 Students.** The Paws test scores show that the percentage of students in the lowest performing category decreased in 2016 from 34.72% to 12.5%. The Paws report for 2017 will be compared with previous report. Meeteetse K-12 school applied for a grant to support the building of a hoop house. With the assistance from the Wyoming Specialty Crop Program, Meeteetse Schools began a school and community garden program and curriculum at the k-12 level that involved students and staff. We have the green space in place and the foundation of the program in operation.



**Powder River Basin Resource Council Impact 40** Initial impact was the 40 volunteers, who helped clean up, till and plant the site. The primary goal of the Sheridan Food Forest project was to plant public food in public places. Farmers and ranchers in this area once provided a great deal of the food eaten by residents of our community. This project is a move to bring more local fruits and vegetables back to the Sheridan area. The Food Forest was designed be



open and free to all members the public and the food the Forest provides made available to anyone who wishes to harvest it. In addition to increasing access to nutritious local food, providing habitat for beneficial insects, and beautifying the community, the Food Forest will serve as an outdoor classroom where residents can learn about growing food and the importance of pollinators in our interconnected natural system. The future impact is estimated to be approximately 250 people per year who will be

involved in planting, managing, harvesting and attending workshops at the site.

## BENEFICIARIES

Beneficiaries included 933 students, teachers, gardeners and volunteers. The projects were varied between schools, nonprofit community organizations and county fairs.

## **LESSONS LEARNED**

Our biggest problem encountered occurred when the project manager at a school or nonprofit leaves in the middle of a project. This led to confusion as to who was going to take over responsibility for the project long term. We have been fortunate to date that other individuals within the organizations have stepped up to support the goals of the projects.

## **CONTACT INFORMATION**

Mary Randolph

Wyoming Community Network

307-760-5727

[merliz@sisna.co](mailto:merliz@sisna.co)

# STRAWBERRY PRODUCTION USING VERTICAL GROWING SYSTEM IN HIGH TUNNELS

## PROJECT SUMMARY

Specialty crop producers in Wyoming face many challenges in growing fruit and vegetable crops. Strawberries are grown as a high-end market crop and by home gardeners for fresh consumption. When grown in the ground, whether under cover or in the open field, strawberries require extensive labor and maintenance. Weeding and harvesting are almost always done by hand which is labor and cost intensive. Growing strawberries using vertical growing systems eliminates land-preparation time, expenses, weed control and harvesting will become much less challenging for producers. Using vertical growing systems will also increase the efficient use of space in high tunnels, allowing producers to grow more in a given space. The **immediate goal** of this project is to examine the feasibility (in terms of yield and production costs) of strawberry production using vertical growing systems and high tunnel production systems. The **long-term goal** is to demonstrate the most efficient growing systems for commercial growers. More efficient production methods will result in higher yields, decreased production costs, and increased profits.

## PROJECT APPROACH

**Vertical Growing System:** Built frames to hold 24 vertical towers, and designed and installed circulating hydroponic irrigation system. 144 bare root 'Sea Scape' strawberry plants were planted a total of 6 times. Three plantings occurred in 2014 and 3 plantings occurred in 2015. Vertical towers are located in the Sheridan College Greenhouse in Sheridan, WY. Plants generally survived 3-6 weeks and we experienced more than 90% plant death. Plants exhibited vigorous vegetative growth for a short period of time. Plants suffered from a combination of root rot, fertilizer burn from plants above dripping fertilizer/water solution onto plants below, spider mites, and nutrient deficiencies. These problems resulted in over 90% plant death. Surviving plants would die as they entered their flowering stage. There was no production using the vertical growing system.

**High Tunnel Production:** 144 'Sea Scape' strawberries were planted in 2014 and 2015 at the ACRES student farm in Laramie, WY. The 2014 planting was lost due to mice, squirrels, and rabbits. The 2015 planting was highly successful and productive. Plants were fertilized at planting. Soil was amended with compost prior to planting. Drip irrigation was installed and used for watering plants. Weed barrier fabric was installed to suppress weeds. Additional weed pulling was required. The first harvest was June 26 and the last harvest was November 12. Strawberries were harvested 3 days a week through most of the growing season, 2 days a week

in October, and once a week the first two weeks of November. The high tunnel extended the growing season 78 days after our first freeze. A total of 87.77 pounds of strawberries were harvested, or an average of 0.61 pounds of strawberries per plant. Plants started producing strawberries in May 28, 2016 and continued production through November 10. Plants were harvested twice each week. Yields in 2016 totaled 168 pounds. The high tunnel extended the growing season of 'Sea Scape' strawberries by approximately 90 days total each year. Because the first year was a complete loss, I was only able to collect 2 years of yield data. I plan to continue collecting third year yield data in 2017 before writing a strawberry production guide.

## GOALS AND OUTCOMES ACHIEVED

**Goal:** Demonstrate the most efficient growing systems for high tunnels and communicate this information to growers. More efficient production methods will result in higher yields, decreased production costs, and increased profits.

**Benchmark:** No data available for Wyoming high tunnel production.

**Target:** Provide information to growers on cost analysis of site preparation vs. vertical growing systems, labor analysis of pest management, labor analysis of harvesting, yields per year in soil-grown and vertically-grown strawberries in high tunnels and number of plants grown in a given space in high tunnels. Through our outreach efforts, 75% of high tunnel producers we reach will have an increase in knowledge.

**Performance Measure:** We will survey those who attend vertical growing seminars or download information from the website to gauge increase in knowledge.

**Outcome:** High tunnel production of day neutral strawberries in Wyoming is a feasible option for specialty crop growers. Plants start producing in late May/early June and produce continuously through early November. This gives producers over 5 months of production during peak summer months when most farmers markets are active. At \$4.00 per pound, these high tunnel strawberries produced \$1024. The cost of the plant material (bare root plants) was \$0.50 per plant, or \$72 total. It took me roughly 15-20 minutes to pick 144 plants, so harvesting is done fairly quickly.

### **Strawberry Production Survey Evaluation Summary for Increase in Knowledge**

Please rate the workshop on a scale of 1-5 (1= terrible, 2=poor, 3=OK, 4=good, 5=excellent)

Average Response: 4.4

Please rate your knowledge of strawberry production prior to this workshop on a scale of 1-5. (1=no knowledge, 5=expert knowledge).

Average Response: 2.7

Please rate your knowledge of strawberry production after attending this workshop on a scale of 1-5. (1=no knowledge, 5=expert knowledge).

Average Response: 3.9

Percentage of respondents indicating increased knowledge: 81%

**Research Outcomes: In ground**

**High Tunnel Production:** This project successfully demonstrated how to grow 'Sea Scape' strawberries in high tunnels using weed barrier.

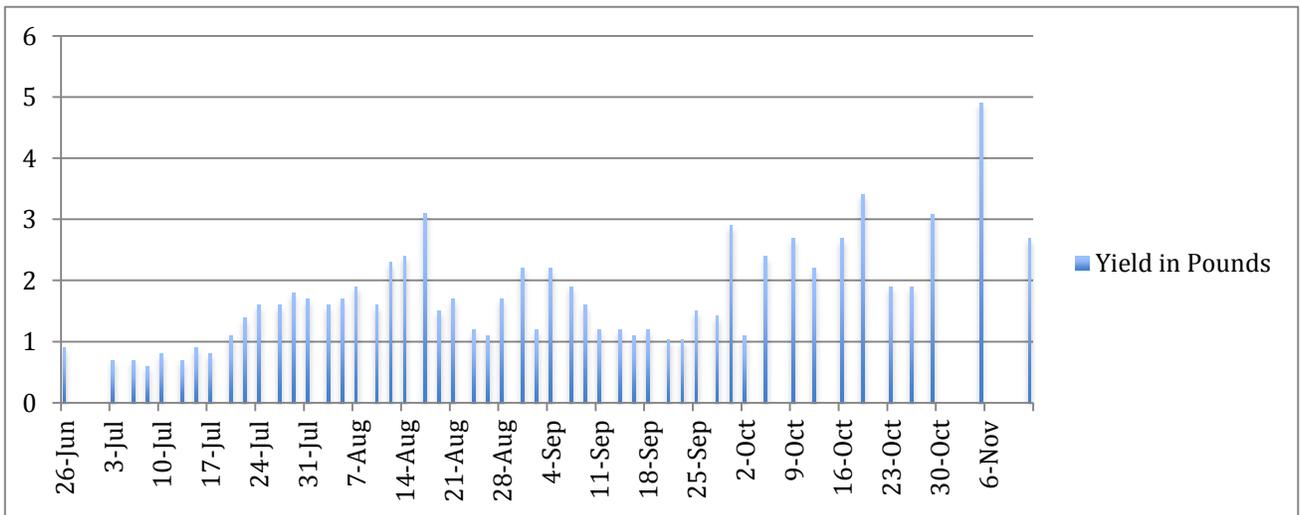
**Strawberries in High Tunnel**



**Strawberry Harvest.**

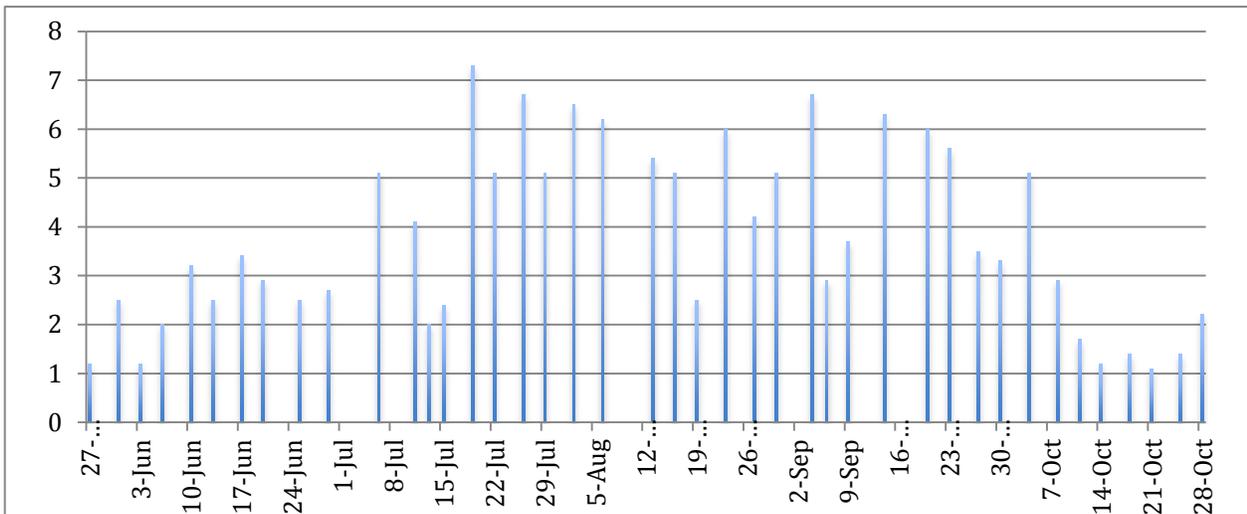


### Size Variation of Strawberries



**2015 Strawberry Yields in Pounds**

## 2016 Strawberry Yields in Pounds



Educational Outreach: I presented results of this project at Wyoming Specialty Crop workshop in Wheatland, at Wyoming Growers and Groundkeepers Association state conference, and to Master Gardeners in Albany, Laramie, Natrona, Sheridan, and Campbell counties. I gave tours of strawberry research to Laramie Garden club, ACRES student farm Open Gate event, and UW Laramie R&E Center field days.

### **Vertical Tower Outcome**

**Indoor Vertical Tower Production:** This project showed growing strawberries using vertical towers is challenging. No strawberries were produced in six different plantings. Disease, nutrient management, insects, and daily monitoring of the hydroponic system are all difficult challenges to overcome. I do not recommend growers try growing strawberries in vertical towers.

### **Vertical towers after planting bare root strawberries**



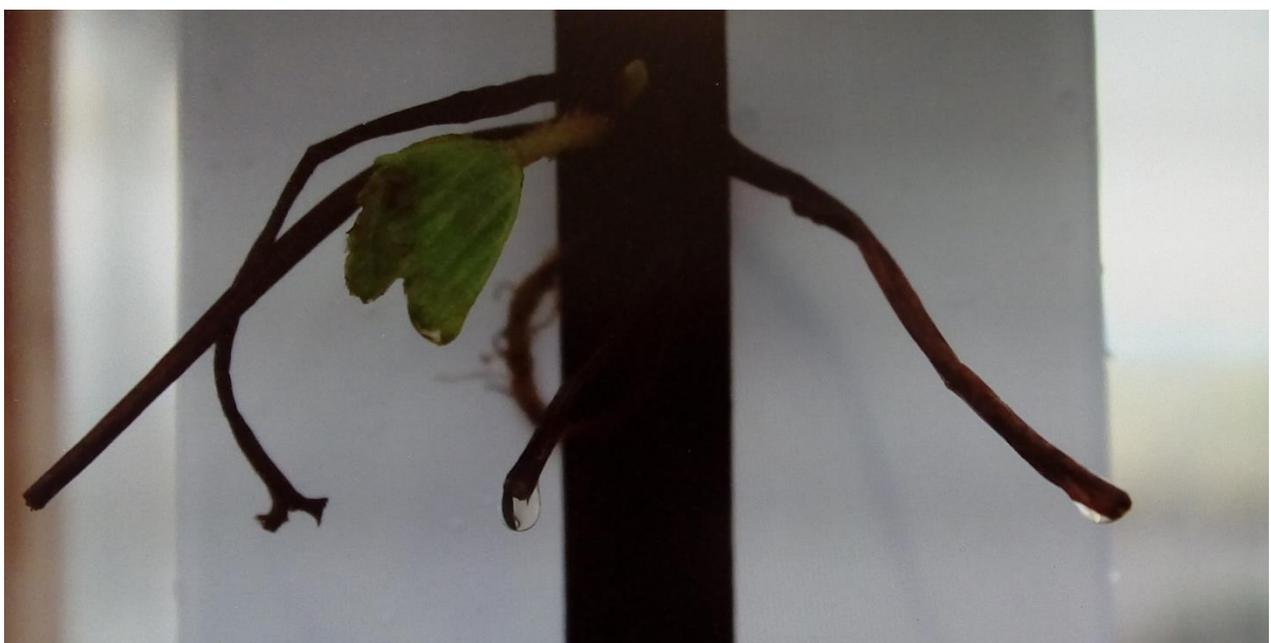
Plants generally survived 3-6 weeks and we experienced more than 90% plant death. Plants exhibited vigorous vegetative growth for a short period of time. Plants suffered from a



combination of root rot, fertilizer burn from plants above dripping fertilizer/water solution onto plants below, spider mites, and nutrient deficiencies. These problems resulted in over 90% plant death. Surviving plants would die as they entered their flowering stage.

**Root Rot in Strawberries.** Two healthy plants (top center) also shown for comparison.

**Fertilizer Burn and Water Dripping**



## **BENEFICIARIES**

UW Extension, Wyoming Specialty Crop growers, UW ACRES students, Master Gardeners. Results of this project were presented at Wyoming Specialty Crop workshop in Wheatland (50), at Wyoming Growers and Groundkeepers Association state conference (25), and to Master Gardeners in Albany (10), Laramie (60), Natrona (25), Sheridan (35), and Campbell (30) counties. Tours of strawberry research were given to Laramie Garden club (25), ACRES student farm Open Gate event (100), and UW Laramie R&E Center field days (75). The average increase in knowledge from surveys was 81.6%.

## **LESSONS LEARNED**

High tunnel production of day neutral strawberries in Wyoming is a feasible option for specialty crop growers. Plants start producing in late May/early June and produce continuously through early November. This gives producers over 5 months of production during peak summer months when most farmers markets are active. At \$4.00 per pound, these high tunnel strawberries produced \$1024. The cost of the plant material (bare root plants) was \$0.50 per plant, or \$72 total. It took me roughly 15-20 minutes to pick 144 plants, so harvesting is done fairly quickly. This project also showed growing strawberries using vertical towers is challenging. No strawberries were produced in six different plantings. Disease, nutrient management, insects, and daily monitoring of the hydroponic system are all difficult challenges to overcome. I do not recommend growers try growing strawberries in vertical towers.

## **CONTACT INFORMATION**

Chris Hilgert

Extension Horticulture Specialist and State Master Gardener Coordinator

Department 3354

1000 E University Ave

Laramie, WY 82071

[307.766.6870](tel:307.766.6870)

[www.uwyo.edu/mastergardener](http://www.uwyo.edu/mastergardener)

## PRESERVING WYOMING'S SPECIALTY CROPS SAFELY

### PROJECT SUMMARY

The overall purpose of this project focused on increasing knowledge and skills of home specialty crop food preservers in Wyoming and to prevent food borne illness as a result of improperly home canned foods. The project provided the printing of updated food preservation bulletins for statewide distribution via County Extension Offices. Canning and food preservation workshops which included research-based information on preserving Wyoming specialty crops. Instruction was provided to participants about high and low-acid foods, safe, reliable, research-based techniques and recipes for preserving fruits and vegetables which included specialty crops. The Nutrition and Food Safety Educators provided workshops, distributed bulletins, and answered questions statewide.

### PROJECT APPROACH

This project was highly valuable and timely as the previously published canning information was produced in 2007. With the rapid updates on information consumers should and do expect information provided by Extension Educators to be current, relevant and research-based. This project allowed a much needed update on information and recipes to be available to consumers. With the recent increase in specialty crop preservation the canning and food preservation workshops conducted by expert UW Nutrition and Food Safety Extension Educators the bulletins are a valuable resource for reliable, research-based techniques and recipes. For food safety, it is vital that research based specialty crop food preservation information and recipes are easily accessible for consumers. The overall goal is for Wyoming people to preserve specialty crops safely to feed their families. Participants have been recruited through media, social media, farmers' market groups, Master Gardeners, Cent\$ible Nutrition Programs, and advisory councils.



### GOALS AND OUTCOMES ACHIEVED

**Goal** –Increase the knowledge of home canners (solely specialty crops) by providing current, research-based bulletins and workshops to increase home canning skills and knowledge.

**Benchmark 1** – Level of knowledge of participants is unknown.

**Target** – We anticipate that at least 80 percent of approximately 200 participants will indicate that their knowledge has increased as a result of their participation in the workshops.

Performance Measure – At the UW Extension Nutrition and Food Safety preservation workshops the percentage of individuals who report an increase in knowledge will be measured through surveying participants at the end of each workshop about what they learned.

## OUTCOMES

Home canning presents potential for food spoilage and foodborne illness. An estimated one in five households in the U.S. practices home canning. This accounts for over 44,000 households across Wyoming. Unfortunately, a high percentage of home canners use unsafe practices that put households at high risk for food spoilage and foodborne illness. UW Extension Nutrition and Food Safety Initiative Team members use research-based canning methods to teach food preservation workshops to improve food preservation practices and reduce risk for food spoilage and foodborne illness. Workshop topics include water-bath and pressure canning, as well as freezing, dehydrating, and vegetable fermentation. A total of 990 individuals have participated in 39 workshops across Wyoming between 2014 and 2016. Class participants reported a behavior change in adopting food safety practices as a result of food preservation classes. Evaluations have shown 100% Knowledge gained and 100% Safe Practices Change. These behavior changes included properly venting when pressure canning (100%), correctly adjusting recipes for altitude (72%), and following tested recipes (77%). Additionally, 75% of participants indicated intentions to preserve more specialty crop fruits and vegetables at home as a result of this program – an important step toward increasing fruit and vegetable intake. Participant ratings for relevance of information, quality of instructors, and overall workshop quality averaged 3.8, 3.9, and 3.9 respectively, on a four-point scale (1=not satisfied, 2=somewhat satisfied, 3=satisfied, 4=very satisfied).

Extension Educators across the state have tested over 90 dial-gauge canners for accuracy and safety and have taught food preservation classes statewide. Nutrition and Food Safety Extension Educators have answered food preservation questions via personal contact, email, eXtension.com Ask-the-Expert, or telephone. Over 23 blogs, Facebook posts (*University of Wyoming Extension Nutrition and Food Safety*), and regional newsletter articles (*Horizons*) were written reaching a diverse population across Wyoming. Over 2040 “Preserving Food in Wyoming” bulletins and “Canners’ Corner” bulletins, containing research-based information and tested recipes, have been distributed statewide at County Fairs, County Extension Offices, and at Food Preservation workshops. A Local Foods Expo in Niobrara County had about 79 attendees. Nutrition and Food Safety educators have reported participating in at least 3 Food



Preservation webinars offered by Jarden Home Brands and the USDA Center for Home Food Preservation, UGA Extension. All seven University of Wyoming Nutrition and Food Safety Extension Educators participated in a two day, on-site Food Preservation Training, “Fundamentals of Consumer Food Safety and Preservation” provided by Edith McSherry from Colorado State University.

## BENEFICIARIES

Extension Educators across the state have tested over 76 dial-gauge canners, distributed accurate research-based food preservation information, and given 39 food preservation programs for a reported 990 individuals across the state. Educators reported having food preservation displays for an estimated 114 people. A reported 26 newspaper (Platte County Record Times), blog, and newsletter articles were written reaching at least 12,480 people and posted on Facebook. One radio program on Food Preservation reached an estimated 4,800 people in Platte County. Niobrara County hosted a Local Foods Expo, for about 79 people attending from Niobrara, Goshen and Converse Counties, Wyoming, and from Sioux County, Nebraska. In addition, educators have answered at least 214 food preservation questions via personal contact, email, eXtension.com Ask-the-Expert, or telephone.



## LESSONS LEARNED

In the *Safe and Nutritious Home Food Preservation* workshops, thorough hands-on experiences and classroom instruction on research-based home food preservation methods participants reported a 91% increase in knowledge related to the foods safely prepared at workshops. Additionally, the average increase in knowledge was over two points on a five-point scale. This represented an increase from low/moderate knowledge prior to the workshop to high/very high knowledge following participation in and completion of the workshop.

## CONTACT INFORMATION

Julie Balzan, MS, NBCT  
Nutrition and Food Safety Educator  
57 Antelope Gap Road, Wheatland, WY 82201  
[\(307\)322-3667](tel:(307)322-3667)  
[jbalkan@uwyo.edu](mailto:jbalkan@uwyo.edu)

# EVALUATION OF KINWA (QUINOA) AS A LEAFY GREEN CROP FOR ADAPTION TO WYOMING

## PROJECT SUMMARY

The purpose of this project is to evaluate kinwa to improve producers' knowledge on this specialty crop for leafy green production, learn whether the crop can be grown for its full growth potential in Wyoming, and finally to develop best production and management strategies for producers. There is an increasing interest to learn and grow quinoa crop (*Chenopodium* spp.) in recent years, especially in Southeast Wyoming. However, there is a risk associated with this desire because of production cost (high seed price for crop establishment) and lack of knowledge of adaptation, production, and management options. Investigations indicated that there was limited information available on kinwa's growth, yield, cultivars, cultivation, and management practices for leafy green production in Wyoming. This project investigated available cultivars of quinoa in Wyoming's environments for leafy green production. Six available cultivars of quinoa were evaluated in replicated small plots at two locations: the James C. Hageman Sustainable Agriculture Research and Extension Center near Lingle and the Laramie Research and Extension Center in Laramie. Both studies were under irrigated conditions. Data on growth, production, duration, and management was collected, processed, and analyzed. Results from the study showed minimal differences in growth among cultivars but large differences between locations. Most of the cultivars performed very well indicating their ability to grow and superior performance in Wyoming conditions. The project generated important information on production and management of quinoa crop for leafy green production which will be particularly useful for producers in Wyoming who are interested in growing specialty crops.

## PROJECT APPROACH

In 2014, six available cultivars (Cherry Vanilla, Mint Vanilla, Red Head, Oro de Velle, Brightest Brilliant Rainbow, and French Vanilla) were selected. Two locations were selected for conducting the study: James C. Hageman Sustainable Agriculture Research and Extension Center near Lingle and Laramie Research and Extension Center in Laramie. A weed free firm seedbed was prepared at both locations under irrigated conditions. All selected cultivars of quinoa were planted at both locations in four replicated small plots. The study was laid out as a randomized complete block design. Seeds of all cultivars were planted on May 21, 2014 at Laramie and May 28, 2014 at Lingle. Data collection included germination, plant vigor (e.g., branching), plant density, plant height, and fresh and dry matter yields.

In 2015, same six cultivars were planted at both locations (Lingle and Laramie) following the same procedures as in 2014. The study was planted on May 18 at Laramie and June 3 at Lingle. Data collection and processes were same as in 2014.

The study was repeated in 2016. The planting was conducted on May 5 at Laramie and May 6 at Lingle. Same methods and procedures as in 2014 and 2015 were used.

## GOALS AND OUTCOMES ACHIEVED

**Goal 1** - The overall goals of this project is to evaluate kinwa to improve producer's knowledge on this specialty crop for leafy green production, learn whether the crop can be grown for its full growth potential in Wyoming, and finally to develop best production and management strategies for producers.

**Benchmark** – Very little knowledge available for leafy green kinwa production in Wyoming.

**Target** - Develop kinwa's best production and management options for leafy green production and disseminate this information to the producers.

**Performance Measure** - The intension of this project is to measure vegetative production potential. Germination, growth, and leafy green yield will be measured at two locations and compared. The results will also be published in appropriate journal and extension bulletin.

**Goal 2** - Disseminating information on leafy green kinwa production will further enhance producers to adopt the kinwa crop.

**Benchmark** - Two producers are presently experimenting with Kinwa in Wyoming.

**Target** – Increase the knowledge of 75% of respondents surveyed post conferences on kinwa leafy green production.

**Performance Measure** - The findings will be presented to conferences/producer meetings and participants will be surveyed on level of knowledge before and after the presentations to measure increased knowledge.

### Goal 1

The goals of this study were to improve our knowledge on the specialty crop, quinoa for leafy green production; learn in depth whether this crop can be grown for its full growth commercially as a leafy green crop in Wyoming environments; and develop best management strategies for adaptation and production in Wyoming.

### Outcome 1:

*In 2014:* Data showed that there were no differences in germination, growth (e.g., fresh and dry matter yields), and nutritive values among different cultivars of quinoa (Tables 1 and 2).

However, planting time and location affected vegetative growth and yield of quinoa cultivars (Tables 1 and 2).

Plot demonstrations and preliminary data were presented at the Lingle and Laramie Agricultural Experiment Station (AES) Field Days. In addition, data was presented at the Specialty Crop Workshop in Wheatland on November 1, 2014.

*In 2015:* Similar results as in 2014 were also observed in 2015 supporting the findings of 2014 at both locations (Figure 1; Table 3). At Lingle, Red Head produced the greatest dry matter yield while at Laramie, Mint Vanilla produced the greatest dry matter yield. Overall, Lingle location produced greater dry matter yields than Laramie clearly suggesting the effect of location on quinoa growth. Nutritive values did not differ among the cultivars except crude protein content at Lingle indicating their (cultivars) superior quality (Table 3).

The study and results were demonstrated at the Lingle and Laramie AES field days. Over 100 people attended in the field and plot demonstrations at both locations. Compared to previous year (2014), people knowledge on quinoa increased more than 80%. Many people visited for the second time and when the question was asked “How many of you know about quinoa?” More than 80% people answered that they knew quinoa and they were interested to know more about production methods and agronomic management practices. It is expected that the results will be disseminated more via these attendees to their neighbors and other producers, especially specialty crop growers.

*In 2016:* Growth and yield of quinoa were similar but lesser than in 2014 and 2015. Quinoa plants were severely damaged by hailstorm in July at Lingle and also by rabbit grazing at Laramie. Some plants started to recover, however the growth was significantly reduced (Figure 2).

Outcome 2 the study was demonstrated at the Lingle and Laramie AES field days and the results were published in the field day bulletin of AES. A poster was prepared and presented at the field days of AES at Laramie and Lingle. In addition, the PI was invited and gave two concurrent presentations on quinoa results at the Master Gardener/Farmers Market State Conference which was organized by Wyoming Master Gardener Association and Wyoming Farmers Market Association and held on March 31-April 2, 2016 in Riverton. This created further opportunities to disseminate results obtained in this study to directly to Master Gardeners and producers who are specifically interested in Specialty Crop Production and Management.

**Table 1. Germination and growth response of quinoa cultivars to locations (Laramie and Lingle), 2014**

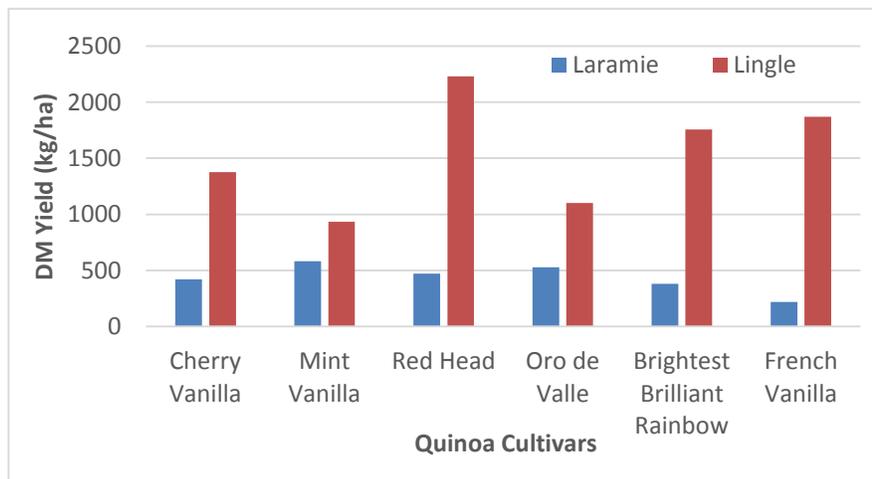
<b>Laramie</b>									
<b>Cultivar</b>	<b>Germination (%)</b>	<b>Plant height (cm)</b>	<b>Branches/plant (number)</b>	<b>Density/plot (number)</b>	<b>Flower (%)</b>	<b>Fresh weight/plant (g)</b>	<b>Dry weight/plant (g)</b>	<b>Fresh yield (kg ha<sup>-1</sup>)</b>	<b>Dry yield (kg ha<sup>-1</sup>)</b>
Cherry Vanilla	95	113	10	87	84	161	34	17313	3756
Mint Vanilla	98	111	7	73	81	149	33	15026	3397
Red Head	93	114	8	83	80	118	26	11287	2529
Oro de Valle	99	112	12	20	86	175	34	4376	859
Brightest Brilliant Rainbow	98	113	8	64	85	153	32	11510	2362
French Vanilla	93	114	10	78	84	175	33	15891	3008
<b>P-value</b>	0.39	1.00	0.72	0.09	0.08	0.41	0.85	0.45	0.50
<b>LSD(0.05)</b>	NS	22.70	0.73	10.14	4.43	63.25	14.97	NS	NS
<b>Lingle</b>									
<b>Cultivar</b>	<b>Germination (%)</b>	<b>Plant height (cm)</b>	<b>Branches/plant (number)</b>	<b>Density/plot (number)</b>	<b>Flower (%)</b>	<b>Fresh weight/plant (g)</b>	<b>Dry weight/plant (g)</b>	<b>Fresh yield (kg ha<sup>-1</sup>)</b>	<b>Dry yield (kg ha<sup>-1</sup>)</b>
Cherry Vanilla	32	105	18	33	84	254	46	9807	1796
Mint Vanilla	23	98	18	26	83	219	37	6839	1160
Red Head	25	103	16	31	78	191	32	7025	1186
Oro de Valle	39	112	21	13	81	224	42	3970	761
Brightest Brilliant Rainbow	25	108	20	22	79	241	40	6720	1131
French Vanilla	28	111	20	31	80	222	40	8474	1547
<b>P-value</b>	0.35	0.52	0.68	0.09	0.77	0.41	0.03	0.09	0.08
<b>LSD(0.05)</b>	NS	17.40	0.79	1.28	10.17	64.09	7.68	NS	NS

**Table 2. Nutritive values of quinoa cultivars in Laramie and Lingle, 2014**

<b>Laramie</b>				
Cultivar	CP	ADF	NDF	TDN
	<b>g kg<sup>-1</sup></b>			
Cherry Vanilla	129	186	262	685
Mint Vanilla	118	183	259	688
Red Head	107	186	261	686
Oro de Valle	138	180	248	690
Brightest Brilliant Rainbow	116	184	255	687
French Vanilla	126	196	267	678
<b>P-value</b>	0.76	0.83	0.92	0.83
<b>LSD(0.05)</b>	48	27	39	21
<b>Lingle</b>				
Cultivar	CP	ADF	NDF	TDN
	<b>g kg<sup>-1</sup></b>			
Cherry Vanilla	287	165	220	702
Mint Vanilla	285	160	221	706
Red Head	290	158	213	708
Oro de Valle	283	161	226	705
Brightest Brilliant Rainbow	282	169	240	699
French Vanilla	282	177	257	693
<b>P-value</b>	0.60	0.62	0.05	0.62
<b>LSD(0.05)</b>	12	26	28	21

protein; ADF = Acid Detergent Fiber; NDF = Neutral Detergent Fiber; TDN = Total Digestible Nutrient

**Figure 1. Dry matter (DM) yield of quinoa cultivars at Laramie and Lingle, 2015**



Cultivars	Laramie				Lingle			
	CP	ADF	NDF	Lignin	CP	ADF	NDF	Lignin
	-----g kg <sup>-1</sup> ----- -----							
Cherry Vanilla	259	210	288	83	241 a	291	352	103
Mint Vanilla	231	220	307	80	240 ab	287	347	102
Red Head	253	214	298	81	237 ab	289	349	101
Oro de Valle	234	214	301	80	237 ab	300	359	104
Brightest Brilliant Rainbow	218	237	327	83	229 bc	308	365	103
French Vanilla	221	228	319	82	223 c	314	370	104
<b>Mean</b>	<b>236</b>	<b>220</b>	<b>307</b>	<b>82</b>	<b>235</b>	<b>298</b>	<b>357</b>	<b>103</b>
<b>LSD (0.05)</b>	48	39	41	8	12	31	30	3
<b>Significance</b>	NS	NS	NS	NS	*	NS	NS	NS

CP = Crude protein; ADF = Acid Detergent Fiber; NDF = Neutral Detergent Fiber; NS = Not significant; \*significant at  $P < 0.05$ .



**Figure 2.** Quinoa plots at Lingle: left, before hailstorm (7/1/2016); right, after hailstorm (8/1/2016).

## **BENEFICIARIES**

The benefits and beneficiaries of the project are large and variable. The project outcomes benefit producers, extension educators, stakeholders, students, master gardeners, and researchers. Findings of the study have been demonstrated at the UW AES field days, specialty crop workshops, Master Gardener/Farmers Market State Conference, scientific meetings (locally and nationally), and classroom teaching at the University of Wyoming. Over 250 growers/producers from three field days came into close contact with the quinoa project and improved their current knowledge on quinoa and their production systems. Increase in knowledge averaged 100%. Producers were starting with no knowledge of how to grow quinoa as it a crop they were not familiar working with. After workshops, conferences, and meetings, many emails and phone calls were received requesting quinoa seeds and management options. Several producers received seeds from the PI and planted quinoa in their local production systems. These all growers are beneficiaries of this study. Results from this study also benefited several Master Gardeners statewide. In addition, the results of the study will be distributed through future events such as during specialty crop seminars/workshops and Master Gardener/Farmers Market State Conference. In general, attendance of these conferences is 125-150 producers and master gardeners. This project provided valuable trainings and demonstrations that benefit farmers and extension educators for production and management of quinoa crop for leafy green production. The information generated through this project will continue to be useful for producers in Wyoming, and perhaps in neighboring states, who are interested in growing specialty crops.

## **LESSONS LEARNED**

Overall, results of the study showed minimal differences in growth, yield, and quality among quinoa cultivars but large differences between locations. Most of the cultivars performed very well and demonstrated their ability to grow in Wyoming conditions. The project generated important information on production and agronomic management of quinoa crop for leafy green production which will be useful for producers in Wyoming and perhaps, in neighboring states.

## **CONTACT INFORMATION**

### **Anowar Islam**

Associate Professor

Department of Plant Sciences

University of Wyoming

307 766-4151

E-mail: [mislam@uwyo.edu](mailto:mislam@uwyo.edu)

# ALLEVIATING GRAPEVINE COLD DAMAGE IN WYOMING VINEYARDS

## PROJECT SUMMARY

The purpose of the project is to evaluate the incidence of grapevine cold damage in Wyoming vineyards and develop canopy management practices for alleviating freezing temperature stress, resulting in improved vine health and productivity. Area under grape production in Wyoming is rapidly increasing as producers seek alternate crops to diversify farm operations. Grapevine cold injury and damage caused by freezing temperatures is a major factor affecting vine survival, establishment and productivity. Although several grape cultivars sustain freezing temperatures, their cold-hardiness is influenced by a number of canopy management practices. Preliminary studies on incidence of grapevine cold-induced damage in Wyoming vineyards reveal that most cultivars suffer from compound bud injury upwards of 50%. We will estimate cold damage to grapevine canes and compound buds in vineyards from eight WY locations. A correlation will be established between extent of cold damage and cultivar, training/trellis system used and pruning techniques adopted, to identify key factors contributing to vine low-temperature response. Finally, we will study the influence of high wire cordon, vertical shoot positioning and Geneva double cordon training systems along with cane or spur pruning on cold-hardiness, growth and yield of 4 wine-grape cultivars. The project comes at a time when a nascent Wyoming grape industry is seeking to expand and will assist growers in making informed decisions on selecting the most appropriate canopy management system for maximizing vineyard yield and productivity.

## PROJECT APPROACH

### A. Collection of cane samples from test locations

We collected dormant cane samples of mature grapevines (7 years and older) from Casper, Powell, Huntley, Cheyenne, Lovell, Sheridan, Worland and Wheatland. Samples were stored at 4°C during the analysis period. A population size of 100 compound buds were selected from each cultivar/location sampled. The cane samples were allowed to thaw for 24 hours following which cross sectional cuts were made to each compound bud with a sharp scalpel, for exposing the primary, secondary and tertiary buds. The numbers of live and dead buds was estimated based on observed tissue color. Green-colored tissues indicated live buds (Figure 1a), while buds suffering from cold damage were characterized by severe tissue browning (Figure 1b). Percent damage to dormant buds was calculated to estimate winter injury on dormant canes. Data on cold-damage to compound buds was also determined by the incubation technique (Figure 1c). In this case single node cuttings were inserted in a styrofoam holder and incubated in a water bath at 30°C for four weeks. The number of cuttings exhibiting growth of compound buds for each cultivar was recorded to calculate the percent cold-

damage observed in each cultivar. Greenhouse-grown grapevines were used as positive controls in each analyses technique to confirm the validity of data collection. During the year 2014, the state experienced an unseasonal freeze on September 11, 2014 which caused severe damage in vineyards and close to 100% bud mortality in the sample collection for that season.

### **B. Planting grapevines at test locations**

i. Trenches were dug and filled with compost in the year prior to planting grapevines. Soil samples were taken and analyzed for pH, EC and other soil characteristics.

Four cultivars, Elvira, Frontenac, La Crescent and Marquette were planted in four rows (18 plants each row) with four replicates in Sheridan at a spacing of 10 feet 5 feet at the Sheridan. The vines were planted in 30 cm deep holes that were filled with compost and supplemented with 50 g 19:6:12 Osmocote fertilizer. Grapevines maintained in the greenhouse were planted at the field site in June 2014. Air temperature probes were installed at eight locations in the vineyard to measure air temperature (Figure 2).

ii. Trellis system installation:

High wire, vertical shoot positioning (VSP) and Geneva double curtain systems were established for the test locations. For the VSP, two pair of catch wires were installed at 2 feet and 4 feet locations to tuck any upright growth of vines. For GDC, cross frames were established at either ends and the middle of each row to support trellis wires. Since the top growth for 2014 and 15 was completely killed due to hard freeze events (polar vortex of 2013-14 and the Sept 11 freeze of 2014), we could not establish any top growth. Vine vigor was not sufficient enough for the GDC system and this was discontinued in 2016.

ii. Growth parameters:

Bud swell (%), and bud burst was recorded to estimate spring frost susceptibility and the percentage of live vines following the winter season. Pruning weights were recorded after bud break was observed to estimate for winter damage/ injury. Pruning weights for year 2014 and 2015 could not be used for any data analyses since the top growth got completely killed due to freeze events.

iii. Flowering and fruiting parameters:

Flowering and fruiting was discouraged in in 2014 to allow for vine establishment. We planned on allowing grapevines to bear flower and fruit starting year 2. Excellent vine growth and development was observed until September 11, 2014 when the state (including test sites at Sheridan and Powell) experienced a snowstorm and received up to 8 inches of snow. The temperatures in the subsequent two days dipped to 18°F killing of all top growth. All top growth (that would cause flowering and fruiting in 2015) was killed during this snowstorm. This was evidenced by subsequent growth that occurred in 2015 where the above ground portions of vines were completely dead and growth occurred exclusively from the crown region of grapevines. Thus there was no flowering and fruiting observed in 2015 as vines had

to be retrained from the ground level upwards. To build grapevine structure we removed all flowers in 2016 so that grapevines could allocate photosynthates for improving vine health and cold-hardiness. We plan to record flowering and fruiting parameters for 2017 and onwards provided we do not observe severe freezing damage during the 2016-17 winter season.

## GOALS AND OUTCOMES ACHIEVED

**Goal** - Analyze cold injury to grapevine cordons, canes and compound buds in vineyards at eight locations statewide and correlate observed cold injury with vineyard location and existing canopy management practices.

**Benchmark** - Assessing compound bud damage during dormancy is the most practical way to gain valuable information on the number of buds to retain following pruning for sustaining vineyard productivity.

**Target** - We will collect grapevine cane samples from vineyards in Basin, Huntley, Lovell, Powell, Riverton, Sheridan, Wheatland and Worland, and analyze compound bud samples for freeze-induced injury.

**Performance measure** - Ability of current grape growers (20-25) to rapidly estimate on site, cold damage to vines following the dormant season and make informed decisions on timing & extent of pruning after a hard freeze event.

**Goal** - Study the influence of grapevine training and pruning systems on mitigating cold injury and maximizing productivity in wine-grape cultivars 'Elvira', 'Frontenac', 'Lacrosse' and 'Marquette'.

**Benchmark** - Grapevine canopy management practices have a significant influence on vine growth, flowering, fruit development and ripening. The choice of training/trellis and pruning systems influences sunlight exposure of vines, canopy and vine cropping levels, which ultimately contributes to vine hardiness during periods of dormancy. The genetic potential of cold hardy grapevine cultivars can be fully realized with the adoption of appropriate canopy management practices.

**Target** - We will study/identify appropriate training/trellis & pruning systems for grapevines under Wyoming conditions.

**Performance Measure** – Adoption of improved canopy management practices by grape growers in Wyoming leading to improved vine health, vineyard productivity and early returns. Another important outcomes includes the generation of information on efficient canopy management that can be used by members of the Wyoming Grape and Wine Association (75 members) and homeowners with backyard plantings.

### **Outcomes:**

Data on grapevine winter injury estimates freeze-induced damage cold in the range of 15-70% for various grape cultivars (Table 1). This can be attributed to a number of factors including high soil pH that limits nutrient availability, insufficient water for irrigation during the growing

season, inadequate canopy management practices and temperature fluctuations late in the season that result in poor wood hardening and winter acclimation. We also observed differences in cold damage injury for the same cultivar at different locations (Figure 3, Figure 4). For instance, cold damage to LaCrescent was higher in Powell and Worland compared to grapevines grown in Wheatland. This might be explained due to the growing conditions (Powell and Worland being drier during the winter season) compared to Wheatland. We will continue to collect cold damage data from several locations to establish a consistent correlation between cultivar and macroclimate. This should enable Wyoming growers choose the correct variety for their particular location. Among the various training systems studied for growing grapevines, the high wire cordon system which consists of training grapevines to the top wire appears to be most promising compared to VSP and GDC systems. It appears that the growing conditions in Wyoming do not permit sufficient vigor to enable training grapevines on trellis systems that support high growth and vigor. Additionally consistent cold damage observed to trunks makes it difficult to retrain grapevines on extremely vigorous systems.

Table 1.

**Table 1. Cold-damage observed in compound buds of grapevine cultivars at various locations in Wyoming.**

Location/Variety	Compound Bud damage (%)		
	Primary	Secondary	Tertiary
<b>Powell</b>			
Troubador	66	28	26
Sabrevois	98	65	58
St. Croix	66	54	48
LaCrescent	69	35	22
Prairie Star	58	31	25
Frontenac	34	13	13
DM 95-6	56	26	20
<b>Worland</b>			
Valiant	100	96	91
Frontenac Gris	78	37	38
Marquette	88	74	63
LaCrescent	87	56	46
<b>Casper</b>			
Marquette	54	45	38
<b>Wheatland</b>			
Valiant	56	44	43
Frontenac	32	15	18

LaCrescent	38	26	20
<b>Sheridan</b>			
Marquette	58	39	21

Figure 1. Analyzing cold damage in Wyoming vineyards. Cold damage estimation was carried out by slicing compound buds and visually observing for bud damage. Brown tissues indicate dead buds (A) while green tissues indicate live buds (B).

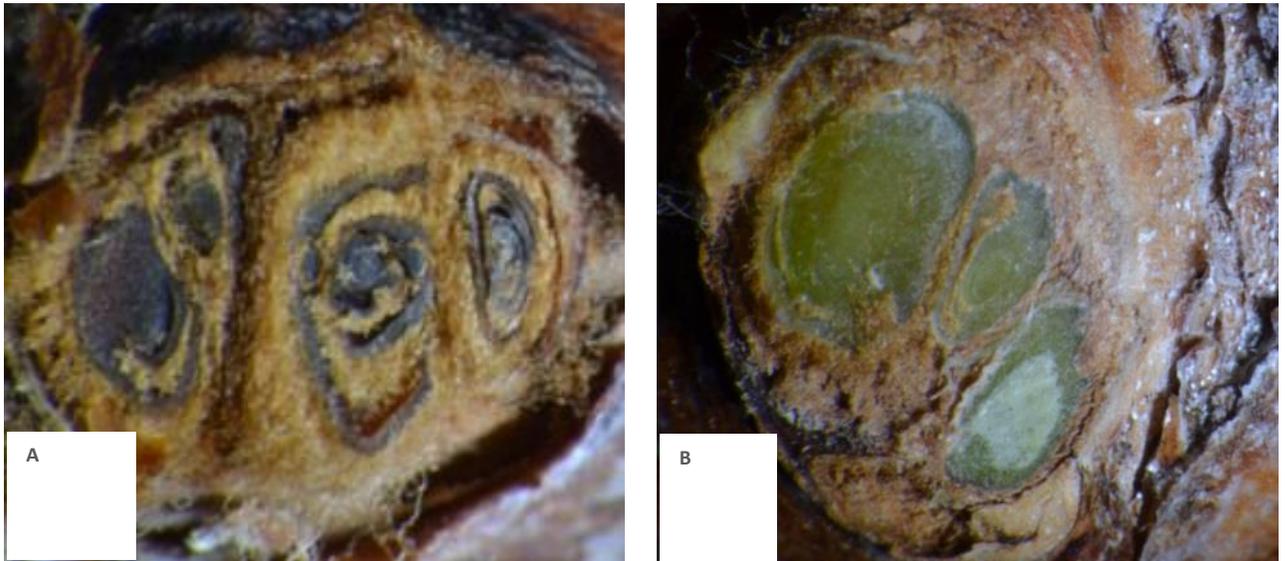


Figure 2. Installation of HOBO data loggers in the vineyard for monitoring air temperature



Figure 3. Differences in cold-hardiness of LaCrescent cultivar at various locations in Wyoming.

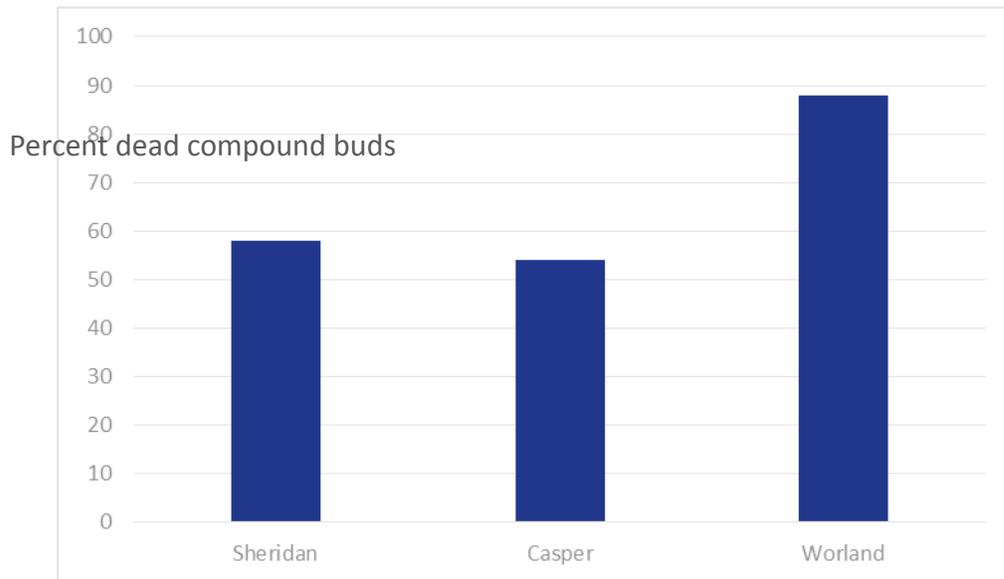
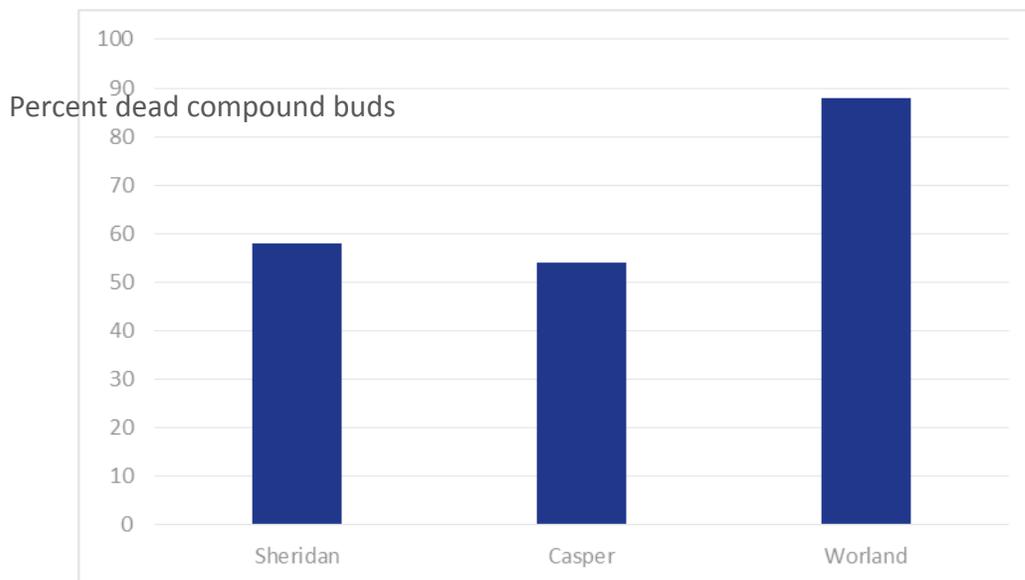


Figure 4. Difference in cold-hardiness of Marquette cultivar across three locations in Wyoming.



A survey to estimate increase in grower knowledge revealed an average 73.6% increase in grower knowledge after conducting the grape production and vineyard management presentations and workshops. Information on grape growing was provided to 640 people at various presentations. Based on survey feedback obtained from prospective growers, we expect to see an increase of 8-10 acres in grape production in Wyoming.

## **BENEFICIARIES**

Presentations were made to increase the awareness on grape production at the following locations for updating grape growers and interested homeowners in research activities being carried out for expanding viticulture activities in Wyoming. Talks were presented at the Master gardeners conference in Sheridan (March 2014 – 50 people). A presentation was made to the Sheridan county master gardeners in April 2015 (15 people). A grape production workshop was conducted in Powell in May 2015 (30 people) to provide information on the use of the right training and pruning systems for cold-hardy grapevine cultivars.

Approximately 30 growers/homeowners were trained on correct techniques for sampling canes in the vineyard, dissecting compound buds and detecting cold damage and subsequently adjusting pruning formulas to account for cold damage in the vineyard.

Presentations and visits were carried out at the annual field days in Sheridan (280 people over 3 years) and Powell for years 2014, 2015 and 2016 (200 people over 3 years). A presentation was also made at the UW Extension ESCAPE conference (50 people). A number of prospective and current grape growers visited the vineyard and obtained information on suitable cultivars and vineyard establishment procedures during (2014,2015,and 2016).

Information to several growers and homeowners was also provided via phone consultations. Thus stakeholders statewide were benefitted from research activities. Beneficiaries of the project included current and prospective grape growers, homeowners and college students. Prospective growers (14) who requested information for growing grapes were provided information on site selection, soil and water analysis, varietal selection, sources for purchasing grapevines and grapevine management practices. Information was also provided to 9 current grape growers.

## **LESSONS LEARNED**

Climatic conditions vary widely from year to year in Wyoming. A freeze in October 2013 prevented proper grapevine acclimation. This followed by the polar vortex caused a delay in bud break and vine establishment in 2014. An early freeze in September 2014 caused a significant delay in vineyard establishment. The key to successful grapevine establishment in various regions of Wyoming depends on the screening and identification of early season cultivars that will mature and ripen prior to the fall frosts/freezes. There appears to be a significant cultivar X location interaction that will necessitate studying additional cultivars in specific regions for cold damage. The severe fluctuations in weather conditions observed make the acclimation process of grapevines difficult. Another important lesson learnt was to delay pruning as much as possible until the danger of the last freeze was over. This date ranged from May 1-10 across various vineyards in Wyoming. Thus recommended dates for pruning grapevines in Wyoming can be made from May 1-10. The key to successful vineyard

establishment will lie in the ability to select early maturing grapevine cultivars that will acclimate rapidly and be cold-hardy to sustain freezing temperatures in Wyoming combined with canopy management practices that will mitigate any freeze-induced damage that occurs in vineyards.

## **CONTACT INFORMATION**

Sadanand A. Dhekney

Sheridan Research and Extension Center, 3401 Coffeen Avenue, Sheridan WY 82801

Ph: 307-673-2754, Email: [sdhekney@uwyo.edu](mailto:sdhekney@uwyo.edu)

# LOCAL FOOD PRODUCTION: HIGH VS LOW TUNNELS FOR VEGGIES AND HERBS

## PROJECT SUMMARY

The purpose of this project was to evaluate 3 different extended season production systems for specialty crops. Vegetable and herb production in Wyoming is a relatively small industry; most of the fresh vegetables and herbs consumed are produced outside the state, or imported from other countries. Therefore, fresh, locally produced vegetables and herbs are less available for the Wyoming residents relative to the availability of fresh vegetables and herbs in the other states. Some of the reasons for the limited fresh vegetable and herb production in Wyoming are the relatively shorter growing season, high altitude, and lack of small homeowner tradition and knowledge/training on season extension for these crops. However, stand-alone low tunnels and low tunnels within high tunnels production systems have not been researched or utilized in Wyoming. Therefore, the broader issue of limited fresh vegetable and herb production and the related issue of lack of knowledge and training on the utilization of stand-alone low tunnels and low tunnels within high tunnels will be addressed by this project. In addition, the results from this project were communicated to the current and potential specialty crops producers and homeowners. Wyoming growers and home owners are interested in small-scale extended season production, both conventional and organic. Such small-scale production could meet family needs for fresh vegetables and fruits. The project is expected to improve access of Wyoming residents to locally produced nutritious food and fresh produce. This will be achieved through research, demonstration, and training of Wyoming producers, homeowners, and Sheridan College/UW students on small scale extended season production of vegetables and fruits. The specific objectives are:

- (1) Comparison of three extended season production systems: high tunnel (HT), low tunnel (LT), and low tunnel within the high tunnel (LTwHT) for:
- (2) Optimization of transplanting time for selected vegetables and herbs for early spring and
- (3) Education and training of Sheridan College and UW students.

## PROJECT APPROACH

### **1. Evaluation of herbs and vegetables under high tunnel, low tunnel and field conditions**

ClearSpan TM Economy Round Style High Tunnel materials were purchased from FarmTek (Dyersville, IA). The high tunnel was constructed according to the guidelines provided by FarmTek. The rafters were spaced at 1.8 m intervals. The width, height, and length of the high tunnel were 6 m, 3.6 m, and 22 m, respectively. Low tunnels were prepared using 1.54 m width, 92% light transmission SunMaster® Pull and Cut Greenhouse Film and Galvanized Premium Row

Cover Hoops (1.89 m wide × 0.91 m high) purchased from Growers Supply, Dyersville, Iowa. Four raised beds were prepared inside the high tunnel (Ht), and two raised beds were prepared outside the Ht. Each raised bed was divided into subplots; subplots were 1.5 m long and 0.91 m wide. The three different extended sea-son production systems compared in this experiment were (i) high tunnel (Ht), (ii) low tunnel (Lt), and (iii) low tunnel within high tunnel (LtHt) (Shiwakoti et al. 2016). Four herb species, oregano, spearmint, rosemary and thyme were planted in the high and low tunnel treatment and under field conditions in year 2014. Vegetables planted included dill, spinach, bak choy, carrot and radish. Herbs and vegetables could be harvested in the high tunnel until the middle of November. Seedlings for tomatoes, beans, hot pepper and cucumber were started on March 15 in a greenhouse. The beds in the low and high tunnels were infested with weeds. The plastic mulch was also degraded. Hence, the land was prepared again, beds were pulled and plastic mulch was re-laid. The seedlings were planted at the test site on May 29. A student worker was interviewed and hired to work on the project. Greenhouse grown seedlings established well in the high tunnel, low tunnels and under outdoor field conditions (Figure 1; 2; 3; 4). Soil temperature probes and soil tensiometers were recorded for each treatment. Similar results were observed in year 2015 and 2016 in the high and low tunnels. Vegetables harvested from the project were served at the field days meal. Information was provided to field day attendees, arrangements were made to interested parties who wanted to visit the field site.

## GOALS AND OUTCOMES ACHIEVED

As expected, temperatures inside the low tunnel and high tunnel treatments were higher than the temperatures for the field treatment. As a result, more favorable growing environment for the herbs was noticed when the temperatures significantly dipped in the fall season. Since minimum daily temperatures were higher in the low and high tunnel treatments, the cropping season could be significantly extended for all herbs (November) compared to open field treatments which experienced the first frost in September. Two harvests could be obtained during the fall season ds even when the outside temperature falls below freezing point by using such season extension methods. Significantly higher yields were observed from the low tunnel and high tunnel treatments compared to the field conditions (Figure 5; Shiwakoti et al. 2016). The oxygen radical absorbance capacity (ORAC) analysis, which is a measure of antioxidant capacity of herbs revealed that the antioxidant capacity of herbs grown in the low tunnel and high tunnel were significantly higher in the second harvest compared to the first harvest. This might be possible due to the abiotic stress imposed on herbs due to low fall temperatures.

*Note: Since the original PI Valtcho Zheljzkov left the University of Wyoming during the period of the project to take up a new position at Oregon State University, the experiments with herb quality analyses could not be repeated. Vegetable seedlings had to be started in the greenhouse in March for transplanting in May. Fluctuations in temperature during April and May combined*

with a freeze in the second week of May necessitated planting in the final week of May. The growing season can be potentially extended by starting seedlings early in the greenhouse followed by planting in the high tunnel/low tunnel to promote early production. The broccoli and tomato plants exhibited extremely vigorous growth and were not suitable for low tunnel cultivation/production. Summer temperatures exceeded 90F under covers and bolting was observed in broccoli. Thus the low tunnel inside high tunnel treatment had to be modified where these treatments were included as part of the high tunnel treatment. Harvesting was initiated on July 6 and continued till October 30 in the high and low tunnel treatments. The plants growing under field conditions without any covers showed diminished production since September and harvesting in this treatment was terminated at the end of September. During year 2, a higher yield in all vegetables was obtained under low and high tunnel treatments compared to field conditions (Table 2). During year 3 however, yields in the open field treatments were much higher than those in the high tunnel and low tunnel treatments (Table 3). This might be possible due to two reasons. i) Temperatures in the low and high tunnel treatments were significantly higher than open field conditions, which may have caused poor pollination and flower abscission resulting in lower yields. Additionally, during the latter part of the fall season, the high tunnel cover was blown away by strong winds (Figure 6), which caused significant damage to crops in these treatments and terminated the growing season. Thus the year 3 data is not consistent with year 2 and no conclusions can be drawn based on this data. Vegetables harvested from the project were served at the field days meal. Information was provided to field day attendees, arrangements were made to interested parties who wanted to visit the field site. Undergraduate students were hired and trained on the project for 3 years. Students were involved in seeding, transplanting, pest and disease management and harvesting of vegetables. Students were also trained to identify nutrient deficiency symptoms, physiological disorders in vegetable crops and signs of drought stress in plants to schedule irrigation of crops. Responses to a survey conducted to gauge interest in vegetable production and using protected cultivation indicated that 52% of the producers living on small acreages were engaged in some production of vegetable/specialty crops while only 16.5% of the current specialty producers utilized high tunnels for season extension of vegetables. Additional information from the survey revealed that 135 had plans on building high tunnels in the future and 282 were interested in information on growing vegetables in high tunnels for season extension. Based on the survey, we expect a 16% increase in the production of fresh vegetables and herbs on small acreages as a result of the project.

## **BENEFICIARIES**

Presentations and visits were carried out at the annual field days in Sheridan during 2014, 2015 and 2016 and information was provided to 280 people over 3 years. Poster presentations were made to demonstrate efficacy of plastic covers at the field days. Six undergraduate and 1

graduate students were trained to identify nutrient deficiency symptoms, water stress symptoms, any pests and diseases and physiological disorders. A booth was set up at the 2016 Farmers market in Sheridan, which was manned by students. Produce from the experiments were placed at the booth and information on growing vegetables under protected conditions were provided at the booth. Approximately 30 people visited the booth during each week (from July – August). Thus information on growing herbs and vegetables under protected conditions was provided to 240 people (homeowners and producers) during the farmers’ market season. The information was published in the University of Wyoming, Agricultural Experiment Station Field Days bulletin during 2014, 2015 and 2016. These bulletins have a statewide audience and are an effective way to disseminate producer-related information. A research publication titled “Growing spearmint, thyme, oregano and rosemary in Northern Wyoming using plastic tunnels” was also published in the journal *Industrial Crops and Products*, 2016, 94: 251-258. Based on the information provided, we expect current and future vegetable and herb growers to benefit from the project.

## LESSONS LEARNED

Fluctuating temperatures during the growing season may necessitate the adjustment of low and high tunnel covers to provide adequate ventilation and prevent flower desiccation and abscission, which might reduce yields. Fluctuating temperatures may also result in physiological disorders in crops such as tomatoes and broccoli. Thus the time of planting may need to be adjusted to account for the growth of these crops under favorable microclimates in low and high tunnels. Wind can be a serious problem in high tunnel and low tunnel production of crops. Wind damage was observed to high and low tunnel structures in 2015 and 2016. This might necessitate the use of smaller high tunnel structures. Use of wind breaks can also alleviate this problem.

Table 1. Effect of various treatments on essential oil yield (mg per 100g of herb) of various herbs

Treatment	Thyme	Spearmint	Oregano	Rosemary	Thyme	Spearmint	Oregano	Rosemary
	Summer season				Late Fall			
Low tunnel	267	762	329	825	431	391	133	NA
High tunnel	349	1002	558	758	460	349	181	NA
Low tunnel within high tunnel	393	842	547	1008	430	267	138	NA

From Shiwakoti et al. 2016

Table 2. Effect of various treatments on yield of vegetable crops grown during 2015

Treatment	Bean (kg)	Broccoli (kg)	Cucumber (kg)	Pepper (kg)	Tomato (kg)
-----------	-----------	---------------	---------------	-------------	-------------

Uncovered	1.5	3.1	36.5	5.6	47.5
Low Tunnel	5.0	3.0	73.1	10.2	59.5
High Tunnel	9.1	5.0	49.7	9.2	58.3

Table 3. Effect of various treatments on yield of vegetable crops grown during 2016

Treatment	Bean (kg)	Broccoli (kg)	Cucumber (kg)	Pepper (kg)	Tomato (kg)
Uncovered	4.2	0.6	32.3	4.5	37.0
High Tunnel	3.7	1.1	27.2	3.1	22.2

Figure 1. A view of the experimental plot    Figure 2. Vegetable production in the high tunnel



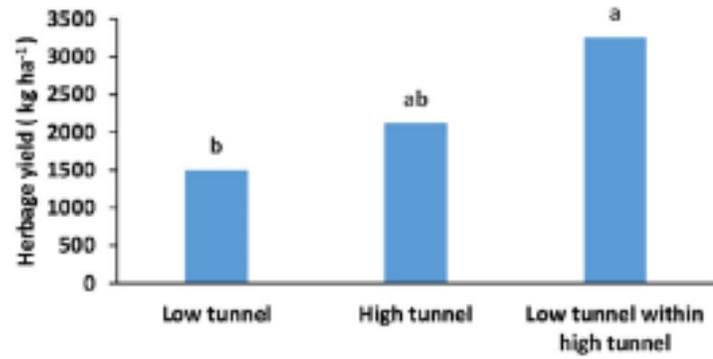
Figure 3. Low tunnel production of vegetables

Figure 4. Vegetable production under field conditions.

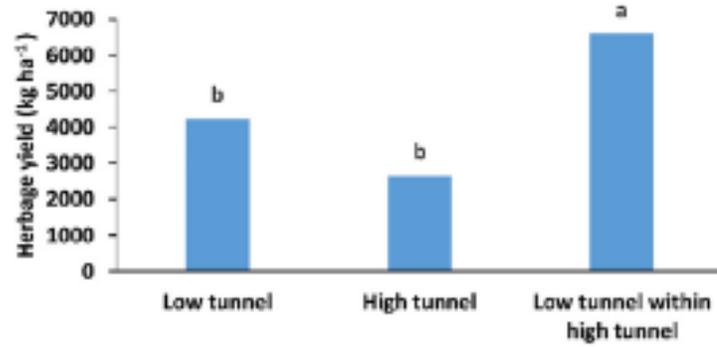


Figure 5. Effect of various treatments on yield of herbs grown in the 2014 season (From Shiwakoti et al. 2016)

### Thyme



### Spearmint



### Oregano

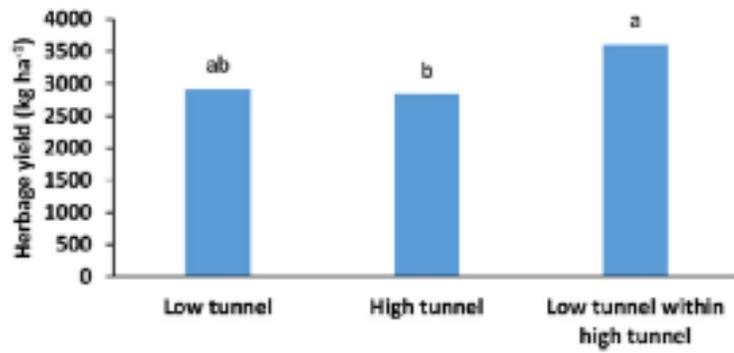


Figure 6. Wind damage to high tunnel in September resulted in early termination of the project.



## CONTACT INFORMATION

Sadanand A. Dhekney  
Sheridan Research and Extension Center  
3401 Coffeen Avenue, Sheridan WY 82801  
Ph: 307-673-2754, Email: [sdhekney@uwyo.edu](mailto:sdhekney@uwyo.edu)

# DETERMINING OPPORTUNITIES FOR EXPANDED SPECIALTY CROPS IN WYOMING

## PROJECT SUMMARY

The overall purpose of this research is to increase the knowledge of producers on potential opportunities to increase production of specialty crops in Southwestern Wyoming. Of specific interest is in the western counties of Lincoln and Sweetwater. These areas have almost no specialty crop production. An opportunity to access presently unused storage irrigation water exists. Land that is presently used for cattle and sheep grazing when irrigated would have the potential to grow specialty crops such as peas, beans or potatoes in a crop rotation strategy. Goal: to increase the knowledge of producers on potential opportunities to increase production of specialty crops in Southwestern Wyoming.

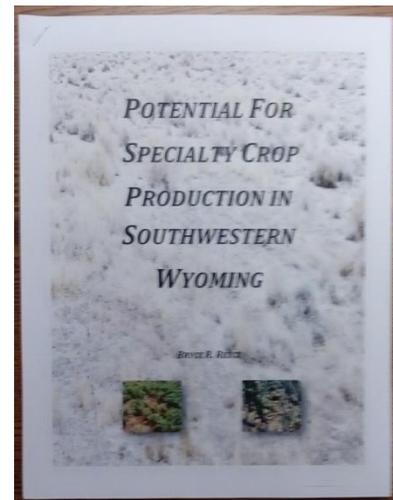
Benchmark: Not available.

Target: Increase the knowledge of 25% of southwestern producers in two counties by providing information on specialty crop expanded production opportunities.

Performance Measure: The research will increase the knowledge of the agricultural industry by identifying and disseminating findings on potential areas not presently incorporating specialty crops in their operations. After dissemination of findings, a survey will be conducted to determine the increase in knowledge of specialty crop production opportunities as well as any increase in specialty crop production in southwestern Wyoming.

## PROJECT APPROACH

A contractor was hired and performed background research to work with producers, agencies and other organizations to help develop a specialty crops industry expansion report for the south western region of Wyoming. The research contractor provided a written report on findings. Utilizing historical records of the state, a detailed analysis of the history of development of water for agricultural purposes was compiled. Analysis of the development of water storage projects and why they never reached completion in the area of the study area was researched and analyzed. A detailed analysis of a research farm that was instituted as part of the development of what was to be a major irrigation project by the Bureau of Reclamation in the 1950's and 1960's, but which was later abandoned, was conducted in order to understand what factors were involved and whether or not those



factors still existed and could affect the development of any new irrigated lands in the study area. A detailed review and compilation of environmental, climatic, soil and other factors required for crop production was completed. Following this analysis and using the findings developed from it, a number of specialty crops were analyzed to determine which of them might best have potential for development and production within the study area, should irrigated lands become available for production. Based upon this analysis, six specialty crops were identified as having potential for development and use on irrigated lands in this part of Wyoming. These specialty crops were: lavender, onions, woody ornamentals, landscaping/Christmas trees and shrubs and strawberries. The report was reviewed by UWYO personnel in order to provide independent feedback to the Department. The report was published in house and disseminated at relevant Wyoming producer conferences and placed on the WDA website.

## GOALS AND OUTCOMES ACHIEVED

**Goal** –to increase the knowledge of producers on potential opportunities to increase production of specialty crops in Southwestern Wyoming.

**Benchmark** – Not available.

**Target** – Increase the knowledge of 25% of southwestern producers in two counties by providing information on specialty crop expanded production opportunities.

**Performance Measure** – The research will increase the knowledge of the agricultural industry by identifying and disseminating findings on potential areas not presently incorporating specialty crops in their operations. After dissemination of findings, a survey will be conducted to determine the increase in knowledge of specialty crop production opportunities as well as any increase in specialty crop production in southwestern Wyoming.

**Outcomes of research:**

### **ALTERNATIVE CROP PRODUCTION IN WYOMING<sup>1</sup>:**

One alternative for increasing profit margins of the Wyoming agricultural industry is through the introduction of new crops. Wallis et al. (1989) defines new or alternative crops as either crops new to a particular county, region or state, or as a crop that has been, or is being developed, from a plant that has never been cultivated for commercial production. Alternative crops such as cabbage, mint, pumpkins, squash, and turf grass seed have been cultivated in Wyoming, but are most often marketed for local consumption rather than being commercially produced. Specialty crops, such as seed potatoes, could possibly be grown in some of the lower elevation areas of the Green River Basin. The Green River Basin will always have a competitive

---

<sup>1</sup> “Wyoming Offers Opportunities for Alternative Crops”; UW Barnyards to Backyards, Winter 2008; Dr. Karen Painter, University of Wyoming Cooperative Extension Service, Horticulture Specialist

disadvantage with respect to specialty crops compared to lower elevation areas such as Wyoming's Big Horn Basin or lower North Platte River Basin.

One of the myths about Wyoming is the climate is too harsh to grow many horticultural crops. Producers may not be able to grow much sweet corn, watermelon, okra, or other warm-season crops, but they can certainly raise cool-season plants. High levels of light and cool nights are conducive to growing all sorts of vegetables in many areas of the state. Radishes, lettuce, spinach, peas, beets, broccoli, cabbage, and even green onions can flourish in the state's generally short growing season. The vegetables can be cultivated in plastic-mulched rows using drip irrigation, but other methods are also used commercially. Grapes are grown in several counties including Sheridan and Goshen, and they can probably be produced in other warmer areas of Wyoming. Raspberries can thrive and maybe even strawberries at lower elevations. Other berries to consider include serviceberries, elderberries, currants, and gooseberries. These are perennial crops that will be in production for many years and so require some up-front planning and thought. They can be placed in rows or plots and all require manual harvesting.

Many culinary herbs can be grown with little fuss in Wyoming's climate. The easiest are those cultivated for their leaves – basil, chives, and mint for example. The toughest are those nurtured for their seeds (caraway, dill, anise, etc.). Usually, herbs are planted from seeds although transplants can be used. Planting in rows and using drip irrigation and mulch is common. Most herbs can be sold fresh at nearby farmers' markets. Many can be dried and preserved and then sold farther from the field. Annual herbs or non-winter perennials that can be raised include anise, basil, coriander (cilantro), dill, marjoram, oregano, rosemary, sage, and summer savory. Biennials, which need two growing seasons, include caraway and parsley. Perennials that will produce for several years include chives, mint, winter savory, tarragon, and thyme.

As a specialty within Wyoming, there are literally dozens of annual and perennial flowering crops that can be developed for fresh market sales or for drying and preserving. Usually reared in rows with drip irrigation and plastic mulch, specific varieties have been developed for this type of production. Most are grown from seeds. The producer can buy seeds and start them on their own or purchase seedlings and then transplant them outdoors. The list of possible plant materials is enormous. A few of the many annuals that can be grown in the field for cut flowers include ageratum (floss flower – fresh or dry), snapdragons (fresh), calendula (fresh), celosia (cockscomb – fresh or dry), gomphrena (globe amaranth – fresh or dry), lavatera (mallow – fresh), statice (fresh or dry), and poppies (fresh). Some perennials to try include yarrow (several species – fresh or dry), butterfly weed (fresh), delphinium (several species – fresh), goldenrod (several hybrids – fresh), speedwell (several species – fresh), and culver's root (fresh). All these perennials and dozens of others are hardy in Wyoming.

Woody plants can be grown in the field for a year or two and then sold to local consumers or at farmers' markets. This is a highly competitive area of but could provide niche types of plant materials resilient in Wyoming that may be hard to find otherwise. Most woody plants are brought in from huge nurseries in other states, and the plant material may or may not be acclimated to the state. There are many different methods of producing woody plants: in rows, in the ground, in containers, and in plots, as examples. There are also different ways to water them, including using overhead sprinklers or drip irrigation. Special planting methods used include grow bags or pots in other pots. Starter materials should be purchased with bare roots and then planted outdoors for continued growth. This type of specialty crop offers more long-term possibilities than others and requires planning far in advance.<sup>2</sup>

### **RESULTS: POTENTIAL SPECIALTY CROP PRODUCTION IN THE GREEN RIVER BASIN**

The determination of specific specialty crops that could be grown in the GRB in the area being considered for new irrigation development is difficult. With the wide range of variables that are involved in selecting alternative crops, coupled with the degree of uncertainty in some of these parameters within the potential development area, selection of specific crops is difficult.

Following a review of crop growth parameters of several dozen alternative crops, the following eight crops were selected for further review: Lavender, Potatoes, Onions, Woody Ornamentals, Landscaping/Christmas Trees, and Strawberries. These crops were analyzed using the following parameters; Optimum Temperature, Soil Attributes, Precipitation, Frost-free Season, Minimum Temperature and Maximum Temperature. The results of that analysis are found on the accompanying spreadsheet.

An assumption as regards perception was made given the fact that the purpose of the proposed water development in southwestern Wyoming is to deliver stored water from Fontenelle Reservoir to new lands to be placed under irrigation. Given the fact that if construction does proceed forward on the new development, water for irrigation purposes, at least initially, should not be a limiting factor. The precipitation parameter was used primarily to screen out crops that require exorbitant levels of precipitation or which require high levels of humidity in order to flourish. Since neither of these environmental variables are present in southwestern Wyoming, crops which might require such were automatically screened out. Under certain conditions, all of these eight crops have potential for production within the study area.

The two most limiting environmental factors in this area of southwestern Wyoming are limitations in soil types and the short growing season. Direct experience on the ground in this area to date, however, demonstrates that with supplemental sources of water, a wide variety of crops can be, and have been, produced.

---

<sup>2</sup> <sup>2</sup> "Wyoming Offers Opportunities for Alternative Crops"; UW Barnyards to Backyards, Winter 2008; Dr. Karen Painter, University of Wyoming Cooperative Extension Service, Horticulture Specialist

Based upon the soil morphology, climate and environmental parameters found in this area, these six crops should be further explored as potential alternative crops that could be utilized in this area of southwestern Wyoming.

<b>Common Name</b>	<b>Lavender</b>	<b>Potatoes</b>	<b>Onions</b>
<b>Scientific name</b>	<i>Lavendula augustifolia</i>	Varies by variety or subspecies	Varies by variety or subspecies
<b>NOTES:</b>			
<b>Optimal Temperature</b>	Varies by variety or subspecies	Varies by variety or subspecies	Varies by variety or subspecies
<b>Soil Attributes</b>	ideal soil is considered to consist of 45% mineral (sand, silt, and clay), 5% organic matter, and 50% pore space, prefers a light, well-drained, deep and not overly rich soil, will grow in a relatively wide pH range between 6.1 (mildly acidic) and 8.5 (alkaline) with a preferred range between 6.5 and 7.5,	Potatoes grow well with a wide variety of soils, and soil pH can be as low as 5.0, with best production between 5.5 and 6.8. Potatoes are less susceptible to scab when soil pH is between 5.0 and 5.5. Good water penetration and aeration are musts for proper growth and tuber formation. Excessive tillage and land preparation cause compaction and should be avoided, soil should	Soil pH is normally in the range of 6-7, but on organic soils, onions can be grown down to pH's of 4. When pH drops below 5.5, magnesium and molybdenum availability drops and above 6.5, zinc, manganese and iron become deficient. Soils need to be well structured and fertile to maximize growth and produce high yields. Soil should be firm, not loose, and well drained.

		be plowed below any compacted layer within the normal root zone, and then disk harrowed before planting. Spike-tooth harrowing to break up clods and level the soil may be needed just prior to planting.	Seedbed condition is critical, particularly if crops are being grown from seed. A fine, consolidated seed zone is required for maximum germination and good establishment. When grown on particularly light soils, inter-row guard crops of barley or wheat, or the use of straw helps minimize erosion. Clods and stones will hinder growth, herbicide efficiency and mechanical harvesting, so heavy or stony soils are usually avoided.
<b>Precipitation</b>	In Wyoming, will require irrigation.	In Wyoming, will require irrigation.	In Wyoming, will require irrigation.
<b>Frost-free Season</b>			90-110 days
<b>Minimum temp.</b>			20F
<b>Maximum Temp.</b>	unavailable or varies by subspecies or variety	unavailable or varies by subspecies or variety	unavailable or varies by subspecies or variety

<b>Common Name</b>	<b>Woody ornamentals</b>	<b>Landscaping/Christmas trees and shrubs</b>	<b>Strawberries</b>
<b>Scientific name</b>	Varies by variety or subspecies	Varies by variety or subspecies	<i>Fragaria</i>

<p><b>NOTES:</b></p>	<p>These are trees and shrubs whose branches are sold to florists and individuals for arrangements and craft products such as wreaths. Most types have colorful stems, odd stems or stems with attractive berries, buds or flowers. Species varies but can include willow, dogwood, aspen, sagebrush, some species of pine, etc.</p>	<p>Varies but can include: Balsam Fir, Douglas Fir, Blue Spruce, Crabapple, Hawthorn, Service Berry, Honey Locust, Poplar, Pine and Spruce</p>	
<p><b>Opt. Temp.</b></p>	<p>Varies by species, subspecies or variety</p>	<p>Varies by species, subspecies or variety</p>	<p>Varies by variety or subspecies</p>
<p><b>Soil Attributes</b></p>	<p>Varies by variety or subspecies</p>	<p>Varies by variety or subspecies</p>	<p>Well-drained soil at least 8 inches deep, slopes of 2 to 4 percent, high organic matter concentrations highly desirable, optimum soil pH between 5.0 and 7.0 (production possible on slightly alkaline soils). Light or sandy soils are suitable for commercial production when irrigation is</p>

			available and close attention is paid to nutritional (fertilizer) needs of the plant. Light soils are advantageous because they (1) warm up earlier in the spring than heavier soil types; (2) drain well, and (3) have fewer root disease problems than heavy soils.
<b>Precipitation</b>	Some will require some form of irrigation	Most require some form of irrigation	Requires irrigation in most areas
<b>Frost-free Season</b>		Varies by species or subspecies	Varies by species or subspecies but in general, ideal temperatures are 60°F to 80°F,,,,sustained temperatures above 85°F can damage weak plants
<b>Min. Temp.</b>		Varies by species or subspecies	25°F--50°F
<b>Max. Temp.</b>	unavailable or varies by subspecies or variety	unavailable or varies by subspecies or variety	unavailable or varies by subspecies or variety

**Performance Measure** – The research has provided an increase the knowledge to the agricultural industry by identifying and disseminating findings on south eastern Wyoming

specialty crop potential. The report was published and handed out at multiple conferences held around Wyoming. In the four south western counties of Uinta, Sublette, Lincoln and Sweetwater a survey indicated that 23% of the respondents living on small acreages are growing specialty crops on a limited basis, 16% plan on producing at some level specialty crop in the future, 21% of the responds would like additional information on growing specialty crops, and 40% have no interest in growing specialty crops. We only aware of small increases in production of specialty crops in the south western part of Wyoming. In the survey of 261 small acre owners only 48 were growing specialty crops for personal consumption or sale. 25% of them were using high tunnels for production of frost sensitive specialty crops due the high altitude and short seasons. The irrigation water referenced in the report is not likely to happen any time soon. No larger agricultural operations in Uinta, Sweetwater or Sublette counties have reported incorporating specialty crops into their operations. Larger operations presently use irrigated land to grow forage for their cattle and sheep. Comments from larger producers indicated that distance to market, need to produce forage crops for animals and the short number of frost free days as major challenges. One producer indicated he was going to try 20 acres of 90 day corn a trial next spring just to see if it will be harvestable. Although not part of area covered in this report area there has been an increase in the number of organic producers who are either interested in or incorporating specialty crops into their operations. Five producers who were traditionally wheat producers in south eastern Wyoming are now producing some specialty crops. They include sweet corn, lentils, chickpeas, peas and beans on approximately 2000 irrigated and dryland acres. One producer is transitioning over 1000 additional acres to organic and plans to incorporate specialty crops in the crop rotations on this land.

## **BENEFICIARIES**

The beneficiaries included small and large acre producers and agricultural professionals in the south western counties. We have printed and distributed in excess of 100 reports to producers at various shows that included the Farm and Ranch Days (37), Riverton Wyoming Farmers Marketing Conference (18), the Wyoming Organic Conference (21), the Wheat Growers Conference (6), and the Wyoming State Fair (25). An additional (80) reports were sent to extension offices in 4 south western Wyoming counties. We continue to make the report available on the WDA website and will provide copies to producers at upcoming trade events.

## **LESSONS LEARNED**

Development of new irrigated acres in southwestern Wyoming has potential to expand specialty crop production. Should this occur in the future, several specialty crops have potential to expand production. This area currently has limited crop production, in terms of both

numbers of acres as well as types of crops produced. Small acre production continues to target local food marketing. Specialty crop production in the area needs to be based upon their environmental requirements matching those found within the study area. Distance to market is also a stumbling block for future large scale production. Much of the area is considered high desert and is sparsely populated so crop production and marketing is challenging on a larger scale.

## **CONTACT INFORMATION**

Mary Randolph

Wyoming Community Network

307-760-5727

[merliz@sisna.com](mailto:merliz@sisna.com)

Ted Craig

Wyoming Department of Agriculture

307-777-6651

[Ted.craig@wyo.gov](mailto:Ted.craig@wyo.gov)

## WYOMING DEPARTMENT OF AGRICULTURE SPECIALTY CROP SUPPORT FOR EDUCATION, MARKETING AND PROMOTION

### PROJECT SUMMARY

The development of produce and horticulture products continues to be a vital goal of the (WDA). By providing support for marketing, education, season extension, research, and product distribution, consumption and safety the availability of specialty crops in Wyoming will be enhanced. The program funds helped to maintain cooperation with other state agencies, the University of Wyoming, Community Colleges, schools, producer groups, producers, processors and consumers to expand specialty crop production in Wyoming. This support is critical to expanding specialty crops in Wyoming by providing site auditing, marketing and technical outreach Site audits done by the specialty crop manager helped to ensure the integrity of the program. In previous years funds have been requested for support of these activities. . In addition, funds provided continued support for seminars, conferences and workshops that provide information on production, marketing and food safety of specialty crops not covered by other projects. The sparse population verses the land size of Wyoming require that the specialty crop program manager be able to not only audit but also provide expertise on some of the projects in order for Wyoming to receive the maximum impact and return on investment.

### PROJECT APPROACH

The project supported the travel expenses, marketing, events and support materials for Wyoming Department of Ag to cooperate with other state agencies, the University of Wyoming, Community Colleges, producer groups, producers, processors and consumers to expand specialty crop production in Wyoming. The program focused on the following activities.

1. The SCBGP Manager worked with other agencies and organizations to help develop the specialty crops industry in Wyoming through workshops and conferences.
2. The SCBGP Manager continued to do site audits of specialty crop projects.
3. The SCBGP Manager continued to support the updating and development of informational brochures, power points website information and other promotional material.
4. The SCBGP Manager continued to provide technical assistance to individual growers, processors, producer groups, consumers and educators.
5. The SCBGP Manager continued efforts to increase the number of quality specialty crop grant proposals.
6. The SCBGP Manager continued to work on state specialty crop marketing efforts.
7. The SCBGP Manager continued to monitor past grant activities where possible to see if they continue to have impact on the goals of the program after past funding had ended.

#### **Activities performed**

**The technical assistance position worked with other agencies and organizations to help develop the specialty crops industry in Wyoming through workshops and conferences.** The SCBGP Manager traveled to and supported three horticultural displays at the 2015 and 2016 Wyoming State Fair, provided support at the Fort Washakie, Meeteetsie School and Casper Food For Thought and Cheyenne Boys and Girls Club high tunnel workshops, the 2015 Famers Marketing Conference, Wheatland Specialty Crop Workshop, the organic Conference, The Bee College, Westi Days and Farm and Ranch Conferences.

**The position continued to do site audits of specialty crop projects as needed.** Audits were completed in Lusk, Cheyenne, Laramie, Saratoga, Lingle, Douglas, Riverton, Casper, Lander, Lagrange, Powell, Evanston, Gillette and Sheridan

**The SCBG Manager supported updating, development and printing of informational brochures, power points website information and other promotional assistance.** A 16x32 high tunnel manual was developed and printed. Brochures for the Producer Season Extension Grants and the Non Profit Small Grant Program were updated, printed and distributed at conferences and workshops. The online specialty crop application manual was updated. Information on the Specialty Crop Program was highlighted in the Casper Star, WDA Tuesday Tidbits and Backyard and Barnyards. The small grant program power point was updated

**The SCBGP Manager provided technical assistance to individual growers, processors, producer groups, consumers and educators.** The program provided support to Rocky Mtn. Farmers Union regarding online farmers market, Wyoming State Fair, well as acidified foods and GAP workshops. WDA continued to provide technical assistance to Wyoming Farmers Marketing Association, UWYO Extension, producers and non-profits on hoop house construction and grant writing

**The SCBGP continued efforts to increase the number of specialty crop grant proposals.** WDA encouraged researchers to reach out to producers to increase the variety and practicality of applications in the 2015-16 cycles. The data base of economic development professionals, nonprofits, agricultural specialists, organic and conventional producers was updated for marketing the specialty crop program. The number of proposals in 2015 was 19 and 13 were funded. Assistance in grant writing was also provided to 10 new to specialty crop producers and 11 nonprofit organizations. A grant seminar was conducted in Lander for producers interested in submitting proposals in 2016.



**The SCBGP Manager continued to work on specialty crop marketing efforts.** Specialty crop program manager worked with the Wyoming Dry Bean Council, individual producers and the Wyoming Farmers Marketing Association on marketing information.

**The SCBGP Manager monitored past grant activities where possible to see if they are continuing to have impact on the goals of the program after the funding has ended.** Personnel



have visited past projects in Lander, Laramie, Torrington, Lusk, Casper, Riverton, Dubois, Sheridan, and Douglas to gauge whether they continue to have impact. Projects in Lander, Lusk, Riverton Laramie and Lingle showed minor damage due to wear and tear or vandalism. All sites were continuing to be used for production of specialty crops. If possible damage was repaired during visit.

- February 2015 Westi Days-Specialty crop booth
- February 2015 Fremont County Farm & Ranch-Specialty crop booth
- February 2015 Idea Conference-Specialty crop booth
- February 2015 New Mexico Small Farm Conference.
- March 2015 Laramie Conservation Expo-Specialty crop booth
- March 2015 At Bee University- Specialty crop booth
- July 2015 Lander-Grants workshop
- August 2015 Wyoming State Fair-Displays showcasing specialty crops were open to the public
- August 2015 Fort Washaki-4H hoop house build
- October 2015 Wheatland-Specialty Crop Workshop booth and speaking



- October 2015 Lander Localfest
- December 2015 Wyoming Bee Keepers-Specialty crop booth
- December 2015 Winter Farmers Market -Surveyed market for number of producers who had invested in hoop houses (4 of 24 vendors)
- February 2016 Fremont County Farm and Ranch booth

- March 2016 Bee University booth
- July 2016 Ag in the Classroom Conference booth and Speaking
- July 2016 Meeteetsie Hoop house Build
- August 2016 Food for Thought Hoop House Build
- August 2016 Wyoming State Fair Displays



## GOALS AND OUTCOMES ACHIEVED

**Goal** – Increase the number of Wyoming specialty crop producers.

**Benchmark** – Not available until 2012 NASS Census data released. Estimated at 270.

**Target** – Increase the number of producers and processors by 2%.

**Performance Measure.** Between 2014 and 2016 the following were recorded; an additional 10 new high tunnel producers, one organic corn grower, new organic chickpea producer two organic lentil producers.

**Goal** – Promote specialty crop food safety through workshops and processing authority reviews as required by FDA under the Food Modernization Act.

**Benchmark** – Not Known.

**Target** – Up to 10 processing reviews will be conducted to determine food safety protocols for specialty crop products.

**Performance Measure** – WDA Consumer Health Services reported that 38 processing letters were issued to date certifying that company processing methods of specific specialty crop products were considered safe under FDA regulations for acidified foods.

**Goal** – Promote the specialty crop marketing through conferences and workshops.

**Benchmark** – Prior support has included the Farmers Marketing Conference, Local Food Fests, Acidified Food Training, Market Manager Training, and UWYO Farm Days.

**Target**-An additional 2 conferences/workshops to provide knowledge to specialty crop producers on production, marketing, promotion and food safety.

**Performance Measure** – In 2015 -52 attendees were surveyed at the GAP trainings in Torrington with a 48% increase in knowledge,

Casper GAP training 33% increase, Riverton 51% increase and Cheyenne 44% increase. The Acidified Food training in Powell and Jackson increased the knowledge of the 32 participants to the level of proficiency necessary receive their acidified foods certificate allowing them to oversee the production of acidified foods for sale to intuitional and retail outlets. All 32 were successful and were issued



certificates. A grant seminar was presented in October of 2015 to 23 individuals with a 41% average increase in knowledge. The Ag in the Classroom vertical hydroponic workshop participants reported that 90% felt they had sufficient knowledge to construct and use vertical growing towers in the classroom.

**Goal** – Promote the specialty crops through the publications.

**Benchmark** – Baseline is 8 articles/new or updated publications.

**Target** – An additional 8 articles/new or updated publications.

**Performance Measure** – 8 Tuesday Tidbit articles, 10 Backyards and Barnyard articles Casper Star article and the following were updated; small grant program brochures, small grant applications, and the Specialty Crop Program brochure and application.

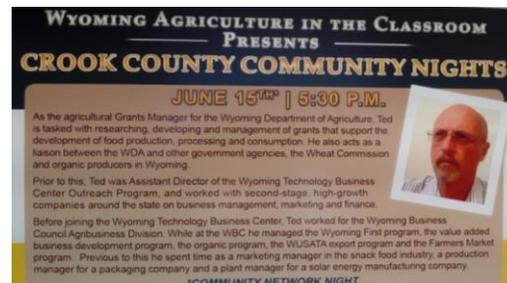
## BENEFICIARIES

The SCBGP Manager continued to build partnerships with Universities, Colleges, nonprofits and producers. The support of UWYO Extension 4 conferences around the State allowed us to expose over 800 producers to the specialty crop program. The hoop house workshops in 2015-2016 where the Program Manager provided assistance impacted 541 individuals. We were able to impact 54 teachers at the Ag in the Classroom Conference. There were 83 producers/ processors and other agricultural professionals that received training on acidified foods or Good Agricultural Practices. Specialty Crop materials were made available at conferences and workshops to over 1600 producers, processors, consumers and agricultural professionals. The 40,000 plus visitors to the Wyoming State Fair were exposed to multiple specialty crop displays planted by the State Fair personnel/Master Gardeners that are managed during fair time by the SCBGP Manager and the horticultural show.



## LESSONS LEARNED

There a continuing need to educate the existing producers, processors and consumers but the program must also be flexible to address the needs of new producers and processors Sub-grantees reporting continued to require extensive oversight. It often required several contacts to get the needed report information. Producers who have limited experience with grants are particularly challenging. We are under a hiring freeze so additional help will not be available in the foreseeable future.



## CONTACT INFORMATION

Ted Craig  
Wyoming Department of Agriculture  
Cheyenne Wyoming 82002  
207-777-6651  
[Ted.craig@wyo.gov](mailto:Ted.craig@wyo.gov)