

Wyoming Department of Agriculture

Specialty Crop Block Grant Program – Farm Bill

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Final Performance Report

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CONTENTS

A GUIDE FOR SPECIALTY CROP VALUE ADDED FOOD PROCESSING IN WYOMING.....	5
Project Summary	5
Project Approach.....	5
Goals and Outcomes Achieved.....	7
Beneficiaries	15
Lessons Learned	15
Contact Information	16
EVALUATION OF GOJI BERRY AS A HIGH-VALUE FRUIT CROP IN WYOMING	17
Project Summary	17
Project Approach.....	18
Goals and Outcomes Achieved.....	18
Beneficiaries	20
Lessons Learned	20
Contact information	22
RESTORATION OF HISTORICAL ORCHARD AT SINKS CANYON CENTER	23
Project Summary	23
Project Approach.....	23
Goals and Outcomes Achieved.....	25
Beneficiaries	27
Lessons Learned	28
Contact Information	29
ON FARM NITROGEN BIO-FERTILIZER FOR ORGANIC SPECIALTY CROP PRODUCTION	
.....	30
Project Summary	30
Project Approach.....	31
Goals and Outcomes Achieved.....	33
Beneficiaries	34
Lessons Learned	34
Contact Information	36
ENHANCING WYOMING’S HERB CROPS WITH AUTHENTICATION PRACTICES.....	37
Project Summary	37
Project Approach.....	37
Goals and Outcomes	37
Beneficiaries	37
Lessons learned	37
Contact Information	37
Project Summary	38
Project Approach.....	38

Goals and Outcomes Achieved.....	39
Beneficiaries	41
Lessons Learned	41
Contact Information	41
WYOMING AG PRODUCER, PROCESSOR AND HANDLER TRADE MARKETING GRANTS	
.....	42
Project Summary.....	42
Project Approach.....	43
Goals and Outcomes Achieved.....	43
Beneficiaries	44
Lessons Learned	44
Contact Information	44
FARM TO SCHOOL/CACEP GARDEN MINI-GRANTS.....	45
Project Summary.....	45
Project Approach.....	47
Goals and Outcomes Achieved.....	48
Beneficiaries	50
Lessons Learned	50
Contact Information	51
Project Summery.....	68
Project Approach.....	68
Goals and Outcomes Achieved.....	70
Beneficiaries	74
Lessons Learned	75
Contact Information	75
GOOD HANDLING PRACTICES FOR LOCAL RAW HONEY	76
Project Summary.....	76
Project Approach.....	76
Goals and Outcomes Achieved.....	77
Beneficiaries	84
Lessons Learned	85
Contact Information	86
HAZEL NUT PRODUCTION	87
Project summary	87
Project approach.....	87
Goals and outcomes achieved.....	89
Beneficiaries	89
Lessons learned	89
Contact Information	89
FEEDING LARAMIE VALLEY SEASON EXTENSION TRIAL AND EDUCATION PROJECT..	90

Project Summary	90
Project Approach	90
Goals and Outcomes Achieved	99
Beneficiaries	101
Lessons Learned	102
Contact information	106
FEEDING LARAMIE VALLEY	107
Project Summary	107
Project Approach	107
Goals and Outcomes Achieved	109
Beneficiaries	122
Lessons Learned	124
Contact information	125
LOCALFEST BACK TO SOIL CONFERENCE	126
Project Summary	126
Project Approach	126
Goals and Outcomes Achieved	128
Beneficiaries	130
Lessons Learned	132
Contact Information	132
INCREASING THE QUALITY OF SPECIALTY CROPS AND POLINATOR HABITAT IN A COMMUNITY GARDEN SETTING	133
Project Summary	133
Project Approach	134
Goals and Outcomes Achieved	137
Beneficiaries	141
Lessons Learned	142
Contact information	143
WYOMING SPECIALTY CROP AGRICULTURAL INNOVATION, MARKETING AND EDUCATION CONFERENCE	144
Project Summary	144
Project Approach	144
Goals and Outcomes Achieved	145
Beneficiaries	150
Lessons Learned	150
Contact Information	150

A GUIDE FOR SPECIALTY CROP VALUE ADDED FOOD PROCESSING IN WYOMING

PROJECT SUMMARY

With the passage of the Food Freedom Act (HB0056) in 2015, this project is timely as there has been much confusion among individuals who are interested in developing value-added specialty crop businesses. The Act has essentially split food processors into two categories: Food Freedom processors (who are not required to process in inspected facilities and are limited to sales directly to end consumers), and inspected processors who can sell to consumers as well as restaurants, wholesalers, and retailers and also ship products across state lines. This project developed a comprehensive planning guide that is specifically for specialty crop processing. The purpose is to increase the knowledge of two specialty crop processor categories. First, for those who begin under Wyoming's Food Freedom umbrella (a law passed in 2015 and revised in 2017) that allows home-processed foods to be sold to the end consumer) it will define what is allowed and what is not. Second, for those who want to take a value-added specialty crop business to the next level (wholesale selling or sales to retailers and food establishments), it will provide a road map to help navigate the startup phase. The project developed the *Guide to Specialty Crop Value Added Food Processing in Wyoming* to reach these audiences, and raised producer awareness about the issues in the Guide in workshops delivered in Wyoming.

PROJECT APPROACH

For specialty crop entrepreneurs to grow beyond direct to consumer sales they have become subject to myriad requirements, including adherence to FDA food safety regulations. Further, they must have a more in-depth approach to business and market planning that encompasses areas such as product insurance, licensing, employee issues, management skills, labeling, packaging, product pricing, material procurement and a host of other issues. This project developed a comprehensive how-to guide to increase the knowledge of both processor categories. For those who begin under the Food Freedom umbrella it defined what is allowed and what is not. For those who want to take a value-added specialty crop business to the next level it provides a road map to help navigate the startup phase. The intent is that readers of the guide will avoid common mistakes. This project created the first Wyoming-specific guide, so this effort provided a valuable resource not only for the startups but also to those who are tasked with regulating or advising them. The approach also included in-person workshops to orient users to the resources. In-person interaction provides for better responsiveness to audience needs, facilitates local peer group interactions and the development of longer-term connections, and allows the

audience to see how places like commercial kitchens and processing establishments look and function.

Project partners included an agricultural entrepreneurs group who provided insights on hurdles they faced when they began adding value to specialty crops. Many also offered advice for beginning producers which was incorporated into the guide as much as possible. This group represented the primary crop areas in these state (the Big Horn Basin and the eastern plains). Further advice was provided by colleagues at the University of Wyoming (from within the College of Agriculture and Natural Resources, both in Extension and in academic departments who pointed the author to numerous resources). Further advice was collected from professionals working in Wyoming, notably Linda Stratton with Wyoming’s Consumer Health Services Division who provided insights on considerations with facilities, food safety processes, and interacting with regulators in the exploration of a value added project. Other topics were identified from a survey of Ag entrepreneurship literature and a review of media coverage of value added ventures. For dissemination, project partners like UW Extension agents are able to distribute hard copies of the guide into the future. The guide will also be a component in a new entrepreneurship effort developed within UW Extension.

Project Activity
Potential resources were first identified, an interview protocol established.
Interviewed producers to validate enterprise hurdles and interviews collected.
"Formed editorial board – the group of individuals with expertise to identify appropriate content and resources including authors"
Finalized Guide topics and authors
Collected and edited content for chapters
Responded to editors comments/questions/suggestions
Laid out Guide
Printed copies
Selected and secured two workshop locations
Advertised and recruited workshop participants. Methods will included newspaper ads (local general newspapers and any regional Ag news publication) and email lists (provided by the partner organizations, other sources include the Wyoming Farmer’s Marketing Association), social media and radio advertising.
Held workshops
Collected evaluation information
Disseminated Guide – hard copy circulated to target audience and agencies across the state. Electronic copy available as UW Extension publication.
Continue to track circulated hard copies of the Guide

GOALS AND OUTCOMES ACHIEVED

Goal 1: Develop a food processing start-up guide for Wyoming producers/processors.

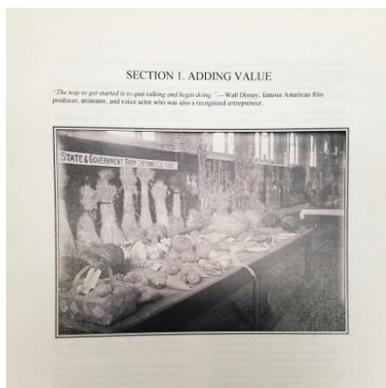
This project began with a review of the insights often offered by authorities such as the regulatory inspectors at the Wyoming Department of Agriculture and from entrepreneurs who have developed their own successful ventures. Information to assist specialty crop producers was available but fragmented and thus required individuals to search out knowledge from various agencies and organizations. This project collected them into concise business management guide. The Guide is appropriate for entrepreneurs considering a venture since it notes common operational and entrepreneurial issues associated with a specialty crop food processing venture in Wyoming.

The Guide is broken in to seven sections, and includes additional resources. The sections and subsections are as follows:

SECTION 1. ADDING VALUE

What is adding value?

Reaching the Consumer



SECTION 2. EXPLORING IDEAS –

WHAT'S COOKING?

Opportunities

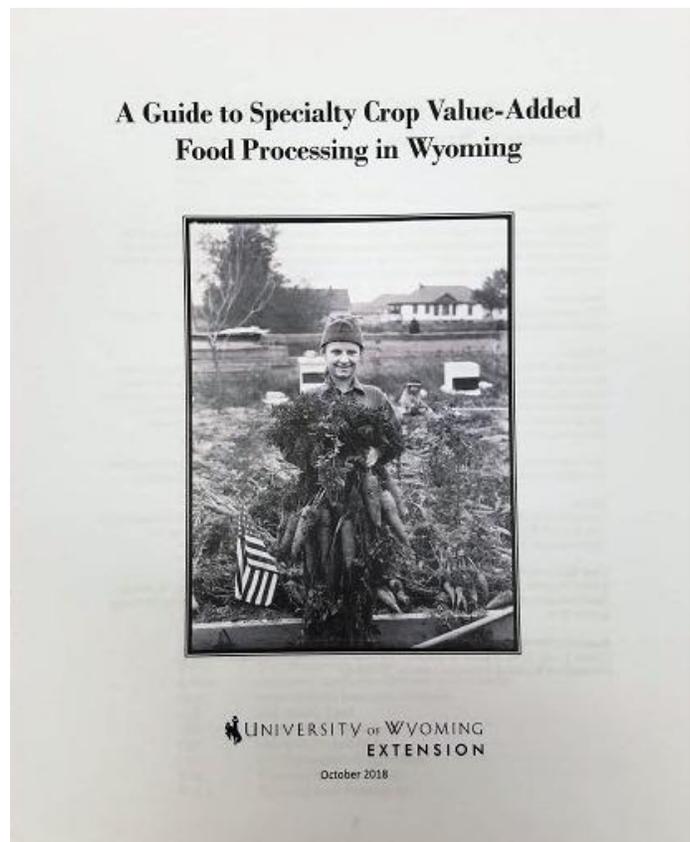
Will Customers Pay Your Price?

Can You Make Money?

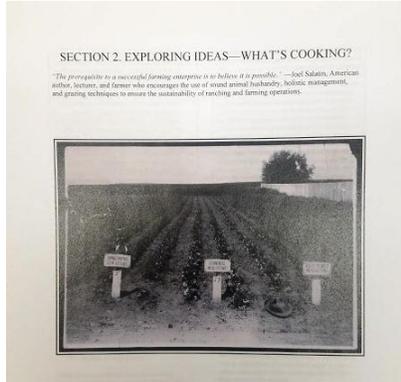
What's Your Breakeven Point?

Where Can You Sell That Much Product?

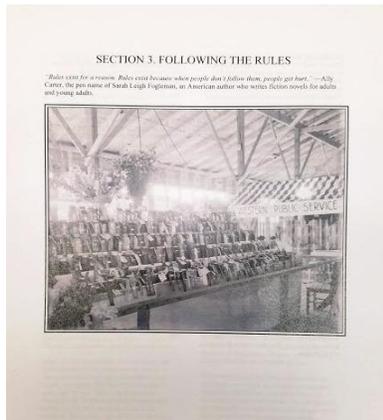
What trends are happening around you?



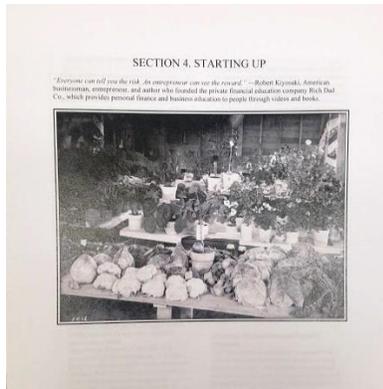
Getting There
Market Segments
Small Business and You
REFERENCES



SECTION 3: FOLLOWING THE RULES
Wyoming Food Freedom Act
The Facility Inspector

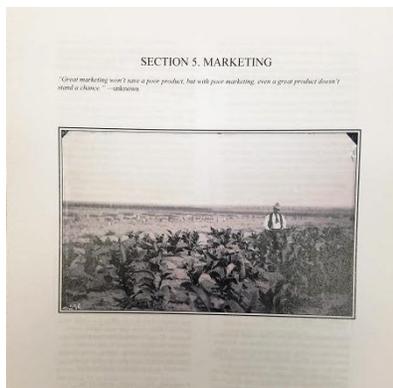


SECTION 4: STARTING UP
Assumptions
People
Capital
Strategy
Should I have a business plan?
Setting Priorities
Effective Goals? SMART
Taking Risks
Further Reading



SECTION 5: MARKETING

- Marketing Management**
- Marketing Mix**
- Value Proposition**
- Promotion Tactics**
- Further Reading**



SECTION 6: SELLING WHOLESALE: BRINGING A FOOD PRODUCT TO MARKET

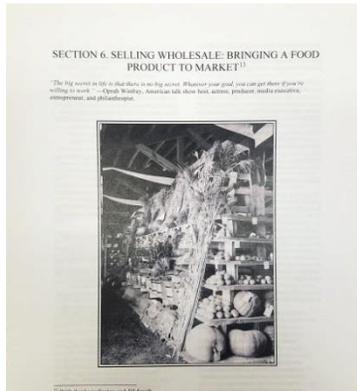
- Wholesaling**
- Types of Intermediaries**
- Selecting Distribution Channels**
- Adding up the Costs**
- Certifications**
- Margin versus Markup**
- Billing and Payment**
- Your Product**
- Other considerations**
- Working with Intermediaries**
- Enlist Help**
- Connecting with Intermediaries**
- Changing Landscape of Wholesaling?**

Final Thought

SIDEBAR: Key Questions

References

Wholesaling Glossary



SECTION 7: RUNNING A BUSINESS

General Management

Tax Considerations

Financial Management

Employment Issues Related to Growing Specialty Crops

SPECIALTY CROPS

Specialty Crops Defined

Programs for Specialty Crops

Crop Insurance for Specialty Crops

Specialty Crops Beyond the Farm Bill

Research

Post-harvest Handling of Edible Horticultural Products

WYOMING AGENCIES AND GROUPS

FURTHER READING

GRANTS AND LOANS

USDA LISTING OF SPECIALTY CROPS

Fruits and Tree Nuts

Vegetables

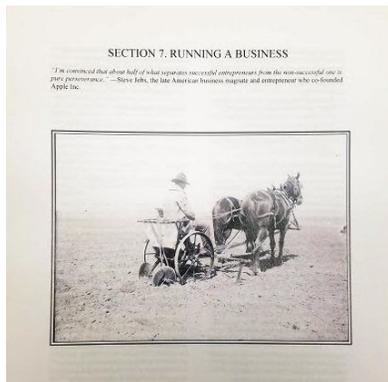
Culinary Herbs and Spices

Medicinal Herbs

Horticulture: honey, hops, maple syrup, tea leaves, and turfgrass.

Nursery and Greenhouse Plants

List of Ineligible Commodities



The content was written and assembled by the project principal investigator owing to the initial difficulty of finding coauthors for specific sections. The project partnered where possible – for instance, some draft content was initially provided by the University of Wyoming Law School’s Rural Law Center as well as the Wyoming Department of Agriculture and the UW College of Agriculture and Natural Resources.

Goal 2: Increase the knowledge of new and existing specialty crop producers on food processing.

Over the course of the project two Food for Profit workshops were offered in Cody and Powell, Wyoming. The Food for Profit concept was to provide an overview on numerous entrepreneurial considerations (profitability, legality, marketing, etc.) to a target audience of producers and their supporters over the course of a half day. Two more project events were also offered to illustrate how value adding activities had worked for others or inform on concepts in the Guide. Another event was planned but was cancelled due to low attendance. In total four events were offered reaching 43 people.

Food for Profit, Sheridan, Wyoming, May 31, 2018

Promotion included advertising in various newspapers (the *Sheridan Press* primarily, but also *Country Bounty*), a flier was developed and circulated and sent to contacts, and direct contacts via email as well as posting on social media (the manager of a local farmer’s market was a particularly good advocate of the program, and several attendees resulted from her recirculating the flier). Partners in the workshop delivery included the Sheridan County Extension office’s Kentz Willis who is UW Extension educator in Nutrition and Food Safety. He provided some of the workshop content, organized the venue, and assisted with hosting.

The program began with a welcome by the PI and then introductions (name, organization and what topics they were interested in). The content of the program contained discussion on the following:

- Food chain and distribution options
- Licensing and inspections

- Demand for differentiated food products
- Food regulations
- Food safety practices
- Home processed foods
- Food Safety Modernization Act

The program concluded with a tour of a commercial-style kitchen. The group was very interested in the requirements for becoming a food establishment under inspection.

The workshop was attended by 12 people. The *Sheridan Press* sent a reporter to the conference which resulted in an article and photograph. Evaluations were collected and participants reported the following based on a self-assessed perceived knowledge gained (PKG) by topic reflective pre-post survey.

Topic	Increase/Decrease in Knowledge
Wyoming food regulations	32%
Resources to help	55%
Business planning	31%
Food Safety	18%
Overall	32%

The group identified the following topics as of especial interest:

- Developing an effective marketing plan
- Food safety
- How to expand profitably
- Pricing
- Assessing opportunities and options for investment (and timing of investment)
- Investing

Many of these topics are addressed to some degree in the Guide, but the ones touching on time and investment options were not. Food safety wasn't envisioned as priority for the Guide, but the interest of the group in the topic may indicate that it is worth addressing in future editions or further efforts.

Food for Profit, Powell, Wyoming, June 7, 2018

A week later the Food for Profit workshop was held in Powell, Wyoming. Promotion efforts included paid advertisements in the *Powell Tribune* (primarily) but also papers in Lovell and Greybull, emailing a flier to contacts, and posting on social media. This time the program was a partnership between UW Extension and the Powell MakerSpace, a nonprofit group that facilitates education and new ventures, and whose venue includes an inspected kitchen that is available for rent. The kitchen manager proved a valuable contact as she organized the venue and helped host the event, and assisted greatly with advertising the

program. The workshop was attended by 11 people. The evaluations report the following based on a reflective pre/post assessment.

Topic	Increase/Decrease in Knowledge
Wyoming food regulations	31%
Resources to help	53%
Business planning	38%
Specialty crops in the Basin	56%
Food safety	19%

The program began with introductions and included content on topics including:

- Food chain and distribution options
- Licensing and inspections
- Wyoming food regulations, including home processed foods
- Competitor analysis
- Pricing
- Food safety practices
- Specialty crops grown in the Big Horn Basin

Presenters in the program included the PI, Kentz Willis with UW Extension on food safety issues, and Jeremiah Vardiman, UW Extension Educator working with crop agriculture on specialty crop issues. Vardiman's presentation provoked a good discussion on specialty crops in the area and how to support them as a community.

Comments in the evaluations indicate that the following topics were of particular value:

- Resources
- Planning

Wheatland Tour, August 1, 2018

A tour of agricultural operations offered August 1 in the Wheatland area reached 14 people. The aim was two-part in that we wished to illustrate what specialty crops be produced in the area (and the methods employed to produce them), and to create an appealing tour of interest to a diversity of people in the area. The Wheatland region is known for producing commodity crops on a large scale, so tour one venue was selected to feature what could be done with a typical commodity crop (wheat, though it is certified organic). This venue has set up a grain mill and bakery. Another stop featured went beyond what is the norm for the area and produces fresh produce that is grown in a modified high tunnel (called a walipini). A final stop featured home processing of farm goods. The agenda was as follows:

9:00 am Welcome and Introductions, LeRoy Jons – University of Wyoming Extension

9:15 Departure to Baker Farm, 2866 County Road 5, Chugwater

10:30 Departure to Eckhardt House, 407 Bowie Avenue (west of Staats Park), Chugwater

11:45 Departure to Lunch, then Marker Farm

Lunch at the Wheatland Fairgrounds

Markers: 50 Riverview Rd, Wheatland

Conclusion

Evaluations were collected and the results were supportive, many noting that they tour format was appreciated (and suggesting more tours in the future), and participants also appreciated the tour stops. Overall, they liked learning about how to add value, and would like more information on marketing.

The tour was advertised via flier, media release (a state-wide release coming from UW Extension, which appeared in local papers), social media posts, direct emails to local contacts and media, and paid advertisements in print media. Our impression is that the most successful methods were newspaper (both media release and paid ads) and emails sent to the Master Gardener group (a partner organization who helped host the tour). Local media attended the tour. Photos are courtesy of LeRoy Jons and include Dennis and Terry Baker who grow and mill specialty grains and Marker Farms with their modified walipini used to produce vegetable and flower starts.



Drafts of this project were also featured at another event, the **Specialty Crop Workshop** held September 24, 2017 in Wheatland Wyoming. The topic of “Specialty Crops: Things to Consider” was provided by the Principal Investigator to a group of seven.



BENEFICIARIES

Direct beneficiaries of this project included 43 people who attended workshops and a tour. These producers, potential producers, and supporters of local economic development learned business planning considerations and resources to use going forward, including the Guide.

This project came at an opportune time in that a group of agencies in Wyoming, Nebraska, and South Dakota, are forming a network to try to better support local food ventures. They assisted in the review of the Guide to help make the list of resources more complete, and they and their audiences will be a beneficiary of the outputs of the project going forward. Had not the project been in development at the time the group was forming, the conversation within the group would have been less productive and the outputs of the project less complete.

150 guides were distributed around the state. Copies of the Guide will continue to be distributed across the state at UW Extension educational events (beginning with winter programming in 2018-2019) and continuing onward. Further contacts after the end of the project will be made online via a new UW Extension webpage that provides resources for local foods development.

LESSONS LEARNED

This project delivered outputs via several methods: developing a guide to adding value to foods, hosting business planning workshops, hosting a tour of model enterprises, and providing an educational session in a conference format. So, based on the variety of methods employed, this project can note the following lessons learned.

- **Take plenty of photos.** Photos will be useful in follow-on events for other audiences since they will get a sense of how other entrepreneurs have approached issues of production, marketing, signage, and so on.
- **Consider multiple workshops in one location.** This project offered one-time half-day workshops as the primary delivery for in-person learning. Offering the same workshop again in the same venue at a later time – say, three months later – might help reach those who did not hear about the workshop the first time or who were unable to attend. Another approach would be to offer another workshop that goes into other topics (or perhaps more depth on some of the topics), allowing attendees from the first workshop to continue to follow their interests and deepen their knowledge while also potentially connecting to new people.
- **Consider a longer format.** This project's workshops were a half day, which is a comfortable length to generate interest in the topics and cover a range of topics at a shallow level. Our experience is that those who come tend to say that they would

have liked a longer workshop. However, our experience also leads us to believe that a longer advertised workshop length would be unappealing to participants in the first place (since people are busy and dedication to a longer format is unlikely, especially given that the nature and quality of the content is unknown prior to attending). So they say they would have liked a longer workshop only after attending a good workshop. Further, recent conference offerings in the state bear that longer format events – particularly multiple day workshops – have not been successful, at least in mid to late 2018. So consider a longer length, but be prepared for the attendance to be low.

- **Tours work.** Agricultural producers (and others) appreciate the opportunity to see how others work: their equipment, their facilities, the opportunity to discuss business processes, etc.
- **Find local hosts.** This project partnered with other organizations in all its in-person events, and it facilitated good attendance, interesting discussion, local connections amongst peers, and showcasing local resources (commercial kitchens, for instance).

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EVALUATION OF GOJI BERRY AS A HIGH-VALUE FRUIT CROP IN WYOMING

PROJECT SUMMARY

The purpose of the project was to evaluate goji berry (*Lycium barbarum*) as a potential high-value crop for Wyoming and study the feasibility of organic production. Goji berry contains 19 amino acids, has greater vitamin C than an orange, is the best source of antioxidants of all known foods, as well as several health beneficial compounds. . The need for this project was presented to the University of Wyoming by local residents. This expressed need and the current interest in local food production and food hub development in the State of Wyoming makes this project very timely. In addition to this timing, goji berry is cold-hardy (zone 3a), early maturing berry that seems suitable for organic production in Wyoming and preliminary studies in Sheridan, Wyoming, indicated that the crop breaks bud earlier than other berries, sustains temperatures below 20F and has a long flowering/fruiting season. This project was an initial project and was not previously funded.

Goji berry is cold-hardy (zone 3a), early maturing suitable for organic production in Wyoming. Preliminary studies in Sheridan, Wyoming, indicated that the crop breaks bud earlier than other berries, sustains temperatures below 20F and has a long flowering/fruiting season. We evaluated performance of the crop at two locations: Powell and Sheridan. Days required for flowering, fruiting, the growing season and yield per plant were estimated at the two locations. Goji berry propagation using hardwood and softwood cuttings to optimize vegetative propagation for rapid production of planting material was studied. Finally, we compared growth and reproductive parameters of plants obtained through vegetative propagation and seed-derived plants to study potential difference in juvenile period and yield. The research project demonstrated that goji berry plants can survive Wyoming's climate and in particular the cold harsh winters. There was 98% survival rate out of 100 plants. A couple goji berry plants produced berries in the establishment year; however were not enough to measure. The goji berry plants tended to break dormancy approximately a month prior (April) to the grapevines growing in the same vineyard. The plants then began flowering around the end of May and continued flowering and fruiting thru October with two harvest periods. The average total yield for the vineyard was 14 pounds, with the average plant yield of .4 pounds and a range between .9 pounds and .03 pounds. This is very encouraging because other fruit crops such as grapes, raspberries and strawberries do not typically grow this late in the season and produce fruit without season extension protection, such as high tunnels or greenhouses. This project also explored how to optimize vegetative propagation systems utilizing four Indole-3-butyric acid concentrations with three types of propagation media. Twelve experimental groups were screened to identify the best root development. The best

rooting was observed in potting mix at 8000ppm with Hormodin commercial rooting powder.

PROJECT APPROACH

1. Two vineyards, Sheridan R&E Center and Powell R&E Center, were planted with a total of 100 goji berry plants, 50 at each site.
2. Both vineyards were monitored for plant survivability and phenology stages (bud break, flowering date, average number of shoots per plant, and berry quality).
3. Propagation studies were conducted in a greenhouse to determine the best root development with growth mediums and root hormone concentrations.
4. Results were shared at field days.

Jeremiah Vardiman was the PI on this project with oversight on the grant funding and reports, in addition to oversight on the entire project. Co-PI, Dr. Sadanand Dhekney managed and recorded data for the Sheridan R&E Center field site, while Jeremiah Vardiman managed and recorded data for the Powell R&E Center field site. Dr. Sadanand Dhekney also managed and conducted the propagation studies in the greenhouse at the Sheridan R&E Center. Powell R&E and Sheridan Research Center provided scheduled field days to share results with producers.

GOALS AND OUTCOMES ACHIEVED

Goal 1: Study goji berry phenology including vegetative characteristics, flowering and fruiting time and cold-hardiness.

Outcomes: Goji berry plants were purchased from Landons Nursery in Sheridan and planted in both field trial locations in 2016 (in Powell and Sheridan fields). A seasonal worker cultivated and maintained (irrigated, fertilized, pest control, etc.) the field plots, keeping 98% of the plants alive. Weed barrier was installed in the rows and around the plants to suppress heavy weed pressure at the Powell Location. This was highly effective and worth the investment from a labor savings standpoint. Phenology data was recorded on all plants for both locations throughout the growing season. There was an average of 11 shoots per plant. 32% of the plants tried to flower with an average of 3 flowers per plant. Of the plants that flowered, 63% had white flowers, 1% had purple flowers, and 33% had both white and purple flowers. 0% of the plants achieved fruit set, resulting in no yield for the first year. The goji plants established poorly at the Sheridan site due to being planted too shallow and did not flower or set fruit. In year 2, the plants initiated fruit set between June 15th and June 20th, resulting in two harvest periods. The first harvest on September 22nd, 2017 averaged .22 pounds of fruit per plant, with a range of .66 pounds being the highest yield and .03 pounds the lowest yield. The second harvest

on October 27th, 2017 averaged .34 pounds of fruit per plant, with a range of 1.8 pounds being the highest yield and .005 pounds the lowest yield. The total yield for the Powell vineyard was 14 pounds. At this point, if goji berry plants were well established in Powell, could produce fruit their second year of growth and with at least two harvest periods. Seed germination rates were very poor (as evidenced from propagation experiments), due to which we could not compare differences between seed-propagated and vegetative propagated plants.

Performance monitoring: There was a high interest in goji berry production among producers seeking to diversify their cropping systems. Information was disseminated to producers at the field days in Both Sheridan and Powell.

Goal 2: Study vegetative propagation to optimize rapid multiplication techniques for goji berry.

Outcome: The primary objectives of the studies conducted were to determine the effect of Indole-3-butyric acid concentrations on rooting of goji berry cuttings in three types of propagation media, and to determine if seed propagation is a viable means of goji berry plant multiplication. As a high value specialty crop goji berry has shown great adaptability to diverse environments. The ability to grow goji berry across multiple biotopes creates a need for efficient propagation methods to be established so



that producers can easily capitalize on producing a high value crop. Through implementing propagation programs, growers can reduce production costs by eliminating the reliance on obtaining nursery stock for production fields. The results of the studies conducted indicate that both vegetative propagation and seed propagation methods used in this study can be utilized by growers for goji berry plant multiplication to varying degrees of success. In general, stem section cuttings were easily rooted in Berger BM7 potting media in combination with Hormodin® 3 (8,000 ppm IBA) commercial rooting powder, often resulting in vigorous roots which were healthy in appearance. Stem rotting was often seen in Rockwool A-OK Starter Plugs™ presumably due to water retention and reduced aeration in the media, and roots which formed in the media rarely elongated to the extent of those observed in Berger BM7. Roots formed within Oasis® Rootcubes® were almost always observed to be of poor quality as they were thin in diameter and weak in appearance. Differences in rooting response amongst the mediums used in this study may be attributed to both physical properties of each media, and uncontrolled factors such as light intensity and duration. As this study was aimed at identifying a low-cost methodology for vegetative

propagation of goji berry so supplemental lighting was not considered in the investigation though it could improve root production. It is recommended that future studies be conducted on goji berry vegetative propagation utilizing Berger BM7 potting media and Hormodin® 3 to establish baselines to be improved upon; and if these investigations were to focus on testing the effects of vapor pressure deficit, light, and mist irrigation management in a tightly controlled environment improved root production could be realized. Multiple factors could have influenced the results of the seed germination studies. Due to the poor germination and viability of seeds derived from field-grown plants, it is recommended that growers who choose to produce goji berry plants from seed focus on maintaining greenhouse stock plants as a seed source. By eliminating field factors which may affect seed quality and following the methods utilized for stock plant production in this study, it is anticipated that goji berry producers can successfully multiply plants through the production and propagation of vigorous seed thus reducing expenditures as field production operations expand.

Performance monitoring: A successful vegetative propagation protocol for goji berry was established along with providing evidence that seed obtained from field-grown plants exhibited poor germination ability. A graduate student working on the project completed his Master's degree. This information will be disseminated in the form of a research publication, field days bulletin and provided to Landon's Nursery in Sheridan who is interested in vegetative propagation of goji berry for distributing plants to homeowners and producers.

BENEFICIARIES

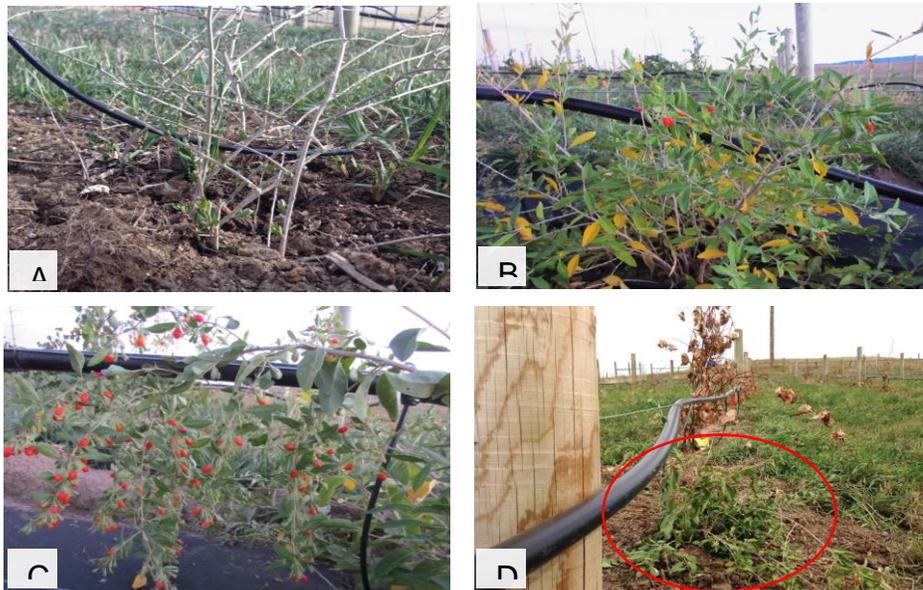
Information on goji berry production was provided to producers and homeowners interested in diversifying their plant operations and growing goji berry as a backyard fruit crop. Presentations and visits were carried out at the annual field days in Sheridan (310 people) and Powell (247 people). Based on feedback, we expect some of the current grape and berry growers to diversify their operations by planting goji berries that can be marketed as fresh fruit for the local farmers markets.

LESSONS LEARNED

- As with many perennial plants, establishment affects the growth, development and fruiting of goji berries. The Sheridan vineyard did not flower or fruit during the project because the plants were planted too shallow resulting in poor establishment and slow growth and development.

- Goji berries are a labor intensive crop to harvest because they continually flower and fruit until a killing freeze (22 to 24°F). The fruit is also individual berries, which must be hand harvested, increasing the need for labor during a short harvest season (August to October).
- More research needs done on fertilization and pruning of goji berries.
- Goji berries are also rhizomatous and in good environmental conditions spread rather quickly. There were problems keeping the goji berry plants where they were planted in the Powell vineyard. Goji berries were sending suckers up where the grapevines were growing, by the posts and on the edge of the plot.
- There was also damage by birds and insects to the ripening fruit which could reduce yields.

Figure 1. Goji berry establishment and fruiting. A. Bud break, B. Goji berry bush growth and profuse fruiting (C). Plant survival following an early freeze (grapevines behind goji plants showed extensive freeze-damage).



Goji berry establishment in Powell, bird damage to fruits.



Germination of *Lycium barbarum* seed following incubation at 30/20 °C with a 12-hour photoperiod and embryo viability testing using trisodium tetrazolium test (TZ).



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RESTORATION OF HISTORICAL ORCHARD AT SINKS CANYON CENTER

PROJECT SUMMARY

The purpose of the project was to restore a portion of the historic apple orchard and revitalize the surviving heirloom apple trees at Central Wyoming College's Sinks Canyon Center (formerly the CWC Field Station). Additional funding was provided from the Popo Aggie Conservation District's Resource Enhancement Program and Central Wyoming College. The project was timely as the orchard had been severely neglected and was in danger of losing unique varieties of heirloom apple trees. Of the original 2500 fruit trees planted in the late 1800's and early 1900's, 51 heritage apple trees survive today. These trees have proven their ability to survive Wyoming's challenging climate extremes. During its years as the State Experimental Fruit Farm several hardy cultivars were developed. Among these were the Brechsteinia, Margaret, Fremont and Poposia. DNA analysis revealed that two Fremont cultivars remain in the orchard. This historic orchard is a source of community pride in the Lander Valley. For decades, community members and school groups have visited the orchard each year to pick apples. Thus, preservation of the unique apple varieties that have survived for decades in Wyoming's harsh climate extremes was of utmost importance. Local apple producers, knowing the value of these heritage varieties, have shown interest in propagating their own apple trees from these hardy trees. The goals of the project were as follows:



Goal 1: To restore the Sinks Canyon Center historic research orchard as a demonstration orchard by planting heirloom apple trees, restoring vigor and health of existing trees and replacing other fruit tree varieties that once grew in the orchard.

Goal 2: Provide educational information to increase the knowledge and awareness of apple orchard restoration and revitalization to producers, community members, and college students through workshops, a blog and educational signage.

PROJECT APPROACH

The main objective of the project was to restore and revitalize the orchard to become a demonstration orchard for apple producers, owners of deteriorating orchards, college students, k-12 grade school groups and interested community members. To this end, the following approaches were taken:

1. Construction of a deer-proof fence enclosing approximately 3 acres within the orchard to protect new and existing trees from further damage.
2. Complete lay out for planting of new trees and flag these locations.
3. Install automated drip irrigation system.
4. Mark dead/decaying trees for removal.
5. Identify trees in need of extensive pruning and trimming.
6. Removal of dead trees, stump grinding, extensive pruning and trimming.
7. Spray heritage trees for fire blight.
8. Provide educational booth on the restoration project at the 2017 Garden Expo.
9. Conduct workshops on apple tree grafting, tree pruning, and tree planting for community members, apple producers and other interested persons.
10. Hold volunteer tree planting days.
11. Tag and number all new and older trees in orchard.
12. Collect leaf samples from heirloom trees and send samples to UW for DNA analysis.
13. Install educational signage on orchard fence.
14. Conduct GIS mapping in fenced orchard and log individual tree data.
15. Develop project webpage on CWC website.



Central Wyoming College partnered with several individuals and organizations all of whom contributed significantly to this project. Dr. Jack States provided his extensive knowledge of historic orchard health, maintenance and productivity. He was very helpful in assessing the overall health of the orchard prior to the start of the project and recommended trees for extensive pruning or removal. He provided recommendations for treatment of fire blight and clean fruit. The Popo Aggie Conservation district played a significant role in the layout of the new orchard area and recommendations for varieties of heirloom trees to plant. The PACD facilitated a speaker to the 2017 Garden Expo, Scott Skogerboe of the Fort Collins

Wholesale Nursery, in conjunction with this project to speak about heirloom apple varieties. Mr. Skogerboe also donated an apple tree he grafted from the “Last Johnny Appleseed Tree” to the project. Dr. Steven Miller University of Wyoming botanist shared his extensive knowledge of heirloom apple trees, care and maintenance through a series of workshops on apple tree grafting, pruning and planting during the Apple Orchard Weekend April 29 and 30, 2017. Jonathan Magby, a University of Wyoming graduate student, contributed significant time in identifying several of the older, heirloom trees through DNA analysis. His work continues as he and Dr. Miller attempt to locate the 9 varieties of heirloom apples developed at this location when it was a UW Experiment Station in the early 20th century. Brett Foss of BT Enterprises, a fencing company, donated some materials for the fencing project. Andy Eckart, a local contractor and former CWC instructor, volunteered his expertise in the design and construction of the fence. Val Layton, landscape contractor volunteered skid loader and auger work to assist in the planting of the new apple trees.

GOALS AND OUTCOMES ACHIEVED

Goal 1: To restore the Sinks Canyon Center historic research orchard as a demonstration orchard by planting heirloom apple trees, restoring vigor and health of existing trees and replacing other fruit tree varieties that once grew in the orchard.

Outcomes: Thirty trees were purchased from Sprouts Greenhouse and planted in the fenced orchard area. Of these 30 trees, 20 were varieties of apple trees and 10 were cherry, plum and pear trees. Fifty two bench-grafted trees were donated by Steve Miller from the University of Wyoming and planted in the fenced area. These trees comprised trees grafted from existing heirloom trees in this orchard and from trees located in other local orchards. Twelve existing apple trees were identified as too far decayed and/or dead and were removed. Remaining trees were extensively trimmed to remove dead wood. These trees were sprayed for fire blight prevention in the spring on 2017.



Goal 2: Provide educational information to increase the knowledge and awareness of apple orchard restoration to producers, community members, and college students on orchard restoration and revitalization through workshops, a blog and educational signage. Average increase in knowledge of survey responses was 81%.

Outcomes:

2017 Garden Expo Exhibit-28 documented visitors received information about the restoration project at the exhibit. Sign-up sheets were available at the exhibit for the upcoming Apple Weekend Workshop. Steve Miller was unable to present the grafting

workshop at the Expo. In his place, Scott Skogerboe from the Fort Collins Wholesale Nursery gave a very informative presentation on heirloom Apples. Scott is well-known for locating and obtaining cuttings from the last known Johnny Appleseed tree in Ohio. He has propagated several trees from these cuttings and presented one at the Expo to CWC for the restoration project.



2017 Apple Weekend Workshops-Three workshops on grafting, apple tree pruning and tree planting were conducted by Dr. Steve Miller. This .jpg advertising the workshops was posted on the CWC Lander Facebook page.

April 29, 2017 Apple Tree Grafting Workshop. 26 people attended. A workshop evaluation was presented at the end of the workshop. All respondents indicated they gained knowledge of the topics presented. 26 respondents indicated they gained knowledge in the following topics: History of grafting, reasons for grafting, types of grafting, tools for grafting, whip and tongue grafting, collection of scions and care of trees after grafting. On completion of workshop 79% of respondents to survey reported they had gained high to very high knowledge on these topics.



April 30, 2017 Tree Pruning Workshop. 21 people attended. A workshop evaluation was presented at the end of the workshop. 12 respondents indicated they gained knowledge in the following topics: When to prune apple/fruit trees, reasons for pruning, how to prune, tools for pruning and care of trees after pruning. 78 survey respondents indicated they had gained high to very high knowledge of these topics



April 30, 2017 Tree Planting Workshop. 8 people attended. A workshop evaluation was presented at the end of the workshop. 7 respondents indicated they gained knowledge on the following topics: When to plant apple trees, how to plant apple trees, water requirements for young trees, how to prepare area for tree planting, how to mulch/types of mulch, care of trees after planting. Workshop participants evaluated the workshop using a Likert scale with knowledge rating scale of 1 very low to 5 very high. 58% of the respondents indicated they had no knowledge of these topics before the workshop. After the workshop 94% reported having gained high to very high knowledge.



Educational Signage: An informative sign on the restoration project was installed on the fence that surrounds the new orchard area.

Project Webpage: <http://www.cwc.edu/orchard>. While this project was being implemented, Central Wyoming College launched a new website. Rather than develop an educational blog about the project, the new website provided enhanced features and was an effective way to communicate the orchard restoration project. The page was launched on October 15, 2017. To date, it has had 320 page views and viewers spent an average of 2+ minutes on the page.

BENEFICIARIES

Project beneficiaries were: 108 individuals directly. There are many school tours and other events at Sinks Canyon that were not related to the projects workshops or trainings but had impact as well. The number of visitors were estimated at between 500-1000 but were not tracked.

- Twenty five volunteers assisted with the fence construction from 7/5/2016 through 10/30/2016.
- Twenty eight documented visitors received information about the restoration project at the 2017 Garden Expo Exhibit.
- Twenty six people attended the Apple Tree Grafting Workshop. Evaluations indicated participants gained knowledge of the topics presented at the workshop.
- Twenty one people attended the Tree Pruning Workshop. Evaluations indicated participants gained knowledge of the topics presented at the workshop.
- Eight people attended the Tree Planting workshop. Evaluations indicated participants gained knowledge of the topics presented at the workshop.
- On May 6 and 12, 2017, 27 volunteers planted 44 apple, cherry, plum and pear trees. Volunteers were instructed in proper tree planting techniques.
- In May of 2017, 125 5th graders from Baldwin Creek Elementary School in Lander had a field day at the new orchard area. The students learned about the importance of the project, history of the orchard, and planted 8 apple trees. The students were instructed in proper tree planting techniques.
- On October 12, 2017, 12 visitors from Simply Supports Disability Services visited the orchard to learn about the history and restoration project.
- On October 31, 2017, 50 students from Arapahoe Middle School visited the orchard to learn about the history and restoration project.

- On November 16, 2017, 20 participants of Leadership Fremont County visited the orchard to learn about the history and restoration project.
- On April 28, 2018, 3 people participated in an apple tree grafting workday. These individuals had participated in the tree grafting workshop and were interested in practicing their skills and propagating trees for their own orchards. 50 trees were grafted during this workday.

LESSONS LEARNED

The project got off to a slow start in 2016. Changes in CWC administration and other key personnel took place from the time the grant application was written to when it came time to finalize and sign the WDA contract. The personnel changes resulted in miscommunications between the project coordinator, key facilities staff and administration. As a result, the project scope was narrowed by reducing the size of the fenced area from approximately 6 to 3 acres. In the end, this change was for the better as the success of the project was highly dependent upon volunteer labor to construct the fence. As it turned out, volunteers contributed a significant number of hours in fence construction - 300 hours. Any more time required would have most likely pushed the generosity of our volunteer pool.

The Orchard Restoration sparked interest from UW graduate student Jonathan Magby. His research focused on using DNA analysis to identify heirloom apple tree varieties and attempt to locate the cultivars developed at the Lander Experiment Station. To this end, leaf samples were taken in the spring of 2017 from 51 of the old apple trees. Results came in on 36 of these trees. The varieties Jonathan was able to identify are listed below. The trees were tagged.

Fremont - 2

Yellow Sweet - 2

Wealthy or Wealthy-like - 6

Martha - 6

Virginia Crab-like - 3

Charlamoff or Charlamoff-like - 5

Whitney Crab - 1

Patten's Greening - 3

Fireside - 1

Wolf River/Bismark - 2



Plumb's Cider – 1

Blue Apple – 1

Pear – 1

Mart – 1

McMahan - 1

It was satisfying to see the response to this project from the community. In addition to the response of volunteers to the fence construction, volunteers contributed just over 100 hours to plant trees in the new orchard area. Additionally, the project garnered interest from state-wide media outlets. This interest was not anticipated but spoke to the ties that many local community members and beyond have to the historic orchard.



It's a rewarding experience to observe the changes in the orchard. Removing the dead trees, extensive trimming and pruning of the old apple trees, and treatment for fire blight has truly brought the old orchard back to life. A small number of trees within the fenced area did not survive the first year, however, the remaining trees appear to be establishing and putting on new growth. Protection from deer and improved irrigation will increase their survivability.

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ON FARM NITROGEN BIO-FERTILIZER FOR ORGANIC SPECIALTY CROP PRODUCTION

PROJECT SUMMARY

The objective of this project was to implement and evaluate an on-farm system for production of nitrogen-fixing cyanobacteria to be used as fertilizer applied with irrigation water for vegetable production. Nitrogen fertilizer is expensive and poses environmental threats in both conventional and organic specialty crop production, and we sought to evaluate efficacy of this alternative, on-farm system for the northern Wyoming region. The system we implemented was developed by Professor Jessica Davis and others at Colorado State University whose work indicates that application of suspended cyanobacteria with irrigation water can provide supplemental nitrogen as well as other benefits to vegetable quality and yield. Our intent was to work with Professor Davis' group to evaluate the system in the climate of Wyoming's Big Horn Basin. We worked with Cody vegetable producer Scott Richards of Shoshone River Farm to build a cyanobacteria production system on his farm. Initiation and increase of the cyanobacteria cultures proved to be too sensitive to contaminants for our on-farm production and we were not successful in scaling production up to the on-farm raceways for application to crops. During the first year, under the direction of Professor Davis, we collected local samples from water bodies in the Cody area and attempted to increase them at the University of Wyoming Powell Research and Extension Center. The local strains were not robust enough to rapidly increase in the controlled conditions and we did not successfully scale up to the on-farm raceway. The second year we used a strain of cyanobacteria provided by the CSU lab that was thought to be more robust. We contracted with CSU PhD student Joshua Wenz to oversee set up of a more sophisticated system at greenhouses and labs of the UW Laramie Research and Extension Center, with the intent of producing concentrated inoculants and transporting them to the on-farm system in Cody. We were able to produce and transport concentrated cyanobacteria inoculants in one-gallon batches and transport them to Cody. But, during repeated attempts to increase them in 40-gallon tanks equipped with flow pumps and pH-regulated carbon dioxide injection, the populations crashed, and the batches were taken over by green algae and other nitrogen-consuming species. We held two on-farm mini-field days that were well attended and interest in the system was high, not only in the on-farm system, but in local vegetable production at the Shoshone River Farm. While we did not

Cyanobacteria raceways and work station installed.



successfully produce nitrogen fertilizer on-farm, our work helped to elucidate points in the system that needs improvement for on-farm implementation.

PROJECT APPROACH

We worked with Shoshone River Farm in Cody, Wyoming, to build a high tunnel and two 700-gallon raceways, along with systems to increase cyanobacteria inoculants from 1-gallon flasks in the lab, to 40-gallon lined stock tanks, to the 700-gallon raceways. We worked with scientists from Colorado State University who had developed the system and had improved the cyanobacteria-increase procedures between the first and second years of our project. This system, implemented in our second year (2017), included the following steps:

Experimental beds mulched next to raceways.



1. Increase of small inoculate samples of the best strain discovered by the CSU group in the Laramie lab using one-gallon glass flasks, grow lights, and aeration pumps. Purity of the growing cyanobacteria was gauged using a microscope and concentration was quantified with a spectrometer. We successfully increased the populations during this step, but for on-farm production, this would require establishment of a clean space;
2. Increase to 40-gallon stock tank in the Laramie greenhouse. Using flow pumps for aeration and a pH meter that automatically injected carbon dioxide to moderate changes, we successfully produced 40 gallons of high-concentration cyanobacteria several times;
3. Split, transport, and increase to four 40-gallon tanks in the on-farm high-tunnel greenhouse. We successfully transported the material in five-gallon buckets and began increase at Shoshone farm in 40-gallon tanks equipped like the one in the Laramie greenhouse, but the populations repeatedly crashed, possibly due to a combination of contamination, temperature, and water quality issues.

2016 Activities

1. Cooperating farmer Scott Richard of Shoshone River Farm (SRF), Cody, joined Jay Norton and Ted Craig to visit the cyanobacteria production facilities at Colorado State University and visited with project manager Joshua Wenz about how to construct raceways and produce the cyanobacteria.

2. Student workers Betsy Trana and Michael Ruiz were hired (partially by UW with the WDA grant and partially by SRF) to work at SRF and establish the cyanobacteria nitrogen experiment.
3. Project partners Norton, Richard, Trana, and Ruiz met to confirm details of hoop house and raceway construction and placement, fertilizer experimental design, and, with input from Wenz, cyanobacteria growth.
4. The 26 x 60 foot high tunnel greenhouse with two cyanobacteria production raceways was built, complete with electric paddle wheels for circulation, during June and July.
5. Attempts to initiate and multiply cyanobacteria proved challenging and repeated attempts were made throughout the summer. We believe that fluctuating temperatures, contamination sources, and problems creating the proper growth medium contributed to the problems. Working with the CSU scientists, we have established improved procedures that will be implemented during the 2017 growing season.
6. The project was featured at a mini-field day at SRF facilitated by UW Extension Educator Jeremiah Vardiman. The system along with its potential and challenges was shown to 12 participants.

2017 Activities

1. Student worker Alan Adams was hired in early spring. Adams and Norton traveled to CSU to coordinate 2017 growing season activities with Josh Wenz, recent MS graduate who managed the CSU cyanobacteria lab and project. We decided to utilize the most virulent strain grown at CSU instead of the strain from Wyoming, which Wenz had found to be less vigorous in warmer temperatures. Wenz shared modified techniques for growing cultures in 1-liter flasks in front of banks of florescent lights. The CSU project is not active so they loaned us four 40-gallon tanks, flow pumps, and a pH detector connected to a switch on a CO2 tank regulator designed to regulate pH, as well as four liters of culture. Adams began successfully increasing the cyanobacteria in a UW greenhouse in Laramie.
2. Adams transported the material in clean 5-gallon buckets and the supplies to Powell and Shoshone River Farm (SRF) on May 29. He cleaned the lab at the UW Powell Research and Extension Center that had been set up by student worker Betsy Trana in 2016 and set up 40-gallon tanks in the project high-tunnel greenhouse at SRF. He began increasing the cultures working with former project employee Betsy Trana (now full-time with SRF) but began having problems with the cultures growing slowly or being invaded by other types of algae.
3. Josh Wenz travelled to Cody on June 6-11 to bring additional culture and help Alan trouble shoot and fine-tune the process at the lab and farm.



4. Over the next six weeks we had repeated failures with the culture. Alan travel to CSU twice for additional material, but on July 27 we moved the supplies back to Laramie. On September 1 Alan was trained by former UW Prof Steve Herbert, an algae production expert, on using his former lab on the UW campus to maintain and increase the culture in flasks.

The system, the lessons learned, and the vegetable production of the Shoshone farm were presented to participants in field days in 2016 and 2017.

GOALS AND OUTCOMES ACHIEVED

Goal 1: Develop on farm cyanobacteria bio-fertilizer production. Goal 2: Evaluate cyanobacterial bio-fertilizer in irrigated vegetable production. Goal 3: Increase the awareness of Wyoming specialty crop producers and agricultural educators of opportunities for on-farm production of bio-fertilizers.

Goal 1: Compare the growth rates and production yields of cyanobacteria bio-fertilizer against conventional N fertilizer and compost.

Performance Measure: Yields of specialty crops fertilized with the cyanobacteria bio-fertilizer, compost, and synthetic fertilizer will be compared.



Target: We planned side-by-side comparisons of the same crop grown with compost or a commonly used organic N source, and conventional N fertilizer applied at the same N rate as the cyano-fertilizer. N rate was to be determined based on crop need and soil properties.

Outcome While we did develop a system for producing cyanobacteria for nitrogen fertilizer, problems with increasing cyanobacteria populations prevented this goal from being achieved. We achieved part of the goal as a critical evaluation of implementing on-farm bio-fertilizer production in Wyoming. Testing effects of the bio-fertilizer on vegetable production was not achieved because we were not able to produce adequate amounts.

Goal 2: Increase the awareness of Wyoming specialty crop producers and agricultural educators of opportunities for on-farm production and use of organic bio-fertilizers in specialty crop production.

Target: Educate at least 50 specialty crop producers and agricultural educators about the benefits of on-farm bio-fertilizer production, how to set up a system, and how to access information on its use in specialty crop production.

Outcome: We did educate 66 producers, CSA members and agricultural educators (and ourselves) about the challenges associated with implementing on farm a system that seemed to be well-established at CSU.

Outcome Monitoring: Without adequate amounts of cyanobacteria fertilizer available we were not able to determine the vegetable production yields verses the amount of bio-fertilizer, compost and conventional fertilizer applied to specialty crops. A field day was held at the cooperating farm and a talk on results was presented. Attendees of the field day were not surveyed as at that point as there were no conclusive results to the project. The second year, agroecology student Allen Adams worked with Joshua Wenz of CSU to improve the system and he successfully produced several 40-gallon batches of bio-fertilizer at the Laramie Research & Extension Center but the process could not be up scaled at the farm as competing bacteria killed the cyanobacteria producing nitrogen.

BENEFICIARIES

Beneficiaries of the work included 9 producers and educators in the Big Horn Basin and the 50 plus CSA members of the Shoshone River Farm who learned that cyanobacteria bio-fertilizer production may be possible, but is challenging in on-farm conditions. The 7 UWYO and CSU researchers and interns who learned that the bio-fertilizer production system is not ready for on-farm conditions, and success and may require investments by farmers to establish a more controlled environment. An additional benefit was the education of three summer student technicians hired by the project. Betsy Trana and Michael Ruiz helped Shoshone River Farm owner Scott Richard build the on-farm system and Betsy established the cyanobacteria production process. Betsy was hired as a full-time manager by Shoshone River Farm at the end of the 2016 growing season and continues to work there. An article on the project is planned and submitted for publication to Backyards and Barnyards with a distribution of 3000 in 2019. The project was also mentioned at the Powell research Station Field days to over 200 people.

LESSONS LEARNED

The lesson learned during this project was that the cyanobacteria bio-fertilizer production system developed at CSU is not ready for current on-farm conditions in Wyoming. A combination of climatic factors and lack of control of temperature and contaminants in a typical vegetable farm situation prevented successful production of the bio-fertilizer. These factors will become invaluable as researchers continue to refine viable on-farm production of this type of bio-fertilizer.

Our cyanobacteria cultures died.



This system could be useful and productive for many farms in the future. There are however several pitfalls to the system that will hinder its widespread adoption. The purifying and scaling of bacteria requires specialized knowledge and equipment not readily available. Without technical support from a university or lab, many farmers will not be able to produce enough quantity of product. The time and labor input of maintaining several stages of cyanobacteria cultures throughout the growing season is beyond many owner-operator farmers who already work long days. Additionally it is difficult to prepare the nutrient mixes and required the use of precision scales to measure out the correct amounts of chemicals, and distributing them in the correct quantities at the right time to feed the cyanobacteria. The experiment had university support in addition to a team of scientists and our culture scaling attempts still failed. Several factors contributed to our cultures dying included contamination during the initial scaling stage, improper nutrient preparation, and fluctuating environmental conditions in the hoop houses. Temperature regulation should be employed while the cultures are in small vessels due to the fluctuating temperatures within the greenhouse environment. Temperatures inside the hoop houses can vary between 50-110F during a 24-hour period. Research indicates cyanobacteria are susceptible to stress and possibly death above 90-95 F. Once the raceway scale is reached there would be enough mass to self-regulate the temperature in the ideal range. Contamination is an issue at every stage due to the design of the culturing vessels requiring an open top. The construction delays forced us to keep the initial culture in a hoop house that was under cultivation. There will always be contamination issues due to the nature of growing cultures on a busy farm, but with the dedicated space they would be reduced. The nutrient mixtures were made with distilled water, but water added to replace what evaporated was city water with fluoride and chlorine present contributed to the cultures dying. The water was allowed to sit in an effort to let it volatilize off those materials but was not tested to see if those elements were still present. Starting the scaling process with

larger volumes of culture would be beneficial and having the nutrient mixes pre-weighed and packaged in a just add water and mix system would help eliminate measuring errors.
(Michael Ruiz)

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ENHANCING WYOMING'S HERB CROPS WITH AUTHENTICATION PRACTICES

PROJECT SUMMARY

To enable and encourage Wyoming growers to produce and distribute hard to find herbs to ensure high quality, American grown herbs are available on the market. Educate growers on the medicinal plants in demand, as well as the plant harvesting, processing and authentication methods that make it possible for more growers to develop Certificates of Analysis (COAs) for their products. The training would include developing reference specimen for botanical identity required by current good manufacturing practices, and documenting macroscopic and organoleptic assessments in a scientifically valid manner. As a result, more high quality herbs would be available in the US sourced market. Project canceled.

PROJECT APPROACH

In 2016, EMH Elk Mtn Herbs began creating a list of potential growers and contacting them about this opportunity. Many of the initial contacts were made via email and telephone. Although there had been interest expressed from growers due to staff turnover Elk Mtn. Herbs requested that the project be cancelled due to staff turnover.

GOALS AND OUTCOMES

Elk Mtn Herbs was unable to complete the proposed work plan, goals, objectives and outcomes. Although some initial work on the project was done the project was canceled at the request of Elk Mtn Herbs due to staffing issues and the contract was terminated.

BENEFICIARIES

There were no beneficiaries.

LESSONS LEARNED

Of the \$24,500 originally allocated \$0 was requested for reimbursement. WDA requested a change in focus to reallocate the funds to other projects. The two additional projects funded were Safely Preserving Specialty Crops and Wyoming Producer and Processor Trade Show Grants.

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SAFELY PRESERVING WYOMING'S SPECIALTY CROPS

PROJECT SUMMARY

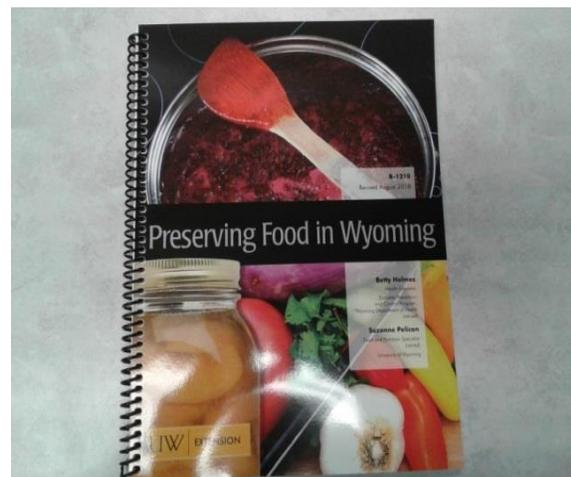
Safe food preservation requires knowledge of safe and sanitary dehydration, freezing, pressure canning, steam &/or boiling water bath canning. Safe specialty crop preservation knowledge and skills has been shown to prevent food borne illness outbreaks. Steam and boiling water bath canning requires accurate altitude adjustments to preserve food safely for an extended period. Pressure canning requires accurate altitude adjustments and properly functioning canner gauges. The specialty crop preservation classes provided instruction and practice in selecting safe recipes, accurate altitude adjustment, and safe and accurate use of canning and dehydration equipment. The project was important and timely as more individuals were interested in preserving food that is locally grown but do not have the necessary training to ensure that it is safe. Extension Educators across Wyoming built on previous efforts to educate individuals about the necessity of safely preserving specialty crops by continuing to provide workshops, bulletins and answering questions. The focus of this project was to increase knowledge and skills of home specialty crop food preservers in Wyoming and to prevent of foodborne illness caused by improperly home preserved specialty crops as a result of using outdated recipes, failing to adjust for altitude, and a lack of knowledge about recipe sources and specialty crop preservation. This project provided printing of up to date specialty crop food preservation information. The bound bulletins were distributed to each county Extension office in Wyoming. Throughout Wyoming the Nutrition and Food Safety Educators provided instruction, workshops, distributed bulletins, and answered questions. This project also provided Nutrition and Food Safety Educators with additional supplies for teaching specialty crop food preservation classes.

PROJECT APPROACH

With the help of the University of Wyoming staff the individual "preserving the harvest publications" were reviewed organized and formatted into a comprehensive Preserving the Harvest publication.

Put bulletins out on bid for printing.

2200 books were printed and distributed to UWYO nutritionists around the state for distribution to people taking food safety classes. Evaluations were distributed to



educators for reporting
Planned, scheduled and advertised 34 canning workshops.
Offered canner gauge testing in each county for a total of 37.
Summarized data and developed an impact statement

GOALS AND OUTCOMES ACHIEVED

GOAL: Increase individuals' food safety skills and knowledge on prevention, detection, control, and intervention food safety practices.

Target: We anticipate that at least 80 percent of approximately 120 participants will indicate that their knowledge has increased as a result of their participation in the workshops.

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

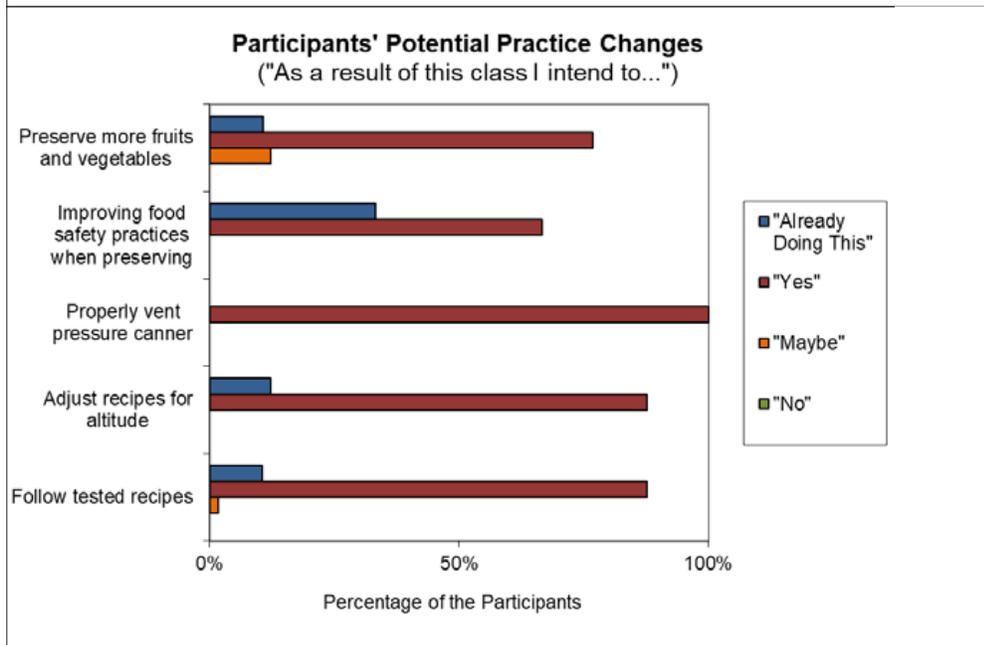
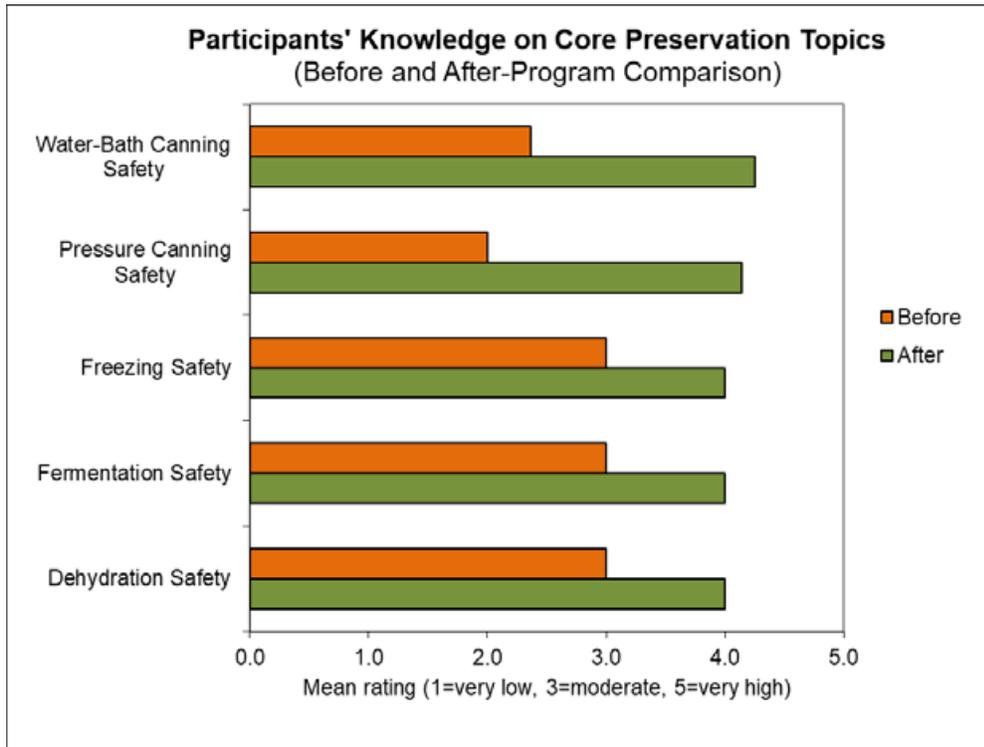
Performance Monitoring: At the UWYOCES Nutrition and Food Safety preservation workshops the percentage of individuals who report an increase in knowledge will be measured through surveying participants at the end of each workshop about how much they learned.

OUTCOMES: 2200 Preserving the Harvest books were published for distribution and food preservation classes were taught to 83 people in areas of the state with a Nutrition and Food Safety Educator.

Satisfaction/Approval: Participant ratings for relevance of information, presentation quality of instructors, and overall workshop quality averaged 3.9, 3.9, and 3.9, respectively, on a four-point scale (1 = not satisfied, 2 = somewhat satisfied, 3 = satisfied, 4 = very satisfied). Additionally, many participants voiced their excitement over learning new skills.

Increase in Knowledge: A large majority of the participants indicated an increase in knowledge surrounding core food preservation topics. 90% of participants indicated an increase in knowledge of food safety topics. Additionally, the average increase in knowledge was over one and one-half points on a five point scale! This represented an increase from low/moderate knowledge before the workshop to high knowledge after the workshop. Additionally, the average increase in knowledge was over one and one-half points on a five-point scale. This represented an increase from low/moderate knowledge before the workshop to high knowledge after the workshop. Most importantly, a large percentage of participants indicated intentions to adopt important food safety practices as a result of contacts with Nutrition and Food Safety Educators and participation in classes.

These behavior changes included properly venting when pressure canning, correctly adjusting recipes for altitude, and following tested recipes.



Behavior Change: Most importantly, a large percentage of participants indicated intentions to adopt important food safety practices as a result of these programs. These behavior changes included properly venting when pressure canning, correctly adjusting recipes for altitude, and following tested recipes. Additionally, 77% of participants

indicated intentions to preserve more fruits and vegetables at home as a result of this program – an important step towards increasing fruit and vegetable intake. Safely Preserving Wyoming's Specialty Crops recipe books are available in each of Wyoming's 23 County Extension Offices. Nutrition and Food Safety Educators have equipment to use when teaching canning classes.

BENEFICIARIES

The Preserving Wyoming's Specialty Crops recipe book is a professional, spiral bound 101-page document. . The total number of people impacted will be 2200 when all publications have been distributed. Up-to-date food preservation information is vital to food safety. UW Extension Educators now have a publication that is relevant, accurate, research-based information and educational. With the increased interest in home food preservation and growing specialty crops, this document is timely and necessary. Readily available Specialty Crop recipes in a professional document make the document a valuable resource for clientele who preserve Wyoming's Specialty Crops. Extension offices across Wyoming have tested over 80 dial-gauge canners, distributed research-based food based information, and provided resources and contact information for Nutrition and Food Safety Educators. Food preservation classes were taught to 83 people in areas of the state with a Nutrition and Food Safety Educator. 10 radio programs in Platte County potentially reached a combined 12,000 listeners. Wyoming Extension Nutrition and Food Safety Educators answered over a 110 questions about preserving specialty crops via personal contact, email, eXtension.com Ask-the Expert, or telephone.

LESSONS LEARNED

Across Wyoming citizens are interested and seeking unbiased, research-based food preservation information in the form of questions, attendance in classes and workshops, requests for pressure gauge testing, and requests for recipes. This Safely Preserving Wyoming's Specialty Crops Grant has allowed information and classes to be provided. Preserving the Harvest books is now available in each Extension office across Wyoming.

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WYOMING AG PRODUCER, PROCESSOR AND HANDLER TRADE MARKETING GRANTS

PROJECT SUMMARY

The Wyoming Business Council helped support independent specialty crops producers by providing Trade show marketing grants to increase their knowledge and marketing opportunities. There are multiple challenges to growing and marketing specialty crops in Wyoming. The state is situated at high elevation, much of it semi-arid high plains with varying levels of soil quality, access to water and short growing seasons.

Wyoming is the least populated state in the country, spreading across a vast geography that often isolates farmers from the kind of support that can vastly improve specialty crops production outcomes. Because of our sparsely populated State, Wyoming specialty crop producers' need to expand their markets outside of Wyoming. More and more producers are learning that being a price maker verses a price taker is critical to the viability of their farms.

Part of this process is a need to increase their knowledge of marketing by

attending national trade events like the Natural Products Expo West or other appropriate trade events. These types of shows are geared toward specialty crop promotion, marketing, and processing. The Wyoming Specialty Crop Program has previously offered grants to increase knowledge of specialty crop producers, processors and agricultural professionals on production, marketing, promotion and food safety of specialty crops. This project was an opportunity for Wyoming individuals to be able to take advantage of trade events to increase marketing opportunities for specialty crops. Once a producer, handler or processor has been exposed to broader marketing opportunities their ability to be a sustainable operation increases dramatically. This project continued the efforts of a previous SCBGP by expanding markets for our specialty crop producers and introducing them to new educational and marketing opportunities through the trade shows.



PROJECT APPROACH

The project provided small marketing grants to cover eligible expenses related to attending eligible trade events. Guidelines for the grant were developed and posted on the Wyoming Business Council website. Grant applications were reviewed and awarded on a competitive basis for specialty crop producers. Three grants were awarded with the requested funds to send producers to the Natural Products Expo West. An application for the marketing grant which included eligibility requirements, eligible expenses, goals, potential impact, measurable outcomes and a budget was developed. Three grants were awarded with the requested funds to send producers to the Natural Products Expo West. While at the show the producers were also able to take advantage of Western Agricultural Trade Association meetings with export buyers. Plans were made to bring additional producers to a second identified trade show Natural Products Expo East. This was not accomplished do to WBC trade show coordinator resigning from the position in the summer of 2018 and the position remained vacant for several months.

GOALS AND OUTCOMES ACHIEVED

- 1) **Goal** - Increase in marketing knowledge for specialty crop stakeholders
 - a. **Benchmark** - In 2017, 5 producers attended Natural Products Expo West
 - b. **Target** – 7 producers will attend marketing trade shows
 - c. **Performance Measure**- Wyoming Business Council will monitor the progress toward this goal by requiring reports that gauge the effectiveness of the marketing grants at increasing the knowledge of the recipients on marketing opportunities and buyer contacts.
Performance Monitoring Producers were surveyed for increase in knowledge. The average increase in knowledge was 93%. Producer quote “Nearly all of my buyers and my exposure to other markets were made strictly because I have attended Expo West.”

- 2) **Goal**- Provide an opportunity for producers, processors or handlers to increase their Specialty crop sales
 - a. **Benchmark**- \$520,000 in sales were generated by NPEW attendance in 2017
 - b. **Target**- 10% increase in sales over 2017 (a return of \$572,000)
 - c. **Performance Measure** - Wyoming Business Council will manage and promote the grant program. The requirement for reimbursement will be the completion of a survey to determine the level of expected return. An additional survey will be administered in September after harvest to producers for contracted acres or sales. All records will be maintained by the WBC. One producer did not sell any product but made contact with 21

potential buyers that she will pass onto other herb growers in the state through the Farmers Marketing Association conference in 2019.

- d. **Performance monitoring:** A survey of the producers indicated that sales from Natural Products West were approximately \$442,000. This was in addition to the \$520,000 in sales from the year before. This fell short of our sales goal but had the producers not been there to talk with buyers they might not have been able to sell their crops at a premium price.

BENEFICIARIES

3 specialty crop producers were directly impacted. One of the producers has 3 other producers in his marketing group. Additional beneficiaries include producers being mentored the attendees who are new to the organic market. . The goal was to impact a total of seven producers.

One producer indicated that they had narrowed down the leads generated at the conference to 21 and they will eventually be provided to other Wyoming herb producers to market products.

LESSONS LEARNED

It often takes several follow up reminders to get the information needed. The resigning of key marketing personnel is always a challenge given the time and energy required to fill positions with qualified people. Cross training is clearly needed in every key position in order to fill the gaps when someone leaves. The number of producers impacted would have been higher had a mission to the Natural Products Expo East been accomplished

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FARM TO SCHOOL/CACEP GARDEN MINI-GRANTS

PROJECT SUMMARY

Schools and child care centers across Wyoming are hungry for local foods. With a short growing season and inclement weather, a school or facility gardens are not always feasible for either education or consumptive purposes. The Farm to School/CACFP (Child and Adult Care Food Program) Mini-grant Project provided funding for schools, child care or adult care facilities to install a garden specific to their facility. These gardens took shape in the form of hoop houses, raised beds, vertical growing systems or other innovative gardening methods chosen by the grantee

The purpose of the project was to provide access to local foods for schools and child care centers, as well as hands-on learning for students. This project is important and timely due to the fact that our world population is growing exponentially and the number of agricultural producers and agricultural land in production is decreasing. On a more local level, communities are concerned about disease, obesity and how, what they are consuming affects them on a daily level. Farm to School programs make two things possible. Firstly, fresh foods are more accessible for use and consumption in school meal programs. These programs include breakfast, lunch and snack options offered both at school and in child care facilities across the state. Secondly, our population is extremely far removed from the actual process of growing and the knowledge that food does not just appear on the grocery store shelves is of vital importance to students. The farm to school programs in the form of mini-garden grants for schools and child care facilities addresses both of these issues.

Poverty is wide-spread in the United States as well as in Wyoming. Many children go hungry and do not have enough to eat. Although the National School Lunch programs provide free and reduced meals to those in need, the Farm to School program provides a more hands on approach. With students learning about the foods they consume and understanding they can producer them on their own, the program is laying the foundation for our next generation to be more self-sufficient and sustainable.

Because of its varied audiences and locations, the Farm to School format varies within each community. The “learn by doing” approach facilitates development of healthy habits at a young age. Targeting both school age students as well as those enrolled at child care centers allows for the program to reach two separate age level audiences.

Over the past few years, local foods have made great strides in Wyoming and we plan to continue growing and advancing the program. Previous concentration has been in K-12 schools. While those efforts are continuing, this project helped advance the scope to include child care facilities. In addition to the benefits these facilities received from having fresh produce to utilize for snacks and in meals, the mini-grants incorporated an education

component utilizing curricular activities from USDA's Team Nutrition resources. While demand for local food consumption continues to increase, so too does the need to know how to grow, harvest and properly consume a healthy diet. With easy access to both high quality and nutritious food and the lessons on how to best utilize this produce, this project provided a sustainable method for providing and educating the target audience.

A past SCBGP project appears somewhat but the projects differed in that the previous grant was directed at non-profit organizations and communities. The current request targets only schools and child care centers enrolled in the Child and Adult Care Food Program (CACFP). The previous grant did fund some school projects but those schools were not eligible to receive funding under this program.

The Farm to School/CACFP Garden mini-grant program successfully increased the number of schools/centers in Wyoming with a garden by 10 locations. Seven locations implemented gardens of a variety of styles including high tunnels as well as raised beds. The final three sites had high tunnel workshops constructed in a joint venture with Jeff Edwards and the University of Wyoming Extension Service. All projects had the potential to reach students from early childcare to high school; however, the majority of directly impacted students were at the elementary level. Each grantee specified the number and nature of persons to be directly impacted in their individual grant applications. Upon reading the reports provided by the grantees, all numbers were achieved and in many cases the direct number impacted was greater than expected. In addition to the increase in number of school or child care center gardens, staff at each location received training and guidance from WDE as well as local gardening groups. University of Wyoming Extension agents and local Master Gardener Groups were among the most utilized resource at all projects. As an added benefit of using the growing of gardens for consumption, educators have been able to incorporate hands-on teaching approaches for multiple subjects. Students have had the opportunity to "learn by doing", thus enhancing their learning experience for classroom topics such as science, math, technology and many others. With the nutritional and growth knowledge learned at these selected sites, it is expected the knowledge will also follow students home to their parents and families, with the expectation that positive experiences will encourage talk and sharing of learned practices and excitement about specialty crop foods not normally consumed.

Goal: Increase the knowledge, growth and consumption of edible specialty crops at schools and or child care centers enrolled in the NSLP or CACFP programs in Wyoming.

Benchmark: Less than 25% of schools and CACFP centers currently have a garden or utilize a garden for education or consumption of specialty crops.

Target: Increase the number of schools/centers with a garden used for education, growth and consumption of edible specialty crops by at least six locations, with a maximum determined by funds.

Goal: Increase knowledge of school and CACFP program educators on how to grow and utilize specialty crops in programs meals and snacks.

Benchmark: Less than 20% of schools and centers currently use on site gardens for nutrition education and consumption.

Target: A minimum of 12 program educators or food service staff will learn how to grow, harvest, clean, prepare and serve specialty crops from their garden to their students.

Goal: Provide training and education for Wyoming students about the benefits of eating well and how to produce and utilize edible specialty crops to feed and energize their bodies.

Benchmark: At least one half of today's students do not know where their food comes from.

Target: A minimum of six schools and/or centers will install and utilize a program garden to teach a minimum of 100 students how to grow, harvest, clean and prepare specialty crops from their garden.

PROJECT APPROACH

Wyoming Department of Education awarded funding to create a garden of their choosing at 7 schools or centers in Wyoming. The schools/centers then executed their plan to create an educational garden producing consumable specialty crop products. For school personnel not familiar with gardening or preparing specialty crop foods for meals, grantees were encouraged to work with Cent\$ible Nutrition, Master Gardeners or other local resources for support in growing and caring for their project. These partnerships with local resources provide support and guidance for sustaining a school/center garden. Centsible Nutrition representatives provide food service staff on how to prepare and utilize items grown in the garden for school meals and snacks. Grantees reported to WDE quarterly as to progression their projects with a final report being submitted at the completion of the project. The grant also allowed for WDE to partner with UW Extension and Jeff Edwards to fund three high tunnel workshops at an additional three locations. Grantees were selected after submitting a proposed project with applications being judged on a rubric scale. Each of the three locations partnered with Jeff Edwards to construct a high tunnel at their location and carry out growth and use of specialty crop products for their school or center nutrition and education programs. Grantees reported to WDE quarterly with a final report detailing how the project had been accomplished and would be sustained.

Please see detailed approach in the goals and outcomes of each project description. WDE's continued monitoring and providing technical assistance throughout the grant period.

GOALS AND OUTCOMES ACHIEVED

The Farm to School/CACFP Garden mini-grant program successfully increased the number of schools/centers in Wyoming with a garden by 10 locations. Students from early childhood to high school level were directly exposed to growing, harvesting and consuming specialty crop products they may not have otherwise had access to.

- **Goal 1:** Increase the knowledge, growth and consumption of edible specialty crops at schools and or child care centers enrolled in the NSLP or CACFP programs in Wyoming.

WDE increased the number of gardens at schools or centers in Wyoming by ten locations. The number of students affected at each location varied as to the location, but all showed an increase of knowledge, growth and consumption of edible specialty crops at their specific site.

- **Goal 2:** Increase knowledge of school and CACFP program educators on how to grow and utilize specialty crops in programs meals and snacks.

Through the monitoring of quarterly reports and final project reports, WDE determined that educators and food service personnel at the ten locations increased their knowledge of gardening through experience and the food service staff gained experience in working with fresh specialty crop items harvested directly from the school/center garden.

- **Goal 3:** Increase the knowledge of Wyoming students about the benefits of eating well and how to produce and utilize edible specialty crops to feed and energize their bodies.

Lack of response on pre-surveys did not provided us with what we considered an adequate baseline; however the post surveys show a definite increase.

The WDE Final report includes attachments of reports as well as photos from grantees.

2018 WDE continued monitoring and providing TA to grantees. Most of the small garden grantees finalized their projects and the three high tunnel workshop locations began in earnest and continued their reporting. Below are the entries from the evaluation of the seven garden grants along with updates as well as the high tunnel site updates.

We continued monitoring and providing TA to our current grantees. With the quality of the reports and proof of completion and progress from the seven garden grantees, WDE transferred some of the money allocated in the grant for travel and converted it to another mini-grant cycle. The remaining \$3900 in funds were awarded to three, schools/child care centers to host high tunnel workshops. The grantees have completed the high tunnels for future use and provided documentation and reports. The awardees were chosen using a rubric scoring system with emphasis on specialty crop growth and education, sustainability

and use of specialty crops in USDA Child Nutrition programs. Summaries of the high tunnel awardees and progress are also listed below.

Measurable Outcomes

Goal 1: Increase the knowledge, growth and consumption of edible specialty crops at schools and or child care centers enrolled in the NSLP or CACFP programs in Wyoming.

WDE continues to monitor progress through reports from the seven grantees. Specific information is listed below on each of the projects, with a few of the grantees completing their projects. This goal was met in 2016, however, when all final reports are submitted, WDE will provide comprehensive information and data collected over the grant period with a final summary of the level of success for this goal.

Goal: Increase knowledge of school and CACFP program educators on how to grow and utilize specialty crops in programs meals and snacks.

WDE continues to monitor the grantees through quarterly reports. Additional students, teachers and community members have become involved in different projects, while others have lost some outside interest. As some of the grantees have completed their projects and others are still ongoing. Although a pre-survey was issued, grantees were not responsive. As WDE has continuously requested this information, because the grant is more the half over-we are foregoing the pursuance of the pre-survey responses and will concentrate instead on the post survey. With the recent submission of final reports-the post survey will be issued immediately to those projects and held until all projects are completed for a final analysis of data.

Goal: Increase the knowledge of Wyoming students about the benefits of eating well and how to produce and utilize edible specialty crops to feed and energize their bodies.

WDE feels that this goal has adequately been met, but due to the lack of response to the pre-survey, we do not feel that we have the data to establish accurate data at this time. With several projects producing final reports-the post survey will be administered to those submitting final reports immediately with WDE to provide and overall analysis of data and success of the goal with their final report in 2018.

PERFORMANCE MEASURE: The number of schools and/or child care centers that were not participating in Farm to school will be measured and their successes documented. Number of program educators and food staff in Wyoming will offer local food on their menu having processed it from seed to plate. Percentage of students who are exposed to school gardening and other Ag education projects that have an increased understanding of where their food comes from.

The following are the results of six schools and preschools who responded to survey.

How many students at locations. 786

What percent of students were directly impacted through the garden project? An average of 83%

How many educators and food service personnel at your location? 123

What percentage of educators and food service personnel were directly impacted through the garden project? Average of 79%

Did student knowledge, growth and consumption of edible specialty crops at your location increase due to your garden project? Average increase over projects 75%

Did educator and food service personnel knowledge, growth and consumption of edible specialty crops at your location increase due to your garden project? Average increase 56%

Did the knowledge of Wyoming students increase as to the benefits of eating well and how to produce and utilize edible specialty crops to feed and energize their bodies? Average 71%

WDE met the criteria but feels it important to continue the tracking of increase. This year the survey recipients have been less responsive to answering survey questions and there has been some turnover in various locations. The turnover and lack of response by some schools did not give WDE as much information on collection of data for comparison of 2016 to 2017 as we would have liked.

The sub grantee reports are included below. We did receive some responses to our survey, but without complete participation, the results are not accurately conclusive. However, based on information gathered through the reports at each site, it is apparent knowledge of specialty crops has increased however there is not a baseline measure or scale to measure against. This project had successful impact increasing the knowledge of students at 10 schools and preschools learning but was not successful in gathering all the expected information on increase in knowledge.

BENEFICIARIES

Total number of beneficiaries reported included 1561 students, 97 teachers, 123 food service personnel and 133 parents and volunteers. Not all students were directly impacted by involvement in activities in the gardens but were able to learn from them in an informal way.

LESSONS LEARNED

Throughout the grant period, WDE found the project centers gained the expected knowledge, but found that tracking and maintaining contact with all the project sites was difficult. Additionally, we had intended to visit all of the project sites. While we still think this is a good investment of time, we feel it would be most beneficial to contact additional

labor to do the traveling or do away with travel time due to the complete documentation of the projects through pictures. At the time of this report, it is known that all projects are still functioning. However, some project focuses have changed locations and purpose, but the initial investment to learn more about specialty crops and influencing students to eat a healthy variety of foods is still present. Although the method of collecting data was simple, we found that a more quantitative approach may be a better approach at collecting measurable data.

Wyoming schools and child care centers are very receptive to learning about specialty crops and gardening. Time, location, short season and lack of funds are the main barriers to educational organizations including specialty crops in their meals and having consistent access.

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Projects funded

The Woodland Park School Garden “Minga”:

Project Summary: Our overall goal for this project has been to provide students with a sense of ownership of their school and greater community, while helping them become better environmental stewards and developing important skills such as patience, cooperation, teamwork, pride and volunteerism. We have done this by providing hands on experience for students to understand the process of farm to plate and to improve the overall health and wellbeing of our students.

Project Approach: Our hoop house was built on September 20th and 21st 2017. We were able to assemble an amazing crew to assist in construction, which turned out to be a record breaking time of just 9 hours. The volunteer build crew was composed of parents/grandparents, staff members, Rooted in Wyoming (RiW) Board Members and other community members. A total of nearly 16 adults participated in the build of the hoop house, with an additional number of people involved in the food and beverage provisions. During the hoop house build, students were excitedly watching the progress from the playground and classroom windows. Many classes of students have been compiling and sending thank you notes to volunteers.

The hoop house has been the first hard structure component of the garden. A dedicated team of staff, parents, and RiW board members assembled and begun regular meetings to plan for the next steps in hard structure components, including water access and fencing. A

decision to fence the area was reached by the planning committee in October, and will be an area of 100' by 100', enclosing the hoop house. This fencing project will be completed by a local fencing company, The Bockman Group, and funded by the PTO, matching funds from UW – ShREC, and RiW.

During construction, a donation of 1-2 free-standing hydroponic systems was made by a volunteer builder/family member. The intent is to house the system(s) in the hoop house this coming spring. The donor is a local producer who will assist in the set-up and maintenance of the systems.

Many community partners have come together to make this a reality: Woodland Park PTO, Rooted in Wyoming, Whitney Benefits, UW Sheridan Research and Extension, WP families and staff members, SCSD#2, and Sheridan community members.

Project Approach Almost two years ago, looking out at the Adams Ranch fields adjacent to our school, 2nd grade teacher Donna Johannesmeyer saw a space perfect for a school garden. With the help of Rooted in Wyoming Executive Director, Bonnie Gregory, the collaboration between Whitney Benefits, UW Research and Extension Director, Brian Meador, and SCSD#2 administration began. Once the plan was underway, Woodland Park's Student Council held a garden naming contest. Each student in the school had a chance to submit a name, and from the submissions a handful were chosen for the school wide voting process. Students voted, votes were tallied, and the chosen name was The Garden of Pride, submitted by 4th grader Carson Foote. Carson was recognized at an assembly, and given a Chamber Bucks certificate by the PTO. (Over 250 students were involved in voting on the garden name.) In a short time, a land use agreement was put into place with the University of Wyoming, and building the garden came to fruition. In September of 2017, the high tunnel hoop house was built with this grant. In April of 2018, a 6 foot no climb fence, funded by the WP PTO (\$2500 contribution), UW ShREC (\$2000 contribution to materials), Rooted in Wyoming (\$1150 contribution) and Dan and Becky Bockman (\$1886 in-kind contribution), was completed by the Bockman Group. In April of 2018, nearly 100 students, parents, teachers and community members showed up to build raised beds (timbers donated by Sheridan County Roads and Bridges via RiW) and a classroom sized teepee for grapes, cover walkways and paths with mulch, and begin an area for vermicomposting. We also held a Supply Drive in April and with all of the donations needed a storage space. Our partners, Rooted in Wyoming, graciously donated a 7' x 7' shed for that purpose. (Over 300 hours of labor on 4/21/18, \$250 cash donation, garden supplies (wheelbarrows, shovels, hoses, gloves, etc.) donated, 3 tons of compost donated by RiW, shed (\$600) donated by RiW)

GOALS AND OUTCOMES:

Goal 1- Supplement the Fresh Fruits and Vegetables Program The produce that was ready to harvest during the school year from the hoop house included spinach and lettuce. These were enjoyed by students in the After School Program and in two second grade classrooms.

Goal 2- Produce enough food that the students are able to share it with and engage their families. Throughout the summer, two families or school programs per week are signed up to care for the garden. An incentive to encourage families to participate is access to harvests from the garden. There is a Harvest Log kept in the hoop house where families record their harvests. At this point, families and students have made harvests of tomatoes, cucumbers, zucchini, spaghetti squash, basil, dill, oregano, mint, peppers, watermelons, flowers, peas, beans, cilantro, potatoes, and onions. Approximate weights have been recorded in the log book.

Goal 3- To collaborate with the Centsible Nutrition Program by providing after school projects/classes for families using the food grown in our garden. The 5th session of our After School Program held a class taught by Lori Dickinson of the Centsible Nutrition Program. Students in the class sorted out seeds donated by local Shiptons Big-R and planted the seeds that are now growing in the garden and hoop house. We plan to hold another Centsible Nutrition class this school year with school grown produce.

Goal 4- Provide academic enrichment opportunities during non-school hours for children, particularly students who participate in 21CCLC.

Outcomes We held 4 6-week sessions throughout the school year for students in the 21CCLC. All classes were related to agriculture, gardening and nutrition.

Students have become involved in the growing hoop house and garden project in many ways:

The Student Council chose the garden as their October project. After being briefed on the progress of the garden area, the student council chose to promote a school wide garden and hoop house naming project. Council members took the project back to their classrooms, and shared the instructions. Teachers collected proposed garden and hoop house names and added them to a school wide shared document. Each student in the school was involved in the naming project, and classrooms submitted 3-4 of the top names. A school wide vote will happen on November 1st to select garden and hoop house names.

More than 60 students have used the hoop house during class time on various occasions. The purpose of use was for an outdoor writing classroom, STEM classroom and a reading location. Classroom teachers have begun to share photos and usage in a shared electronic folder.

The After School Program class, which is called Learn, Grow, Eat and Go, has made use of the hoop house on several occasions for inquiry and class projects. The class meets two days per week, and varies in size from 16-24 students.

A pre-gardening class survey was given to students. The purpose was to gather data before class exposure to determine background in areas of plant knowledge, gardening experience, food preferences and activity levels.

Specifically, the Texas A&M based curriculum, has a component that includes a project called Paper Towel Gardening. The class uses paper towels as a tool to map out square foot gardening to plan and size beds according to the desired crop that will be planted. The class

researched fruits and vegetables that could be planted in the early season of 2018, and made a preliminary map of crops to be planted in raised beds. The six-week class will culminate with the building of several raised beds in the hoop house and a plan for spring use.

The class has also used the hoop house as a potential site for germinating seeds in an experiment that looks for ideal sprouting conditions. Choices for soil sprouting were 1) dry soil, 2) moist, warm soil, 3) moist, wet soil, and 4) soaked soil. In choosing places to leave containers, the class hypothesized that since outside temperatures were in the 30-40 degree range, the hoop house would be a good candidate for the cold environment. The class then went to measure outdoor temperatures, and temperatures within hoop house. Only one student predicted that the hoop house would be warm, and the others were surprised by the temperatures. The students were then making predictions as to why the hoop house was warmer than outside, with most responses involving a heat source. This led to an inquiry based lesson on hoop house method of operation.

As the 2017-2018 school year came to a close in May, water access was made to the garden with the generous donation of time and materials from Rapp Plumbing and Heating. As with all gardens, once water was in, planting began in full force! The 20 outdoor raised beds, one for each classroom, were planted with seeds sown by our After School Program students and maintained at the UW Greenhouse. We also planted a pumpkin patch, grapes for the teepee, beds inside of the hoop house, and a pizza garden.

Throughout the first summer, we have 2 families or summer school groups per week signed up to maintain the garden. In addition, the garden has been an outdoor classroom space for three different programs this first summer.

One program, Summer STEAM Camp, used the garden on a daily basis for two weeks in June. The number of students from across the school district using the garden was 22 per week.

In addition, the garden was used by the Summer Acceleration program for three weeks 7/23-8/11. Each day approximately 14 students were in the garden for an average of 45 minutes.

Finally, the autism program used the garden daily for 5 weeks during the summer as an outdoor classroom. On average, there were 5 students that spent roughly 30-45 minutes per day in the garden doing such things as watering, weeding, planting, or simply exploring. The Autism Program at Woodland Park has begun designing a sensory garden area this first summer as well.

Beneficiaries: Students: 310, teacher and staff members: 30 community members 20

Hoop House Build- 10 community members

April Build Day- 100 parents, students, teachers, community members

Water Installation: 3 community members

Shed construction: 6 adults, 2 children

July Build Day – 7 volunteers, 2 teachers and 5 parents

Summer Maintenance – 28 families or staff members signed up to do one week of summer care

After School Participation – o Session 2: 19 students, 3 teachers o Session 4: 18 students, 3 teachers o Session 5: 14 students, 3 teachers o Session 6: 25 students, 4 teachers

Seedling watering and care at UW – 3 community members

Raised bed prep for planting and planting: 12 classrooms, approximately 18 students per classroom plus teachers. 216 students plus 12 teachers. Parties involved in building projects were community or family based parties who volunteered to help with the effort. Their participation was on a need basis, and most of the volunteers have expressed interest in helping with future need.

Future Plans Our garden community has great plans for the future use of the hoop house and whole garden. In particular, the hoop house is in the process of being prepared for a fall planting of a salad/snack garden to supplement the school cafeteria. The goal is for the project to expand and reach all members of the school community. Recent developments have been contact from the new Food Service Director for the school district who is interested in bringing garden produce into the cafeteria program! Throughout the process of implementing and building our hoop house and garden, we have had support and guidance from staff at the UW Research and Extension Center and the UW College of Agriculture and Natural Resources. We have also had unwavering support from Rooted in Wyoming Youth Gardening Collaboration. Our Centsible Nutrition Program has been involved and plans to continue working with our students and staff in teaching how to plan and prepare meals with fresh produce.

Pinedale Children's Discovery Center – High Tunnel Workshop Grant (Fall 2017)

Project Summary: The project goal was to give students knowledge of why a Hoop House allows us to grow specialty crops over a longer period of time. The Children's Discovery Center needed a hoop house to help assist feeding 45 students and 6 teachers breakfast, lunch and snack year round. Since we live in such an alpine climate, it is hard to grow crops in our natural ground, so the addition of a hoop house was beneficial to providing some fresh produce. Additionally it provided educational opportunities for the children to learn where their food comes from and how to plant, water and harvest the crops.

Project Approach: During the grant period, we didn't start construction until spring due to weather reasons. In the Spring, we had some raised beds built for us by Sluyter Construction, black fabric donated by Petersen Landscaping, rock shipped in by Teletractors, Inc., the mulch donated again by Petersen Landscaping, and the soil given to us at a discount by Wind River Gardens. We were very thankful for all organizations and the parent volunteers involved. The high tunnel was completed with the assistance of the UW Cooperative Extension staff and several volunteers from the community and our facility.

GOALS AND OUTCOMES:

Goal: To give students knowledge of why a Hoop House allows us to grow specialty crops.

Outcomes Achieved: We had 45 students who were involved with planting, watering, and harvesting crops from April – Sept 2018. We also had about 10 volunteers with the building process, as well as 10 additional volunteers when planting seeds in the spring. We were able to feed up to 45 students and 6 adults Breakfast, Lunch and Snack daily which alleviated our food costs during this growing season (May – August).

Goal: To incorporate specialty crops into Kitchen Classroom and Cooking Class curriculum

Outcomes Achieved: For our older students in the summer, we were able to use our specialty crops for cooking classes, curriculum use, and for fundraising at our Local Farmer's Market.

Students were involved in hands-on cooking classes and food preparation for our Farmer's Market during the months of June, July and August. We were able to teach to 15 older students about food education throughout the summer and how to appreciate the process of planting, watering and harvesting and were able to grow crops in our hoop house that aren't normally grown in Wyoming or that don't survive without a Hoop House/Green House.

Beneficiaries: We had up to 45 students and 6 teachers who benefited from the crops in our kitchen, and who were a part of the hands on education of planting, watering, and harvesting. We had a volunteer day that allowed us to build us our Hoop House in less than 48 hours, and another volunteer day that included approx. 10 volunteers who helped us setup the inside of our Hoop House and helped plant seeds. We also had many organizations/businesses that donated materials to make our Hoop House complete. We were very thankful for all organizations and the parent volunteers involved. In the future (next spring), we plan on planting seeds again to an even larger group of kids; an increase of 45 kids to more than 50. We want to see crops grow from spring until fall, instead of spring and summer.

LEAF Garden Hoop House (Fall 2017)

Project Summary: The LEAF Program Hoop House Garden project addressed the need to strengthen our nutrition and academic programs, and provides an outdoor classroom through which to teach to the STEM curriculum, and implement the objectives of the CACFP. With this new resource, we have been able to collect data, measure results, and interpret outcomes in a way that contributes to global health, and the exposure to STEM in our early and primary education programs. It can be extremely difficult to establish a garden, and grow a variety of vegetables in the high plains ecosystem. Many children may not have ever had the opportunity to tend to a garden and learn about the highly complex system of food. The establishment of our hoop house garden not only gives our students a chance to learn how to nurture a garden, but also exposes them to science, technology, food systems, and nutrition. By hands-on teaching we are able to shed light on a multitude of

potential career paths and interest for our students to explore as they continue to learn and grow. Opportunities for individual growth and exploration open new pathways to higher learning in Wyoming, and have the potential to lead to diversification in our economies.

Project Approach: After the completion of the hoop house workshops with Jeff Edwards of UW Extension, and 9 volunteers from GROWyoming and DPDC, we began the initiation of curriculum in the classroom by teaching lessons in food systems and plant biology. In April 2018, we assembled a crew of volunteers to build ADA compliant raised beds, and fill them with donated soil. During this time, GROWyoming donated seeds and plants for our hoop house, and assisted with the germination of seeds and lessons in plant growth and biology. In April 2018, we began monitoring temperature gradation in the hoop house to determine when the environment was stable enough to transplant our seedlings. In early May our students assisted in transplanting and planting activities, and our classrooms began a weekly rotation of watering and caring for the garden beds and plants. Once we completed our raised beds and filled them with soil, Claire Ratcliffe of GROWyoming agreed to meet with us every Wednesday to work with our students in planting, transplanting, and harvesting. During this early stage of planting and transplanting, we extended our resources to our preschool classes at DPDC by setting up class visits, and giving lessons in renewable energy, sustainability, and the mechanics of how a hoop house works. While visiting the hoop house, students were exposed to scientific instruments, such as a thermometer, and were taught how to associate the warm temperatures they felt in the hoop house with the numbers on the thermometer. Throughout the 2018 summer program, classrooms continued their weekly cycle of caring for the plants and hoop house, and teachers taught lessons in ecology, technology/instrumentation, identification, photosynthesis, cellular respiration, sustainability, food systems (farm to plate), and the idea of native and invasive. During this time, Ratcliffe continued to assist us every Wednesday by providing seeds, plants, and fun activities for the kids. As the hard work of our students and staff began to come into fruition, our students were taught how to identify, harvest, and incorporate many new foods into their diet. Students ate specialty vegetables, such as kale, snow peas, and tomatoes, and discussed color, flavor, and texture. They were also asked to come up with dishes and products that these vegetables are used in, which helped them see the food systems process of farm to plate, plant to product, and food to human health and energy.

GOALS AND OUTCOMES:

Goal: to establish a hoop house garden, cultivate and harvest specialty crops, and use the resources of our hoop house and harvested vegetables to improve our nutrition program, STEM curriculum, and the nutritional health of the community.

Outcomes Achieved

We completed an ADA compliant hoop house with ADA compliant raised beds and layout in time to begin planting and transplanting for optimal growth. Our decision to begin planting and transplanting was based on data showing consistent grow temperatures (above 40

degrees, night and day) measured by a digital thermometer placed in the center of the hoop house. The Target for improving our nutrition program and STEM curriculum was based on a successful implementation of weekly classroom lessons geared toward introducing new, healthy vegetables into our student's diets. The idea was to build-up to the actual consumption of our own, hoop-house-grown vegetables through a series of games, activities, and lessons in plant biology, agriculture, and food systems, so that our students would feel familiar with, and willing to try these new vegetables when it came time to harvest, prepare, and consume them. Our ADA compliant hoop house and raised beds were completed on April 23, 2018, and due to data collected by our digital thermometer, we were able to begin planting and transplanting our vegetables in the first week of May. A consistent temperature reading above 40 degrees helped to insure our success. Lesson plans, which were established at the beginning of the school year (October 2017) insured that we were well prepared to use the hoop house as an outdoor classroom when the grow season began in May. Since we could not show our students the final product until harvest season, we purchased vegetables from the local supermarket that represented the plants we were growing. This helped them identify the plant with the vegetable, and allowed them to try the vegetables they were growing. As our plants matured, we successfully harvested tomatoes, snow peas, carrots, kale, and bell peppers. Our brussel sprouts and cabbage are doing very well, but still need a few weeks before they are ready for harvest. Our goal for improving nutrition was to generate anticipation and pride through the hard work of skilled cultivation. As a result, the majority of our students willingly consumed vegetables that they had never tried before. The willingness to eat new, healthy foods translates to the willingness to incorporate new foods in their diets at home, as well as later in life. In terms of our goal of improving local and global health, we needed to 1) successfully cultivate vegetables ready for harvest and consumption, and 2) prepare students to willingly consume the vegetables they grew, which would, in turn, lead to the willingness to incorporate healthier eating practices in the home. One of our greatest outcomes is a lifestyle change. As we continue to grow our own food—to bridge the gap in our relationship with food—our children are increasingly more willing to try the different fruits and vegetables we offer during mealtime. Equally important, and on a broader scale, is that our students now have the ability to begin thinking about systems. A tomato is not just something on a supermarket shelf that is purchased and consumed. Now, when our students look at a tomato, they can begin to think about science, technology, engineering, art, culture, mathematics, and the myriad of jobs that are necessary for getting that tomato to their plate. Above all, this exposure to a new way of thinking opens up a myriad of opportunities for growth and development.

Beneficiaries: 200 Students, 15 Teachers 10 Community Members

Students from both DPDC and the LEAF Program were involved with the hoop house project through class visits, lesson plans, and hands on activities, such as planting, transplanting, watering, harvesting, and monitoring the hoop house environment with

technologies and scientific instrumentation. Students learned how to use thermometers, for example, to determine watering, ventilation, and shade cover adjustment needed to maintain an optimal growth environment. As we prepare for the 2019 grow season, students will continue to visit the hoop house, germinate seeds, and discuss the incorporation of new foods and technologies into their lives. Teachers took turns monitoring environmental factors, and learned how to optimize plant growth through trial and error and the use of scientific instruments. When teachers noticed signs of fungal wilt in our tomato plants, for example, they conducted research and implemented a plan to address the problem (trim affected areas and reduce watering). Community members, such as volunteers from Feeding Laramie Valley and GROWyoming, helped us oversee our gardening plans and growth period by using their knowledge, experience, and resources to help inform decisions and guide our project to success. We hope to expand our hoop house project and garden by securing grants that will aid in the continued growth of our programs. In a recent grant application for a SparkFun Community Partnership grant, we requested a weather meter kit and Raspberry Pi kit so that we can build a weather station. Although we are primarily interested in building a weather station to collect data in relation to agriculture and plant biology in our gardens, we are equally interested in plotting correlations between biotic and abiotic components within the natural and built environment. We are continually interested in food systems, and furthering systems theory thinking so that our students can get a better grasp of how food plays an important role in various ecologies. The step-by-step process of “farm to plate,” is not only beneficial to our nutrition program and STEM curriculum, we believe that it also serves as a central force and springboard into our programmatic focus on environment, natural resources, and ecology. In the future, we plan to use our hoop house to expand into a variety of overlapping academic disciplines. We are thankful for all the help received from GROWyoming, Feeding Laramie Valley, UWYO Extension, UWYO ACRES Student Farm, and UWYO Williams Conservatory.

Garden of Eatin’ – Moorcroft, WY

Project Summary:

The initial purpose of the grant was for the Moorcroft K-8 to increase knowledge through hands on projects and collaboration. Students were to learn from farm to table concepts; working for a healthy body while caring for the environment.

The older students researched, designed, and created the raised beds for the garden. The younger students helped with planting, caring for, and harvesting the garden. These efforts required the students to work with others and create something meaningful while providing tangible results for the students as well as the community. Our experience started off wonderful. We had numerous amounts of In-kind donations. In-kind donations include labor, materials and expertise. All parties helping with the blue prints for the high tower garden, research and community experts volunteering their time and services. Their support cut our budget by at least half or more, so with their support and the funding from

this grant we were able to provide the children and community with a great resource for learning. One hang up we had was one of our core volunteers had an accident and was not able to complete the construction on or even close to the original deadline. Eventually this worked out and the project was completed at no extra cost and is made by and for the community. The garden once complete provided a place for the children to plant and cultivate their crop so they could grow food and once it was grown they brought in some items for the snack bar at lunch. They take pride in what they produced and shared with their peers. The garden did not yield a ton of food for the 460 students but they did bring in several dozen tomatoes at a time on several occasions. The opportunities for the children to learn and share are priceless.

GOALS AND OUTCOMES ACHIEVED

Goal: Develop partnerships with parents, community, high school agriculture dept., and Family and consumer science classes to increase student knowledge on growing and consuming nutritional foods. This will be measured by students making healthy food choices during the school day.

Outcome: The administrators were able to locate and get commitment from local volunteers to construct the project, the next goal is to meet the deadlines and get the greenhouse and beds completed. We also had master planters come to help students with planting once the building and beds were completed. This resulted in the completion of the green house and raised beds. Seeds were planted, cultivated and then shared. The experience resulted in the students growing their own crop and sharing it with classmates while making healthy choices and becoming more self-sufficient.

Goal: Students will be engaged in school garden project by ownership in the development of the raised beds. The students will incorporate math in the construction phase of the raised beds. This will be measured by the functionality of the completed beds.

Outcome: Children worked with volunteers to create the greenhouse and raised beds for their garden. Students assisted those volunteers with the construction and also grew and harvested the garden produce. From this hands-on experience, the students gained a sense of accomplishment with long-term knowledge for healthy eating.

Beneficiaries: Throughout the project, approximately 460 students at the K-8th grade level, and about 30 teachers and 15 community members were directly impacted through the project. The community members helped build and care for the garden with the children. 30 plus children were part of the building, about 20 with the planting, and cultivating. The entire school was an able to learn and enjoy the fruits of the labor. We will continue to utilize the greenhouse and its contents for years to come, we plan to grow different items throughout the seasons and share with the children at the MK8 School. We can grow flowers and other items as well. We will have 3 a greenhouse learning center available for classes and afterschool programs.

Transitions Vertical Learning Garden – Casper, WY

Project summary I applied for this grant to purchase three classroom-model growing towers from Bright Agrotech. These towers allowed me to implement year-round, hands-on, food science STEM curriculum with my high school science classes. It allowed me to develop and implement cross-curricular projects between science classes, culinary classes and the school's lunch program. Students grew lettuces, peas, spinach, cabbage, kale and various herbs in the classroom. They used these vegetables to study plant cells and contributed to the school lunch program. Students also improved upon the design of the grow towers and solved problems concerning the towers.

Goals and Outcomes Achieved

Goal: In a 20-week semester, science students will grow and eat 5 specialty crops in the classroom and share these crops with the school lunch program.

Benchmark: By the end of a 10 week quarter, students will have started 5 specialty crops from seed and plant them in the grow towers.

Target: Students grew 6 different specialty crops during the semester and shared them with the school lunch program throughout that time.

Impact: Students gained knowledge of agriculture technology, specialty crops, and plant cells.

Outcomes Achieved: Students gained pride and interest in growing their own vegetables and currently ask to work with the towers even though they are not in the class anymore.

Beneficiaries

At least 100 at-risk students came through the science classes at Transitions during this time. More than 300 students benefited from these crops by eating school lunch over this time. My project partners included the culinary teacher and the agriculture teacher at Pathways Innovation Center. Their tower provided herbs grown by students for the culinary program. Thirty-eight students passed through their program this year. 5 teachers, 350 students, 2 school aids, 2 schools Pathways Innovation Center helped with bringing new growing technology to an academy-based school focusing on agriculture. Transitions Learning Center exposed at-risk youth to gardening, new types of fresh produce, and innovation with the use of the grow towers. Pathways Learning Center will continue using one of the towers in their agriculture and culinary program. The other two towers will be moved to Natrona County High School to be used in science classes.

Mills Elementary Greenhouse Hydroponic System

Our staff and student body have expanded this year, and many of our staff and students are unfamiliar with the system.

The goal was to have a working greenhouse in 2018. We will utilize the hydroponics system with our afterschool greenhouse club doing some comparison and contrast with soil-based growing methods, and teaching students how hydroponics works. Students in garden club and 4th and 5th graders have been continuing to learn about and care for our

hydroponic system. We are currently growing cilantro, basil, arugula, and two types of kale in the system. Just prior to spring break, students enjoyed a Swiss chard soup using produce from our aquaponics system. Mills Elementary will transition to Journey Elementary, to open in the fall, at 2401 Hickory Street in Casper. This school is slated to be twice the size of Mills Elementary when at full capacity. Currently the hydroponic system is being dismantled, and it will be re-installed at our new site. Journey Elementary has been gifted a greenhouse that will be twice the size of our original. Casper Community Greenhouse project will be building this greenhouse for us, and the hydroponic system will be housed in it. Our hydroponics system is currently being dismantled to move to the new site at Journey Elementary School.

Enhancing Nutrition and Sustainability Concepts in Preschool through Gardening

Project Summary: The UW ECEC had a school-wide garden area but it really struggled getting anything to grow. We had the garden on ground level and the soil seemed to be poor as well as making it difficult for children to navigate through the area without trampling plants. Animal (rabbit and moles) issues also played a part in the poor success of the garden. We also struggled to find specific vegetables and herbs that would be successful in our dry climate and dry soils. We initially worked with UW ACRES (student run farm on campus) to talk about and brainstorm solutions to our garden issues. It was determined that we needed to add raised beds to our garden as well as have a better prepared soil including compost and peat. We received additional funding from the Laramie Rivers Conservation District. With the help from LRCD we built 12 raised beds and created a much more appropriate soil. The first year we were able to get seeds and small starter plants. We then did several educational activities with the children at the ECEC to talk about the care of the beds (water, weeding, etc.). Some of the educational activities were done by UW Extension faculty as well as UW nutrition students. The first year we did not start the garden as early as we were hoping due to construction of the beds. So, the yield was not as strong but it was much more successful than the previous year. The second year was much better as we were able to get everything planted early (some of it started indoors) and had a much stronger growing season. The result was incredible! Our garden literally exploded with plants and vegetables! The staff, children, and parents immediately recognized how successful the garden was this year. The amount of vegetables quadrupled from the previous year. Our harvest and our annual garden soup day will be a strong success this year. We look forward to continuing help and advice from ACRES and LRCD as our garden continues to grow leaps and bounds. We have purchased a small composter to have the children directly involved in that process to add to our garden next spring. With the great work that was done last year on the garden, we were able to get a much earlier start than last year.

With consultation from the UW ACRES personnel we were able to determine soil quality in the beds and make some necessary changes with addition of peat and compost. We planted

both seeds and starters in the beds in late-May and are seeing big progress in growth already. We also worked with Laramie Rivers Conservation District to decide on best rotations of plantings in the planters. LRCD also gave us more mulch in the ground to add a nice walking area in the garden. We have also added a much larger pollination garden than last year which has added a much nicer visual aspect as well as practical aspect to the garden. (See attached photos)

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Goals and Outcomes Achieved

Goal: Increase garden production at the ECEC

Benchmark: An increase of 50% of vegetable growth in first year.

Target: Production in the first year easily surpassed 50% increase. There was a 150% increase in the second year of the garden.

Impact: The increase of growth allowed for several more things to happen: children saw the impact of their work and how the garden was more successful. More nutrition activities could take place because there was more food to sample, cook with, and explore. The raised beds added a dimension of success that we had not previously had.

Goal: Add a larger variety of produce for children to work with.

Benchmark: Have a variety of 5-7 different items that would be new or different for the children to grow, harvest and taste.

Target: We were able to be successful with over 26 different vegetables and fruits. We also had a very successful pollinator garden which brought in a variety of insects which helped keep the garden healthy.

Impact: We will have a large enough variety of vegetables that we have been able to have multiple classrooms harvest throughout the summer and fall for various cooking and educational activities. We have also had enough tomatoes, zucchini, herbs, and lettuce to offer to parents throughout the season. We will easily have enough during our fall harvest for a school-wide soup day which was one of our goals.

Having met almost all of our goals, we really feel like we are in a better place to have a much more productive and sustainable garden. With the assistance from LRCD and ACRES as well as the addition of our composter and raised beds I feel like we will continue to be more successful each year. It is hoped in the next couple of years we will be able to narrow down and have a variety of vegetables that are most successful and decide how we best want to grow a larger production of a specific vegetable(s) so that we can begin to contribute to places such as Feeding Laramie Valley, Interfaith Good Samaritan, and the local farmers markets.

Beneficiaries

89 students benefited from having raised beds and the increased the number nutrition activities we were able to include them in. The students also helped with weeding watering and harvesting the vegetables. Most of the children had never been involved in gardening. An additional 50 college students participated in nutrition curriculum development using vegetables harvested from the raised beds

Lyman High School Beehives

Project Summary: LHS used the grant money to purchase the equipment and materials needed to start a beehive lab at the school. With the bee population in decline this has been a great opportunity to discuss the ecological issues around bees, care and maintenance, and honey harvesting practices. Beekeeping has a very high initial cost and this project would not have been possible without this grant. During the first year there were 4 hives purchased, at the end of the 2017 summer season we now have 8 hives and will continue to expand as space and hive health allows. The LHS Ag Department was able to expand the current beehive project from 3 hives to 10. In the spring of 2017, 4 students purchased their own bees and rented the hives, bases, and equipment needed from the Ag department. During the course of the summer they learned how to care, feed, split hives, check for parasites, harvest honey, and winterize their hives for the coming cold. Unfortunately, we did lose 2 hives but the remaining 8 are looking healthy and strong. The remaining hives will be split next spring and the students can choose to keep their new

juvenile hives or sell them to other students. Overall we harvested 36 pints from 4 hives (some were too small to harvest from this year), which is a big improvement from last year when we only were able to get 22.

Goals and Outcomes Achieved

Goal: First year beehive establishment- get enough hives, frames, feeders, and bees to establish 4 colonies at LHS.

Benchmark: 4 hives were purchased but one was lost during the season when a queen died.

Target: Students were able to work in the bee lab in small groups and practice hands-on learning.

Impact: Students were able to learn basic beekeeping skills including feeding, pest management, honey harvesting, and winterizing. They also learned about the importance of bees to agriculture and all other plant life.

Goal: Expand the current hive population through splitting hives and purchasing nucs.

Benchmark: Have additional working hives at the end of the 2017 season with student owned projects. 4 Students have purchased their own colonies and placed them on the school lab. They rented tools and boxes from LHS and were able to harvest their own honey as well as the school-owned hives in the fall of 2017.

Target: Our target was to have additional hives thriving at the end of the season; there are now 8 on site heading into winter.

Impact: Students not only continued to expand their knowledge of beekeeping, they were able to teach the new students about the bees while working on their own hives. Students who purchased their own hives have incentive to care for their hives in the hopes that they can split them next spring and double their production.

Outcomes Achieved: Beekeeping is now a functioning part of the LHS Vo-Ag department and will continue to expand. Incoming and continuing students are very enthusiastic about not only the honey collection but the overall care of the bees.

Beneficiaries: The current Ag department has 68 students enrolled, all of whom help in one way or another. Some are directly involved in the hive care while others help with inventory of all tools and equipment, hive construction and repair, bee-based garden nearby, and using social media to promote the program. Uinta County Conservation District also provided funding for buying additional frames and boxes for the student expansion portion of the lab. All current students of LHS will continue to work on the bee lab as long as they are in the Ag program. UCCD also has students come and report on the status of the bee lab annually. This has been a great project and helped a lot of students become involved in an agriculture enterprise without having access to a farm or ranch. Wyoming FFA also awarded our FFA chapter the Outstanding Chapter Model of Innovation for Growing Leaders at the state convention in 2016.

From Sage to Food on the table- A School Crop Setting in a Desert Community with Sustainable Crops

1. Set up summer plants and instructed summer teachers and principal about the function of the hydroponic planter.
2. Invited Halle from Bright Agrotech to speak and she advised to summer school students.
3. Prepared seedlings and instructed new 3rd graders on the parts of a plant; and the workings of the grant.
4. Cleaned and set up hydroponic planter.
5. Contacted U.W. plant department as to a field trip.

Harvested lettuce and bok choy, Swiss chard cherry tomatoes and lettuce

The teacher responsible for the project was moved to a classroom in Elk Mountain and permission to move the planter with her was granted. I advised her to check with the school principal and agreed to the move. The teacher taking over her current classroom did not have any interest in pursuing use of the planter and I felt the move to the then new school would keep the project alive vs. dying due to change in staff. Repeated efforts to contact the teacher at her new school as well as the teacher that took her place have yielded no communication.

Hulett School Garden

Project Summary: We worked with UW Extension office, local master gardener's club, and the Wyoming Department of Agriculture. Students drafted a design for the school garden, taking measurements, costs, functionality, and necessary materials needed. Working with the community, companies, and faculty they were able to construct raised garden beds, a community garden, and necessary deer fencing on approximately eleven thousand square feet. Students from grad levels 7-12 participated in the completion of our current school garden and cultivated, planted, maintained, and harvested a wide variety of vegetables for the whole school and particularly the Everyday Living class. Students learned the techniques of processing and canning food, cooking with fresh vegetables, and the advantages of using homegrown vegetables in the process.

Goals and Outcomes Achieved

Goal: Expand education beyond the typical CTE programs.

Benchmark: Plant, raise, and utilize vegetables from a student maintained garden.

Target: Students not necessary interested in conventional CTE programs are provided an alternative hands on program.

Impact: Student knowledge of what it takes to garden.

Goal: Learning the different varieties of vegetables that can be grown in Northeast Wyoming.

Benchmark: Determining production yield for different varieties based on quantity.

Target: Students will be able to duplicate the results in their home gardens.

Impact: Several students created their own gardens and have sold produce at local markets.

Outcomes Achieved: Students learned various gardening techniques, seed varieties, harvesting methods, different methods of preserving fresh vegetables, and various ways to prepare and cook fresh vegetables.

Beneficiaries 78

Students 50: Throughout the process the students were directly involved in the creation and maintenance of the school garden. In the first year students in grades 7-12 were involved at every step of the process.

Teachers 11: Teachers throughout the school utilize the garden for various teaching/classroom activities.

Community Members 18: In addition to the community members who planted their own crops in the community garden, we were able to provide fresh vegetables to elderly people in the community who are unable to have their own gardens. Next year we are planning to plant more of one type of vegetable to donate to the senior citizen center here in Hulett. Also, we are looking to involve the school lunch program, and expanding into the elementary as well.

RESOURCE AND REGULATORY GUIDE FOR WY SPECIALTY CROP FARMERS

PROJECT SUMMARY

Wyoming has many people who grow specialty crops for sale to others, but recent changes in state and federal laws and regulations have confused these entrepreneurs. This project was timely as it developed a Wyoming-specific regulatory and resource guide that clearly outlines the state and federal food safety rules, regulations and laws, and the conditions for which they apply. In addition, it lists sources of technical and financial support opportunities available from the USDA and other agencies that can be used to start and grow specialty crop operations, and by food hub organizers, educators, and regulators. The guide was released at an event that targeted these groups held in Casper, Wyoming. Speakers from Cornell University, the University of Nebraska, and the Wyoming Department of Agriculture addressed issues of food safety, state and federal rules and regulations, and grants and loans to build crop growing opportunities. Post-conference distribution of the guide occurred via invitations to producers and leaders in agriculture and Ag education to use the guide and to forward it to their contacts. Printed copies were also circulated around the state, and the electronic versions on flash drives were made available to targeted contacts. The outputs of this project were developed by Lovell Inc., University of Wyoming Extension, and the Wyoming Department of Agriculture who partnered to write, distribute and fund the publication that is available in paperback, on a flash drive and electronically.

PROJECT APPROACH

The development of the local food industry in Wyoming has lagged behind other states, and the number of specialty crop producers in Wyoming is still relatively low. This is due in part to a low consumer demand for local foods in many areas given Wyoming's thin population. But producers in the industry have reported a lack of awareness about the resources available to assist specialty crop producers and a lack of understanding of new regulations governing specialty crop production. Based on insights gathered at other USDA Specialty Crop Grant-funded events and through other interactions, we realized that presentations at conference-style events were not enough for producers to fully understand or take advantage of the information. What was desired was more depth. However, the producers at in-person events did appreciate introductions to the topics such as FSMA regulations, GAP certification, crop insurance, season extension, financing options and USDA and other grants and support services, and the opportunity to engage directly with others in the industry.

This project proposed to develop a comprehensive yet understandable publication, called *Food Ventures in Wyoming: A Resource and Regulatory Guide for Specialty Crops*. This guide was aimed at assisting producers in building sustainable businesses and make informed business decisions. The topics requested by producers, Ag stakeholders and key

informants included state and federal regulations that pertain to specialty crop producers, as well as information on food safety regulations, GAP certification requirements, food labeling laws, labor regulations, Wyoming business structures law, the 2015 Wyoming Food Freedom Act, and the Farm Bill. The ultimate aim was to develop the envisioned reference, then connect producers to it.

Lovell Inc. met with UW Extension specialist Cole Ehmke and planned the scope and content of the guide, and its rollout in Wyoming. The development of the guide then proceeded as anticipated. A survey was developed to help prioritize the topics of interest to producers and experts. The top topics of importance were these, in order of votes received:

- FSMA
- Food Freedom (generally)
- Raw fruits and vegetables
- Prepared foods
- Inspections
- Labeling and packaging

Ones rated as 'important' from the top were:

- Taxes
- Zoning
- Business licensing
- Honey

A few topics were rated as unimportant by some respondents, including zoning.

The results reinforced the content we intended to cover, but made us realize that some topics were so important that it would be important to carefully explain them since readers would likely be paying especial attention to what was said.

After the survey, the source content was gathered, text was written, and the document reviewed by the project team. The text was then edited by a professional editor. The resulting guide was then laid out in an attractive format by UW Extension graphic artists and a pdf document generated. Hard copies were then printed for distribution within this project and for circulation indirectly by supplying copies to stakeholders with an interest in rural economic development. We planned and hosted a workshop for the guide on May 14, 2018 in Casper, Wyoming and then held a webinar on June 26 (which was an abbreviated version of the workshop). The purpose of the workshop and the webinar were to make people aware that there is a guide is to help Wyoming growers and producers understand the rules and regulations on specialty crop growing if they wish to sell what they produce. Each was well received.

This project relied heavily on partners both to review the content of the Food Ventures guide and to distribute it to audiences in the state. The manager at the Wyoming Department of Agriculture's Consumer Health Services division Linda Stratton advised on what issues have been problematic for their clients (which includes venture that are inspected food facilities and thus able to process and sell food to intermediaries and the

end consumer). Her perspective was part of a survey of the publication's target audience done to identify and confirm topics to be included in the guide and in follow-up interactions with the editor. Once the guide was developed, Linda Stratton then reviewed the entirety of the content for accuracy and provided comments as necessary. A second reviewer, Warrie Means at the University of Wyoming in the Department of Animal Science, looked specifically at the content regarding meat. Once the publication was fully developed, other partners assisted in its distribution. As noted, hard copies were distributed by Lovell, Inc. directly at the workshop and to interested intermediaries such as county-based economic development officers. Copies were also provided to Cole Ehmke with University of Wyoming Extension for distribution with in Extension around the state as well as to producers, and to Consumer Health Services.

GOALS AND OUTCOMES ACHIEVED

Goal 1: Specialty Crop Producers will have less confusion concerning how to access and utilize the resources available to them and gain a deeper understanding of how regulations might impact their operations in the future and how their operations can achieve compliance with these regulations.

Measureable Outcomes: Completion of Resources & Regulatory Guide for Wyoming's Specialty Crop Farmers that provides specialty crop producers both a broader understanding of the available resources and how to access them along with a deeper understanding of the various regulations which could have positive or negative impacts on their operations.

Target: 50% of Specialty Crop Producers statewide will access and use one form (print, digital, web) of the guide in the first year of publication. As noted above there will be a data base of purchasers and online visitors to monitor success in this regard.

Performance Measure: The above goal will be measured via feedback surveys after the Specialty Crop Farmers have been introduced to the guide during the webinar/workshop. Pre and post surveys will be administered to measure specialty crop producer understanding and perceived usefulness of the guide. A data base of purchasers and online visitors will be kept to monitor success in this regard. Email surveys will be sent to users to get this feedback. This data will be shared with WDA.

Data collected to date indicate that this target has been met. Hard copies of the Guide surpassing the number of specialty crop producers in the state were distributed at the project workshop and other events in the state (more than 300). Project partner Cole Ehmke circulated them at events including Food for Profit workshops in Powell and Sheridan (June 7 and May 31, 2018) at a farm tour August 1 in the Wheatland area, and at the Tristate Regional Food Ventures group meeting in Scottsbluff, Nebraska in January 2019 (a group of agency professionals and specialty crop farmers), and he sent copies to each county Extension office for the use of Extension educators and for circulation to local

contacts. Electronic copies were posted on the Lovell, Inc website (<https://lovellinc.org>) and circulated to a list of producers and intermediaries that numbers about 316. UW Extension posted it to its Food Ventures website www.uwyo.edu/uwe/programs/food-ventures.html. Traffic over the period July 1, 2018 to January 24, 2019 shows 68 page views, with an average time on page of 00:03:24 – a time long enough for a viewer to adequately examine the resources and select which ones to explore further. The period from mid-September to late November was the busiest time, which would be appropriate for viewer to be agriculturally oriented (the main specialty crop seasons having ended). A pre/post survey was circulated at the project workshop in Casper. The average increase in knowledge of surveys returned was 34%. Discussion of the whole group and individual comments made to the planners were supportive of the project outputs. Further distribution will continue through winter 2018 and 2019 at venues likely to be attended by those in or exploring specialty crops, including WESTI Ag Days in Worland, Wyoming; Fremont County Farm and Ranch Days in Riverton, The Wyoming Bee College in Cheyenne; and the High Plains Organic Farming Conference in Cheyenne. Other events will be targeted throughout 2019 and beyond. No serious change in either federal or state law seems to be developing as of this writing, so the Food Ventures guide will continue to be relevant unmodified for some time to come.

We are excited to have all the information compiled in one concise book. It is a valuable resource for projects our organization has been working on locally, and across the state. With the publication of Food Ventures in Wyoming: A Resource and Regulatory Guide for Specialty Crops, growers throughout the state now have the information in an easy-to-follow guide. Instead of a few producers in pockets around the state, we observe that growers are organizing, and with the power of the provided information they are marketing locally-grown food through many outlets. Ultimately, this work improves nutrition in Wyoming by providing fresh and desirable products, and it improves the financial bottom line of growers.

One of the goals of the this project was that specialty crop producers would have less confusion concerning how to access and utilize the resources available to them and gain a deeper understanding of how regulations might impact their operations in the future and how their operations can achieve compliance with these regulations.

As anticipated, Food Ventures in Wyoming has provided specialty crop producers both a broader understanding of the available resources and how to access them along with a deeper understanding of the various regulations which could have positive or negative impacts on their operations. Feedback via personal interactions at this project's events indicates that the outputs were successful in increasing their knowledge.

The dissemination activities included a specific-purpose debut event. Specialty crop producers, food hub organizers, educators and regulators gathered in Casper in early spring for the debut of the new guide to help people market locally grown foods. Speakers from Cornell University, University of Nebraska Extension, and the Wyoming Department of Agriculture presented information about food safety, applicable state and federal rules and regulations regarding the sale of produce, as well as grants and loans to build crop growing opportunities. The agenda was as follows:

10:00 AM WELCOME AND INTRODUCTION.

Elaine Harvey – Lovell Inc, Executive Director
Cole Ehmke – University of Wyoming Extension

10:15 AM KEYNOTE SPEAKER. **LINDA STRATTON - WYOMING DEPARTMENT OF AGRICULTURE - “INTRODUCTION AND APPLICATION TO THE FOOD VENTURES IN WYOMING: A RESOURCE AND REGULATORY GUIDE - WAYS THAT PRODUCERS CAN INCREASE THEIR MARKET WITHIN (BECAUSE OF) THE LAW.**

11:45 AM – 12:15 PM Break, Lunch

12:15 Lunch Speaker. Ted Craig – Wyoming Department of Agriculture, Grants Manager – “Yes, there are resources available.”

12:45 Break

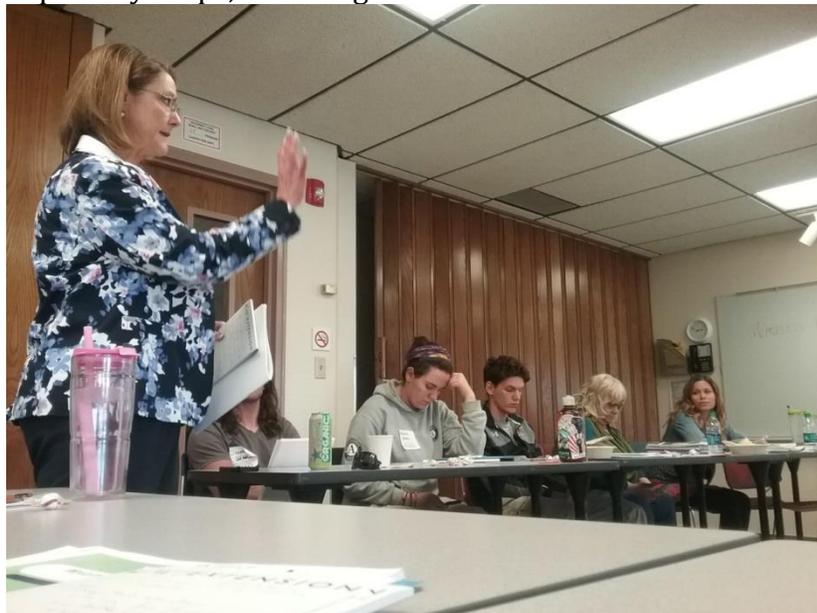
1:00 PM - Donna Pahl, Cornell University, Produce Safety Alliance – “Introduction to the Food Safety Modernization Act, Produce Safety Rule”

1:45 PM David Lott, Horticulture Extension Educator from the University of Nebraska, will discuss Good Agriculture Practices “GAPS”

2:45 PM Conclusion / Summation. Elaine Harvey

No registration fee was charged. Advertising for the event included a media release, direct emails (and reminder emails), save-the-date calendar postings, paid advertisements in Ag publications, and postings to social media. Information was sent to a broad range of outlets which might have contacts in specialty crops, including contact such as

- USDA FSA,
- the Wyoming Ag Mediation program,
- coordinators of Master Gardener programs, and the attendees of a MG conference,
- the SBDC,
- farmer’s market managers,
- farm to school vendors,
- the Wyoming Business Council Ag Division, and
- Community college Ag people.



This conference was attended by 16 people from across the state – people as far away as Riverton and Laramie drove 1.5 to 2.5 hours respectively to the event. Represented were producers, nonprofit staff, and beginning farmers. The audience was engaged with the material and asked appropriate questions. The presentations were all well done, with only occasional questions on the content. Because of the good presentations the group was able to think ‘big picture’ about how to overcome the hurdles in the market. This discussion centered on how to bring about a change in priorities of consumers who do not buy local food, and how to take advantage of the resources described in the presentations and the Guide. Staff from one non-profit later developed a successful USDA Farmer’s Market Promotion Program application and received about \$400,000 to address the issue of distributing local food in Wyoming.

The photo is of Elaine Harvey, Executive Director of Lovell, Inc., leading a discussion at the specialty crop workshop in Casper, Wyoming.

The text of a sample email sent to contacts to advertise the event is below:

WORKSHOP – WY Resources & Regulations for Specialty Crop Producers

We’ll release the "WY Resource and Regulatory Guide for Specialty Crop Producers" in a workshop on May 15th in Casper! There will be speakers and activities to help better understand the regulations relevant to farm and food businesses in the state, with a focus on small scale and direct-to-consumer sales. You’ll see information on specific food products as well as jurisdiction. Linda Stratton of the Wyoming Department of Agriculture and Cole Ehmke of UW Extension and the author of the Guide will be there to discuss and answer questions.

This will be interesting to Specialty Crop Growers, Local Food Distributors & Marketers, Economic Developers, Food Processers and Agriculture Educators

The event is free because of funding provided by the USDA Specialty Crop Grant program, but please register for a lunch count. The workshop goes from 10 to 3 at the Agricultural Resource and Learning Center in Casper (2011 Fairgrounds Road) on May 15.

Register at the Lovell Inc website: www.Lovellinc.org

Please share!

The text of a media release is below:

Free Wyoming Food Ventures Workshop in Casper May 15th

Lovell Inc, in conjunction with the University of Wyoming (UW) Extension, is hosting a free workshop for people wanting to sell food products. The workshop is May 15 from 10am to 3pm and will feature three speakers on the rules and regulations that govern the production, processing, preparation and sale of food in Wyoming.

The keynote speaker is Ms. Linda Stratton of the Wyoming Department of Agriculture who will discuss “Introduction and application to the Wyoming Resource and Regulatory Guide” – How to Grow Your Agribusiness Business Safely and Successfully.

At this workshop, Agriculture Grants Manager at the Wyoming Department of Agriculture discussed the resources available to producers for training and some grant opportunities.

Donna Phal of Cornell University will discuss Food Safety Modernization Act (FSMA) requirements and available training. David Lott, University of Nebraska will speak about Good Agricultural Practices (GAPs) training for preventing the contamination of food.

Attendees will leave with a copy of a new UW Extension publication that discusses federal and local regulations on food production and sales. Apart from federal regulations, the Wyoming legislature amended the Wyoming Food Freedom act in 2017 which allows the sale of home-produced food to the end consumer, and new requirements. The publication also provides resources for entrepreneurs, including grants and business resources.

The workshop will be May 15 at the Agriculture Resources & Learning Center, Casper Room, located at 2011 Fairgrounds Road, Casper, Wyoming. The workshop will begin at 10:00 AM and conclude at 3PM. There is no charge to attend and the community is welcome. Please register at www.LovellInc.org to reserve your seat and a meal, or call Lovell Inc. at (307)548-6707 if you have any questions. Copies of the guide will be given away during the workshop and will also be available online at LovellInc.org.

This workshop is part of the continuing economic development and community outreach of Lovell Inc. as it works to create a growing, healthy, and more diversified economy, and increase employment, payroll, business volume in the Lovell Wyoming area. It uses funding provided by the USDA Specialty Crop Grant program.

BENEFICIARIES

The in-person workshop was provided to 16 people from around the state and represented government, nonprofits, education, and Ag production. Hard copies of the Guide were distributed to them and circulated to interested parties around the state. Over 250 color copies of the 56 page bulletin were printed and distributed to increase the number of beneficiaries. An electronic copy was posted on the Lovell, Inc. website, and further copies were posted UW Extension and Wyoming Department of Agriculture’s Consumer Health Services division pages. A USB drive with the Guide was mailed to economic development, legislative, and Ag organizations around the state, and copies of the USB were sent to project partners for distribution to their contacts. A webinar which was a much shortened version of the workshop was recorded for distribution via the Lovell, Inc. website. We hope that the result of these efforts maximized the use of the funding programs and advisory services. Indications in the short term are that they have. Since the end of the project, project partners have printed extra copies and will be distributed at the future at venues such as Extension offices, grower meetings and other educational offerings.

LESSONS LEARNED

Work to a timeline. This project brought several agencies together to develop the content of the guide and deliver a workshop. Early in the planning process a timeline with specific deliverables was developed and agreed upon. Referencing it became an important part of making sure that everyone was on track.

Keep communication lines open. Early in the project in-person meetings were held to develop the timeline and the deliverables. Regular communication afterward helped make sure that there were no surprises. It helps if each partner brings expertise, curiosity, and a lack of ego to the project.

Timing is important. Specialty crop growers are often busy in the middle of May doing final preparation before getting into the field or high tunnel, so the attendees at the workshop primarily came from intermediaries such as nonprofits who assist in economic development and food marketing. This is an excellent audience, and one we wanted to reach, but additional producers would have added more to the conversations about how the guide will be used.

There are many people who are knowledgeable in Ag resources available in Wyoming. There is a tremendous network of willing people who want to share knowledge and experience. The expertise of the Wyoming Department of Agriculture in both providing and reviewing content for the project was superb, and the WDA's grants leader Ted Craig provided excellent support and contacts. And by working with Cole Ehmke, who provided further contacts as well developed the Guide, we were able to help people build their small business capacity.

CONTACT INFORMATION

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Executive Director
Lovell, Inc.
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GOOD HANDLING PRACTICES FOR LOCAL RAW HONEY

PROJECT SUMMARY

We examined handling methods to conserve flavor, aroma, and health benefits for local, raw honey during the packing process of liquefaction, short-term storage, and bottling. The flavor and aroma of a honey's sugars are enhanced by alcohols, esters, and other compounds volatile enough to be detected by the human nose. However, "The delicate bouquet and fine flavor of honey are particularly vulnerable to heat and improper storage" (Dadant and Sons 1979, page 504). Raw honey becomes a solid when the main sugars precipitate out of the supersaturated honey solution (honey crystallizes because it is a supersaturated solution). This happens in the hive and in the jar. A honeybee colony liquefies hive-stored honey by warming the honey to 93 to 95°F, the normal temperature inside the cluster of a brood-rearing colony (op. cit., pages 193, 247). Commonly, US honey packers heat honey rapidly into the range of 140 to 190°F for force-filtering to remove fine crystals (also removes pollen) and thus retard re-solidification. Our objective was to test honey-handling methods that would more fully conserve "The delicate bouquet and fine flavor of honey." This project was not built on previously funded specialty crop work. The information gathered through this research was timely and of practical value to the owners of apiary yards and the local honey-packing industry. The project provided valuable information for those Wyoming honey producers seeking an alternative to selling their honey to out-of-state packers.

PROJECT APPROACH

1. Honey is stored in 55-gallon drums (660 lbs.) and because it is raw it solidifies. We monitored honey temperature during liquefaction several ways, most recently using K-type thermocouples attached to a dual-channel, electrical compensated controller that is said to adjust for thermocouple error and therefore gives greater accuracy. We checked thermocouple readings with a calibrated digital thermometer and we checked the digital thermometer calibration using an ice bath following the recommendations of the International Dairy-Deli-Bakery Association (2013, www.iddba.org). These instruments were used to measure honey temperature as the honey flowed out of the drum warmer before entering the bottler.

Honey water content affects rate of liquefaction, therefore to test 'low-and-slow' as a honey-packing model, we measured both honey moisture and time for a drum of crystallized honey to drain into a bottling tank. Honey quality was assessed before and after liquefaction, and after short-term storage, with a refractometer and by

percent light transmittance of the honey compared to reagent-grade glycerol. A Palm Abbe digital refractometer by MISCO (www.misco.com) was used to determine percent solids, water, and density, while a HI 9685 honey color analyzer by Hanna Instruments (www.hannainst.com) was used to measure percent light transmittance in millimeters on the Pfund scale [after August Herman Pfund (1879–1949) an American-born physicist, spectroscopist, and inventor]. Flavor, aroma, and texture were assessed in 3 taste tests involving 160 people as tasters.

2. We obtained two types of temperature-controlled bottling tanks; a 70 gallon Dadant water-jacketed tank (Dadant 2015 catalog, # M00628, page 93) and a 76 gallon dry, digital-temperature-controlled tank advertised to more uniformly and more quickly warm the honey without exceeding desired temperatures, and to be more energy efficient (waxmelters.com). We obtained lift tables for each type of bottler so that we could use the different bottling tanks with the same drum warmer. We used both bottlers as part of our usual packing process and evaluated ease of use, power consumption, consistency of set temperature, and overall utility for packing raw honey. We monitored electrical use of the WaxMelter bottler using a P4460 Kill A Watt EZ power meter (only for 110-120 volt appliances; the Dadant bottler is 240 volt). Electrical use of honey bottlers at project partner, Big Hollow Food Cooperative (Co-op) was also measured. This included a coffee-urn-converted-to-honey-bottler at the start of the project and subsequently, a new bottler selected on the basis of our above bottler comparison. Both power monitoring efforts used the P4460 meter.

GOALS AND OUTCOMES ACHIEVED

GOAL 1: Determine liquefaction rate at 95°F for barrels of Wyoming honey.

PERFORMANCE MEASURE: Honey temperature as it leaves the drum warmer.

BENCHMARK: Warming temperature $\leq 95^\circ\text{F}$

TARGET: A constant temperature $\leq 95^\circ\text{F}$ and drum to empty within 7 days.

OUTCOMES:

Our equipment does not keep a drum of honey at a constant 95°F; in practice we set the drum warmer to an initial 90 to 95°F and monitored the temperature as the drum warmed. As the honey liquefied and the drums emptied, the temperature of the honey flowing out of the drums increased. Initially, we reduced the temperature when it exceeded 95°F but found liquefaction at about 95°F too slow and therefore impractical, i.e., our original 7-day target period for liquefaction did not fit our production demands. Subsequently, if the temperature approached or exceeded 110°F we reduced the temperature setting. Further, as was discovered in related work and reported below, holding honey for 7 days at 95-

100°F might degrade flavor and aroma more than a higher but shorter-term liquefaction temperature. Bogdanov (2008) reports that warming honey to more than 104 °F is necessary for complete dissolution of all crystals but he allows that complete crystal dissolution may not be needed for liquefaction. Our experience is that complete crystal dissolution did not occur even with honey warmed to 110°F (short-term exposure). We attribute the contrast with Bogdanov to the lower water content of Wyoming honey (see Table 2 below) combined with short-term exposure to the high temperature. With experience, our target warming temperatures became an initial 90 to 95 increasing to 105 to 106°F. With our new thermometers we are confident we stayed more consistently within that temperature range through the summer of 2018. During that time we recorded start and finish times for 6 drums with finish times more variable since we did not check honey flow at night. Given that qualification, the drums required an average 3 days to empty with a range of 2.3 to 4.2 days.

GOAL 2: Determine whether liquefaction temperature influences standard indicators of honey quality by measuring moisture and pre- and post-liquefaction percent light transmittance.

PERFORMANCE MEASURES: Percent solids, water, density (refractometer measurements), and percent light transmittance of the honey compared to reagent-grade glycerol (Honey Color Analyzer measurements).

BENCHMARK: We used a small sample of honey taken from the drum before it was put into the warmer as a check against bulk liquefaction. A small sample was reasoned to require less time and heat to liquefy and was therefore more likely to have retained quality characteristics.

TARGET: We postulated that the low liquefaction temperature and short exposure time to our liquefaction temperature would result in no difference in measured quality indicators between pre- and post-liquefaction samples.

Pre-liquefaction samples were taken from drums 13, 16, and 17 so that the sampled honey was not exposed to a 3-4 day process of full-drum liquefaction as was the case with bottler samples. The post-liquefaction bottler sample for drum 13 was #5 and was in the bottler for 7 days at 90 ± 3 °F, taken when the bottler was nearly empty. The drum 16 bottler sample was #1 and was in the bottler for 2 days at 90 ± 3 °F. Drum 17 bottler sample was #4 and was in the bottler for 4 days at < 83 °F, being warmed to 83°F the day of bottling. We encountered some challenges in collecting the refractometer and color analyzer data. First, both of these instruments use light transmission so that we repeatedly got “out-of-range” readings when testing samples liquefied in our process. We eventually held samples in a kitchen oven at about 115 °F until few or no crystals were present to interfere with light transmission. (If a person will be handling many samples, we recommend getting a small oven with precise temperature control.) We also found it important to clean the

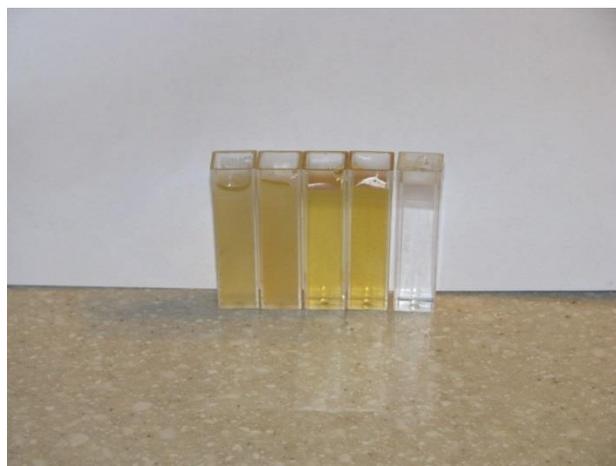
refractometer well (i.e., the bowl-like depression where the sample is placed) and the color analyzer cuvettes with 70% isopropyl alcohol between samples to completely remove honey from the previous sample—water does not get the instruments clean without excessive effort and time. It was also important to allow a sample to sit in the refractometer well for a full minute (as per instructions), before trying to read data. As detailed in Table 2-1 below, there were no differences among sample pairs except some lower light

Table 2-1. Refractometer and Color Analyzer data Data from Three Pairs of Drum /Bottler Comparisons.					
DRUM	SAMPLE	SOLIDS (%)	H2O (%)	DENSITY (g/mL)	mm Pfund
13	Drum	87	13	1.4	41, --, --
	Bottler #5	87	13	1.4	32, 31, 31
16	Drum	87	14	1.4	34, 33, 32
	Bottler #1	87	14	1.4	33, 33, 33
17	Drum	87	14	1.4	40, 39, 40
	Bottler #4	87	14	1.4	36, 39, 36
Table 2-2. Supermarket Sample (mean of six subsamples)					
	Mean	83.6	16.4	1.4	36,36,36
	Std. Dev.	0.2	0.1	0.0	0.0

transmittance for some of the drum samples. In this case the lower light transmittance was not due to color but to incomplete liquefaction of the honey so that small honey crystals reduced transmittance (Fig. 2-1).

For comparison we also tested the in-house brand of honey at a local large-chain supermarket (Table 2-2). The mean and standard deviations (S.D.) suggest the supermarket honey to be significantly lower in solids and higher in water than our samples of Wyoming honey.

Figure 2-1. Five color-analyzer cuvettes showing two cloudy samples at left with incomplete crystal liquefaction, compared with two samples warmed to remove most crystals and to glycerol on the right.



GOAL 3: Determine a post-liquefaction storage temperature for Wyoming honey that prevents re-solidification; retains

aroma and flavor as measured by customer preference and facilitates dispensing into smaller containers.

PERFORMANCE MEASURE: Taster preference

BENCHMARK: None

TARGET: We surmised that because of the short storage time and relatively low temperatures that there would be no differences among samples.

Will honey quality be retained during liquid storage in a bottler prior to bottling? This appears practical since data from Bogdanov (2008) citing White (1975), imply no change in chemistry for honey stored less than 80 days at 86 °F or, less than 2 years at 68 °F. Bottler storage after liquefaction should be at some temperature that is warm enough to slow re-solidification and cool enough to maintain quality. To obtain a statistically-defensible assessment of aroma and flavor from honey samples representing different post-liquefaction storage conditions we conducted taste tests at three venues: 2017 Wyoming Bee College, Cheyenne Winter Farmer’s Market, and at the Big Hollow Food Co-op in Laramie.

Figure 3-1. Taster test set up for Big Hollow Food Cooperative, November 2017.

Tasters were given no information other than we were doing a honey-taste test. The results were compared with 95% confidence intervals calculated using the standard error of sample proportions based on normal approximation. Samples rated significantly better than other treatments are underlined; if multiple samples are underlined they are not different from each other; ns = no significant differences.



Wyoming Bee College (WBC) Taste Survey March 2017

-----%-----

Which Honey Do You Prefer?

#1 - 28 #2 - 58 #3 - 14 N = 57*

*There were 22 undecided participants, but their responses to honey qualities are included.

And Why?

	#1	#2	#3	
Taste -	31.2	<u>51.9</u>	16.9	N = 77
Texture -	24.7	<u>47.9</u>	27.4	N = 73

Aroma - 30.0 36.0 34.0 ns N = 50

Description of Samples: #1. 90°F, 7 days; #2. 80 to 84 (82) °F, 2 days; #3. 100°F, 2 days

Cheyenne Winter Farmers Market (WFM) Nov 2017

-----%-----

Which Honey Do You Prefer?

Sample #1 - 64 Sample #2 - 36 N = 42

And Why?

	Sample #1	Sample #2		
Taste -	54.8	45.2 ns		N = 31
Texture -	52.0	48.0 ns		N = 25
Aroma -	45.45	54.5 ns		N = 11

Description of Samples: #1. 91°F, 11.2 days; #2. 108°F, 3.6 days

Big Hollow Food Cooperative (BH) Nov 2017

-----%-----

Which Honey Do You Prefer?

#1 - 36 #2 - 44 #3 - 21 N = 39

And Why?

	#1	#2	#3	
Taste -	<u>39</u>	<u>44</u>	17	N = 41
Texture -	<u>38</u>	<u>43</u>	19	N = 37
Aroma -	44	28	28 ns	N = 18

Big Hollow Sample Descriptions: # 1. 73 to 82 (77.5)°F, 14 days; #2. 91°F, 18 days; #3. 108°F, 3.6 days.

Discussion: We conducted three taste tests in three different venues with three different groups of people. At the WBC there is a high interest in bees and honey whereas the WFM is a social shopping event and BH is a natural grocery co-op. Yet, in all tests there were statistically significant differences favoring the honey samples from lower short-term-storage temperatures. This is consistent with White and Doner (1980, page 90-91) who measured quality changes during storage at a variety of temperatures.

Conclusion: We reject our null hypothesis and conclude that tasters preferred honeys stored at cooler temperatures even for short-term storage. Therefore we recommend a

short-term storage temperature between 80 and 90°F with the lower temperature preferred if the honey viscosity is consistent with the packing process.

GOAL 4: Compare energy use and performance of a water-jacketed bottling tank with that of a digital-temperature-

controlled (dry) bottling tank.

PERFORMANCE MEASURES: Electrical use and the ease with which honey is packed.

BENCHMARK: None

TARGET: We postulated an energy-use advantage for the dry tank with no difference in the ease of honey handling.

The heating element of the Dadant water-jacketed bottler is 240 volt, 4500 watt (Watlow Electric Manufacturing Co., St. Louis, MO) and thus can be expected to use $(4500 \text{ w})(1\text{hr})/1,000 \text{ w/KWH} = 4.5 \text{ KWH}$ during one hour of power-to-the-heating-element use. The WaxMelter bottler is a 120 volt, 1530 watt appliance which can be expected to use 1.5 KWH during one hour of power-to-the-heating-element use. During six hours of monitored power-use with power switch on, we found only 4.32 KWH used (0.7 KW/ hr.). The WaxMelter bottler (Fig. 4-1) has excellent insulation and is thus capable of warming and holding temperature of a tank-full of honey with less energy than a 4500-watt appliance that is not insulated. However, we found using the WaxMelter bottler required the honey be stirred frequently to get a more uniform temperature of honey in the tank. Further, as the honey level decreased during bottling, the set temperature was not maintained and on two occasions resulted in carbonized honey at the bottom of the tank (Fig. 4-2). In contrast to the product description, there are hot spots in the heating tank.

Figure 4-1. Waxmelter bottler on lift table showing melt controls on the side and the back raised to facilitate honey flow to the outlet.

Figure 4-2. Removing carbonized honey from bottom of the “dry” bottler

Avoiding this unfortunate and costly occurrence required constant monitoring with a long-stem, bimetal thermometer, frequent stirring and manually switching the power off and on



to maintain the desired honey temperature. We also found it difficult to empty the flat-bottom tank even after elevating the back by 3-4 inches.

Given the above problems with the “dry” bottler, a Dadant 10-gallon water-jacketed bottler (120 volt, 1700 watt), was purchased for the Big Hollow Food Coop (Fig. 5-1). The Coop measured power use of their coffee-urn bottler, 20 September 2017, through 10 October 2017, for a total of fourteen 12-hour days (unplugged at night) or 168 hours use. Power use during that time averaged 0.05 KW/hr. [Because there was no thermostat the temperature of the honey fluctuated from an average of 88 degrees in the morning when the power was turned on to 104 degrees by 2:00 PM, with a low of 64 and high of 127 recorded]. Power use of the new water-jacketed bottler was measured 24 March through 26 March 2018 during which time the bottler was not turned off. Power use averaged 0.4 KW/hr. [Honey temperature was maintained between 73-81 degrees, with an average of 78 degrees.] Coop staff report higher quality of honey due to no over-heating incidents, a time savings in not having to monitor bottler temperature, and fewer refills due to the larger capacity.

Conclusion - Regardless of the greater power use by traditional water-jacketed bottlers, we found them to be a better value than the dry, digital-temperature-controlled bottler in that they required less labor due to holding a more uniform temperature that scorched no honey, and that drained more completely.

GOAL 5: Determine if application of our findings result in improved raw-honey sales in a food cooperative setting.

PERFORMANCE MEASURE: Honey sales.

BENCHMARK: Sales before installation of new bottler.

TARGET: We predicted increased customer satisfaction with higher quality honey but postulated the null hypotheses of no difference between honey sales before and after installation of the new bottler.

With the converted-coffee-urn bottler, the Co-op’s honey was sometimes overheated. That issue was addressed by providing the Co-op, on the basis of our bottler comparison (Goal 4), a 10-gallon water-jacked



Dadant bottler (Fig. 5-1). Honey sales for 10 months after installation of the Dadant bottler, were comparable to sales for 10 months prior to its installation when honey was dispensed with the converted coffee urn, i.e., we did not detect a difference in bulk honey sales.



However, we will continue to assess sales as the Co-op has recently relocated to a larger store and the bottler that was kept in a back room, is now out on the floor in full view of the customers (Fig. 5-1). The staff and management are very pleased with this bottler; they are able to keep the honey at a lower, consistent temperature and with less time monitoring it.

Figure 5-1. Water-jacketed bottler at Big Hollow Food Cooperative’s new location. Note 1.5-inch outlet to accommodate “thick” honey.

When disconnected from the power source, it maintains the temperature for several hours due to the water jacket. ‘Low-and-slow’ honey is preferred by customers according to Co-op co-owner Jeff, who stated, “Your honey out sells all of our

other honey options combined. We carry 6-8 other options, including certified organic, raw, creamed, flavored, etc. But half of our honey sold is Cheyenne Honey.”

BENEFICIARIES

This project was a response to customer comments at Farmers Markets and our desire to develop data that would guide best-handling practices for Wyoming raw honey. Our findings can benefit the owners of the approximately 2000 registered Wyoming apiaries by giving them information on best practices for raw honey. Hobbyists who produce honey for pleasure, may especially value retention of the aroma, taste, texture, and health benefits of

their honey; our results provide important guidelines toward that goal. The project will also benefit packers, retailers, and raw-honey consumers everywhere by suggesting more careful handling practices for local raw honey. Most important are the consumers who are, and will be, getting higher quality honey products as a result of our findings on the importance of temperature control during liquefaction and short-term storage.

Most commercial Wyoming honey producers sell their product to out-of-state processors and packers. However, there is a small, but growing Wyoming honey-packing alternative and we expect our project will help expand the volume of Wyoming-packed honey, thereby keeping more of the value-added honey business in state.

The 2015 Wyoming Bee College had 140 registrants and in 2018 it had 275. The Southeast Wyoming Beekeepers Association had 35 attendees at the organizational meeting. The 35 member Wyoming Bee Keepers Association, of which we have been members for about 38 years, is a key organization for all Wyoming beekeepers and honey packers. All of these people are potential beneficiaries of what has been learned from this project and we have given one or more presentations to each of these groups using information from this project.

The project will have multi-state effect. Beekeeping is increasing in popularity throughout the US as is the public's desire for locally-produced, minimally processed food. Thus, it is likely that the results and recommendations developed by this project will have an influence throughout the region if not beyond.

LESSONS LEARNED

1. A liquefaction temperature of 95°F did not give a satisfactory liquefaction rate compared to 90 to 95°F increasing to 105 to 106°F. The latter warming regime emptied drums in an average 3 days.
2. In contrast to Bogdanov (2008) who has reported that warming honey to more than 104 °F is necessary for complete dissolution of all crystals; we found that complete crystal dissolution in our honeys often did not occur at 110°F during transient exposure.
3. We learned some hints for using the refractometer and color analyzer that we did not find in the instrument instructions nor that we could find on the internet. The suggestions are included in this report for the benefit of others.
4. Refractometer and color analyzer data demonstrated the average lower water content of Wyoming honeys.
5. Beyond the above finding, refractometer and color analyzer data seem to have limited value in measuring quality characteristics of raw honey with incomplete crystal liquefaction. Taste tests are a better measure of aroma, taste, and texture but

are not practical for standard production monitoring. Gas chromatography analyses would be helpful in monitoring the volatiles of these honeys.

6. Tasters preferred honeys stored at cooler temperature even for short-term storage.
7. For in-store dispensing and bottling, a standard water-jacketed bottler avoided over-heated and scorched honey, and reduced labor cost due to less temperature monitoring and less frequent filling.
8. The purchase of high quality temperature monitoring instruments should be made at the beginning—not near the end—of a project; and, they should be consistently used by honey packers wishing to conserve “The delicate bouquet and fine flavor of honey.”

CONTACT INFORMATION

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HAZEL NUT PRODUCTION

PROJECT SUMMARY

This project sought to demonstrate the viability of hybrid hazelnuts for the challenging and high-altitude areas predominant throughout the State. Through partnerships and strong networking, important production, innovation and diversification lessons was to be shared with others. As with many other farms in Wyoming, SandHill Ranch is a multi-generation farm seeking to secure long-term viability that will support and sustain future generations of farmers. For this to happen, it was imperative that small farm holdings advance beyond single commodity into producing wholesome food with value-added products that are profitable, sustainable, and in high demand. Because of this after research and consultation with leading institutions, introducing hazelnuts was chosen. As a high-value versatile product with many value-added end products, this specialty crop can be used for food, confectionary, meal, oil and is a leading candidate for biofuel. The initial focus was to establish a trial hazelnut orchard comprised of different varieties in order to assess their viability for the area. Environmental conditions and crop development will be methodically monitored in order to determine contributing and detrimental factors. The goal for the first two years, in addition to establishing an orchard, was to develop crop records and to disseminate public reports. As a second stage, there was to be research and test appropriate hazelnut harvesting and processing technology for low-cost operations. Marketing options were to be identified as well. This project did not build on any previously funded specialty crop grant projects.

PROJECT APPROACH

In order to increase our knowledge base in cultivar selection, plant screening, appropriate technology, development of local hazelnut industry, and grower collaboration, among others, Lee and Irene Romsa attended the 7th Annual Conference on March 4 and 5 in Gays Mills, Wisconsin. The event was organized by the University of Wisconsin Extension, with the support of the Upper Midwest Hazelnut Development Initiative, The American Hazelnut Company, Minnesota Hazelnut Foundation, University of Minnesota, and Iowa Nut Growers Association. We met one of our hazelnut suppliers at the conference and negotiated our order of seedlings. Although we were able gather valuable information, we were disappointed to find out that the Upper Midwest isn't as advanced as we expected. They are still struggling with finding the right cultivar of hybrid hazelnut and have not developed efficient harvesting, cracking, or processing equipment. Their marketing is also in its infancy. Nevertheless, participation in this event was of great importance to gain a better

understanding of the developments in the hybrid hazelnut industry. It was also an opportunity to interview researchers, growers, and nurseries working with filberts. Research on cultivars was conducted and conversations held with different nurseries. 300 bare-root hazelnuts, of 2 different varieties, were purchased from Forest Agriculture, LLC in Wisconsin. We negotiated with the Laramie County Conservation District to have their professional assistance with planting the hazelnuts. We will prepare the soil according to their specifications, and Conservation District will utilize their equipment for mulching and planting. The fabric mulch will also be purchased from the Conservation District. In order to share project developments with stakeholders and general public a domain name: www.sandhillwy.com was created. The initial design and content for the website was developed. Information on the hazelnut project and our participation to the Upper Midwest Hazelnut Growers Conference was uploaded. A Facebook page and relevant content was created: <https://www.facebook.com/SandHillWYO/> and we opened a specific email address (sandhillwy@gmail.com) and phone number (307-316-2777) to facilitate later promotion and communication.

A partnership was established with Tate Smith from Regenerative Stewardship, and through his assistance, identified two potential locations for the orchard and selected the one that gathered the best conditions for plant success. Soil samples were taken from both possible locations and sent to the Colorado State University soil lab for testing. A partnership with Cooperative Extension Service for technical assistance was established. We met several times with Catherine Wissner, the University of Wyoming Extension Horticulturist to help support our project. Wissner is also encouraged us to create a pollinator habitat to attract bees and even consider partnering with a beekeeper. She gave us contacts of people who might provide some funding to purchase the seeds for the pollinator habitat. Irene Romsa attended "Bee College" in Cheyenne, Wyoming to learn about how to create conditions for bees in the ranch, and connect with beekeepers who potentially could keep bees at our place. The hazel nut bushes were regularly watered in order to help establish them through the summer of 2016. We had anticipated some hazel nut bush loss over the winter of 2017 and were prepared to replant any that died.



In the spring of 2017 it became evident that deer had been feeding on the hazel nut bushes and had caused severe damage to many of the plants. Of the 300 trees we had planted 290 die due to winter kill, deer and rodent damage. After discussing with UWYO Extension and specialty crop grant manager it was decided that without building a deer fence around the one acre of hazelnut trees that replanting them would have the same results.

GOALS AND OUTCOMES ACHIEVED

Goal 1: Prove viability of hazelnuts as an alternate specialty crop suitable for conditions characteristic of Southeastern Wyoming.

For all our efforts to prove the viability of hazelnuts in Wyoming we were unable to prevent the orchard from losing 96% of the trees to deer and winter kill in the first year of planting.

Goal 2: Increase the awareness of other growers in the region on hazelnut production by compiling and disseminating practical and useful information on the project to other potential growers.

The project was canceled and this goal has not been realized.

It was decided to cancel the project. The remaining funds were reallocated to a new project titled "Feeding Laramie Valley Season Extension Trial and Education Project"

BENEFICIARIES

Even though the project was not successful in showing that hazelnuts are a viable crop for Wyoming it will make other Wyoming producers think twice about trying to grow hazelnuts.

LESSONS LEARNED

The biggest lessons learned are that bare root stock may not be the best option for establishing a hazelnut orchard. Also before establishing an orchard it would be prudent to erect deer fencing and also wrap the base of the trees to prevent rodents such as rabbits from stripping the bark off the base.

CONTACT INFORMATION

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FEEDING LARAMIE VALLEY SEASON EXTENSION TRIAL AND EDUCATION PROJECT

PROJECT SUMMARY

The purpose of this project was to determine what type of hoop house/high tunnel covering material (skin) contributes to the longest, most favorable combination of light, temperature, moisture, and generally controlled environment capable of extending the growing season. There are multiple geographic-related challenges to growing specialty crops in Wyoming. In Albany County in Southwest Wyoming where this research is taking place, the average growing season for the region is just 56 days without a frost. The semi-arid, high plains in the Laramie Valley, the high altitude sun and fierce winds that frequently batter the land, together with varying levels of soil quality and access to water, can test the most dedicated specialty crops producer. The use of hoop houses to grow fresh vegetables and fruit in Wyoming has increased substantially in recent years. The number of frost-free days in Wyoming varies dramatically across different locations due to elevation in addition to latitude. Hoop houses offer season extension benefits in all areas of the state. Three identical hoop houses had different covers installed. The first house was covered in a clear skin (“Clear”). The second hoop house was covered with a fiber-reinforced skin (“Tarp”) in order to increase the resistance to tearing. The third unit was covered with a bubble-encapsulated skin (“Bubble”) to increase resistance to heat loss. These modifications to the hoop houses provided information on the value of various cost effective techniques. These different skins were shown to have varying impacts on the amount of heat retained and, more importantly, on the production and variety of specialty crops available in the Wyoming food distribution channel. Winter markets are now common in three Wyoming communities due to hoop house production. An additional goal was to increase overall knowledge of specialty crop growing with season extension methods, specifically, through the use of hoop houses. Garden tours and presentations for student and community groups were conducted throughout the period of research. Continuing this research will build on the efforts that are presently being implemented.

PROJECT APPROACH

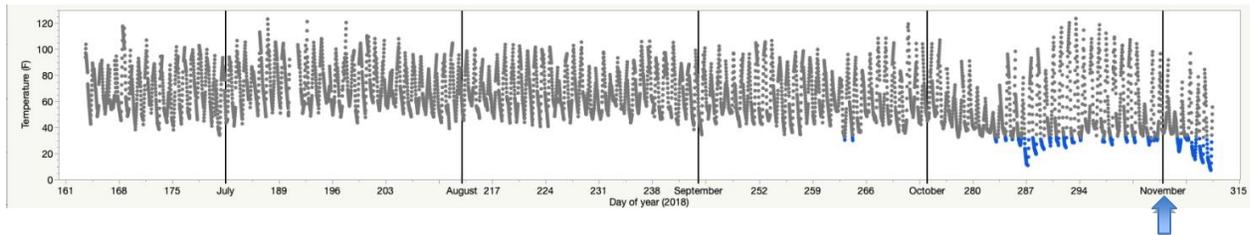
Three identical hoop houses were constructed, each with a different material used to cover them (Clear, Tarp, and Bubble). Construction for the hoop houses, overseen by Reece Owens, the Food Production Coordinator, was completed mid-May and constructed with the aid of a team from an AmeriCorps National Civilian Community Corps (NCCC) and the Feeding Laramie Valley (FLV) Summer Shares Team. Identical types and amounts of specialty crops were planted in each hoop house on June 13, 2018. The specialty crops

grown in each hoop house included cabbage, broccoli, cayenne peppers, jalapeño peppers, bell peppers, cucumbers, tomatoes, and okra. The growing procedure was identical for all hoop houses, including the use of the same soil type, time of watering, etc. The soil had been previously amended in 2017 for both the Bubble and the Tarp house, but not for the Clear house. The soil was amended for all three hoop houses in late May, 2018. Planting, watering, soil amendment and harvesting all conducted by the FLV Summer Shares Team and overseen by Reece Owens.

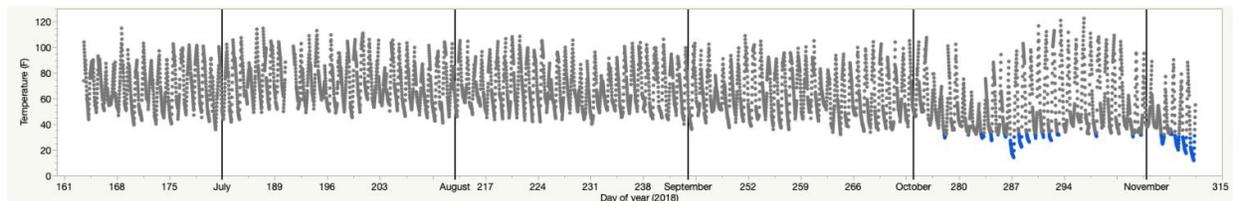
Seven Engbird IBS-TH1 sensors were used to record temperature and relative humidity; two in each hoop house, one measuring the air, the other the soil; one sensor was placed outside as a control for recording outside air temperature and relative humidity. The sensors measuring the air in the hoop houses were placed in the center of each house. The sensors measuring from the soil were placed 6 inches into in the soil and also in the center of the hoop houses. Relative humidity was calculated by taking the amount of moisture in the air and dividing it by the amount of moisture the air could hold. Monitoring range was 150 feet; temperature accuracy was $\pm 0.5^{\circ}\text{F}$; humidity accuracy was $\pm 3\%$ relative humidity. Each sensor recorded both temperature and relative humidity every 30 minutes. Data was collected every 2 weeks.

Air Temperature as a function of Time by House Type

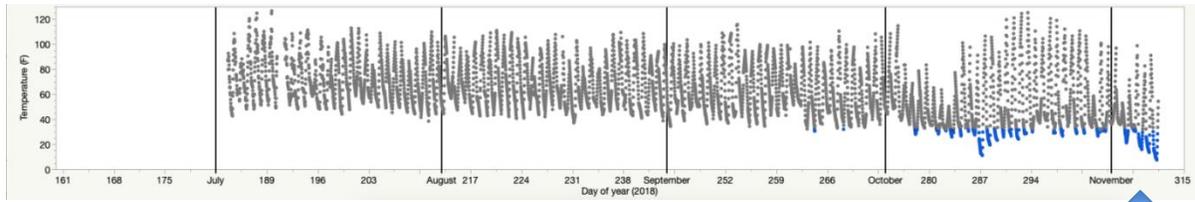
Clear



Bubble



Tarp



Control

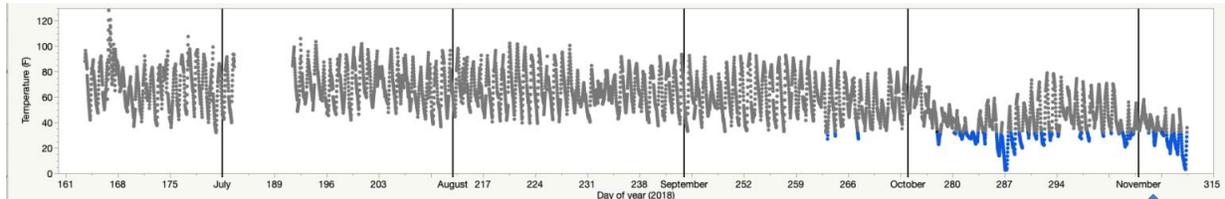


Figure 1. Temperature in degrees Fahrenheit as a function of time for three house types (Clear, Bubble, and Tarp) and Control, a probe that was placed outside the houses. The high-frequency variations are the “diurnal” changes in temperature that occur from day-to-night-to-day as the sun rises, sets and rises again. Although there are some gaps in the data, all of the probes have near continuous temperature data from mid July to early November. Blue data points highlight measurements of temperature below 32°F, reflecting freezing conditions. Note that the Bubble house type kept temperatures above freezing until October 5, 2018, which is 15 days longer than the other house types and the Control (outside conditions).

Spline Fit to All Temp Data (lambda = 0.000001 – extremely flexible)

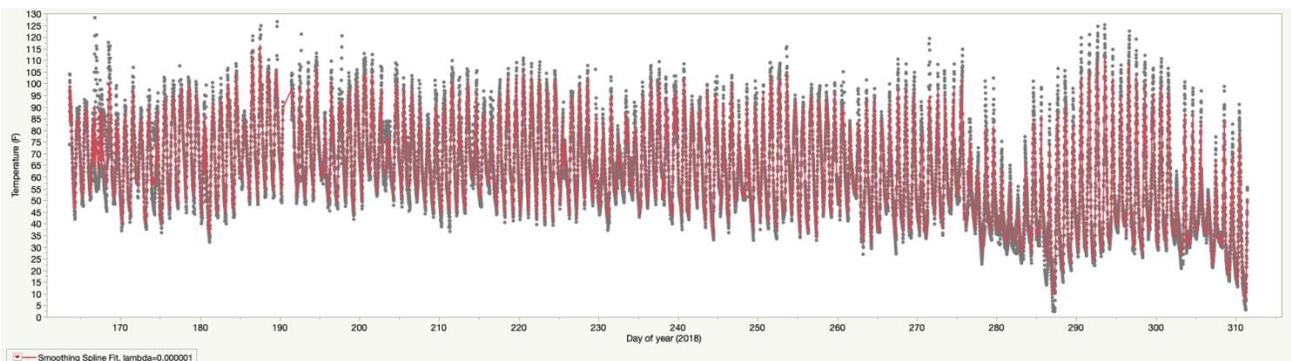


Figure 2. All air temperature data (from all four air probes) plotted against time. Red line shows best-fit spline (flexible, with lambda = 0.000001), which captures both the seasonal and diurnal fluctuations in temperature across the different house types.

Detrended Temperature Data

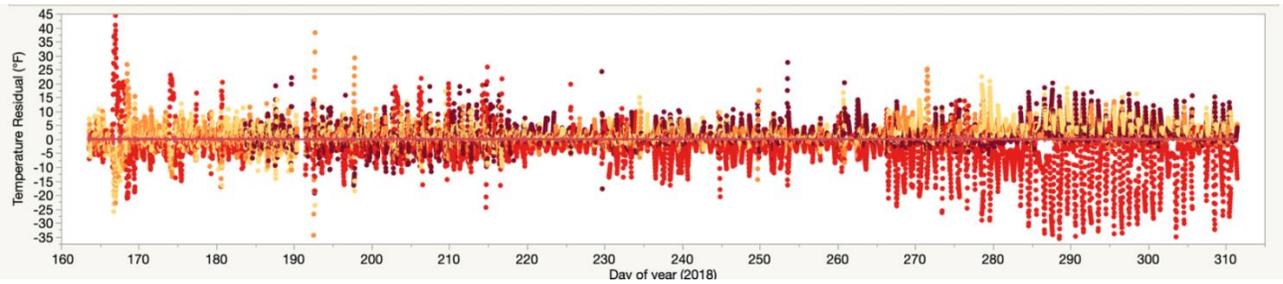


Figure 3. Detrended air temperature data. Colors represent different probes: Bright Red is Control; Yellow is Bubble; Orange is Clear; Dark Red is Tarp. This plot shows the difference between the measured temperature and the spline fit in Figure 2. In other words, this shows the data minus all of the seasonal and diurnal fluctuations, which dominate the variance in temperature in this data set. Thus, it should only contain information about the site-to-site differences in temperature, maximizing the chance to detect statistically significant differences in temperature across the site.

Figure 3 shows that there may be some substantial differences across the sites, particularly during the latter part of the record. These differences can be quantified using analysis of variance (ANOVA) coupled with a Tukey Honestly Significant Difference test.

ANOVA on Detrended Temperatures

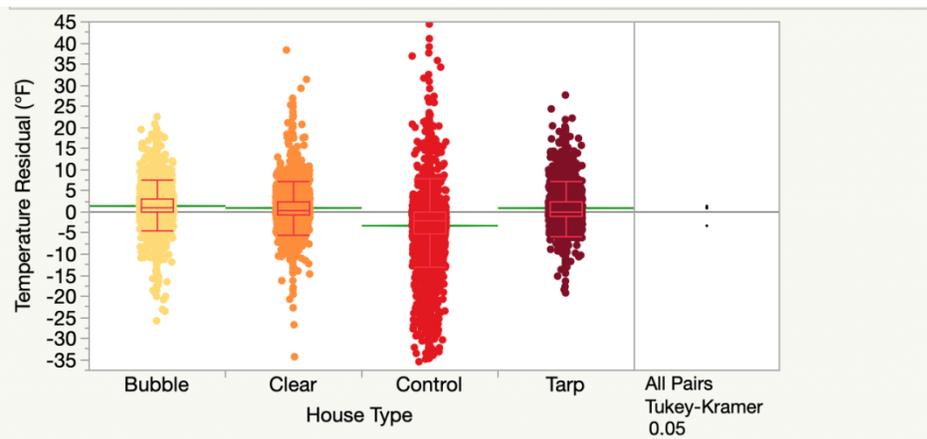


Figure 4. Temperature residual as a function of house type. Residuals are calculated by subtracting the spline-predicted temperature from the measured temperature (i.e., the difference between the gray points and the red line in Figure 2). Although there is substantial overlap between sites, analysis of variance (ANOVA) shows that the mean temperatures are markedly different: The mean residual Bubble temperature is 4.66 ± 0.08 °F greater than the residual Control temperature; The mean residual Clear temperature is 4.22 ± 0.08 °F greater than the residual Control temperature; The mean residual Tarp

temperature is 4.18 ± 0.08 °F greater than the residual Control temperature; The mean residual Bubble temperature is 0.49 ± 0.08 °F greater than the residual Tarp temperature; The mean residual Bubble temperature is 0.45 ± 0.08 °F greater than the residual Clear temperature. All of these differences are statistically significant, with $p < 0.0001$. Only the Clear-Tarp comparison yields a difference that is not statistically significant (0.04 ± 0.08 , $p = 0.95$).

The differences across the sites are large enough to be detected by ANOVA. In addition, the differences are particularly large during the latter part of the record, as temperatures dropped toward the onset of autumn. These differences can also be quantified using ANOVA coupled with a Tukey Honestly Significant Difference test.

Removing seasonal and diurnal variations (Figure 2) allowed us to easily detect divergences based on house type without the interference of seasonal and diurnal variations that dominate the data. Divergences are most apparent in the later months of September, October and November, with all hoop house temperatures markedly higher than the outside air temperature as expected (see Figure 3). Analysis of data with ANOVA showed that the Bubble house was distinctly warmer than the Tarp and Clear, and that all three were markedly warmer than the Control (Figure 4).

Detrended Temperature Data by Month

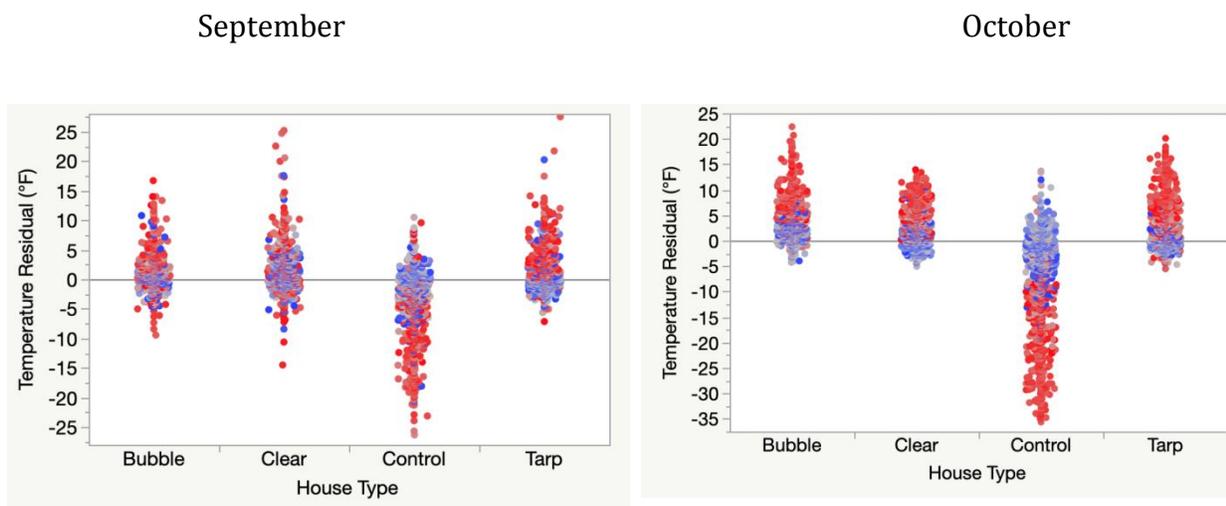


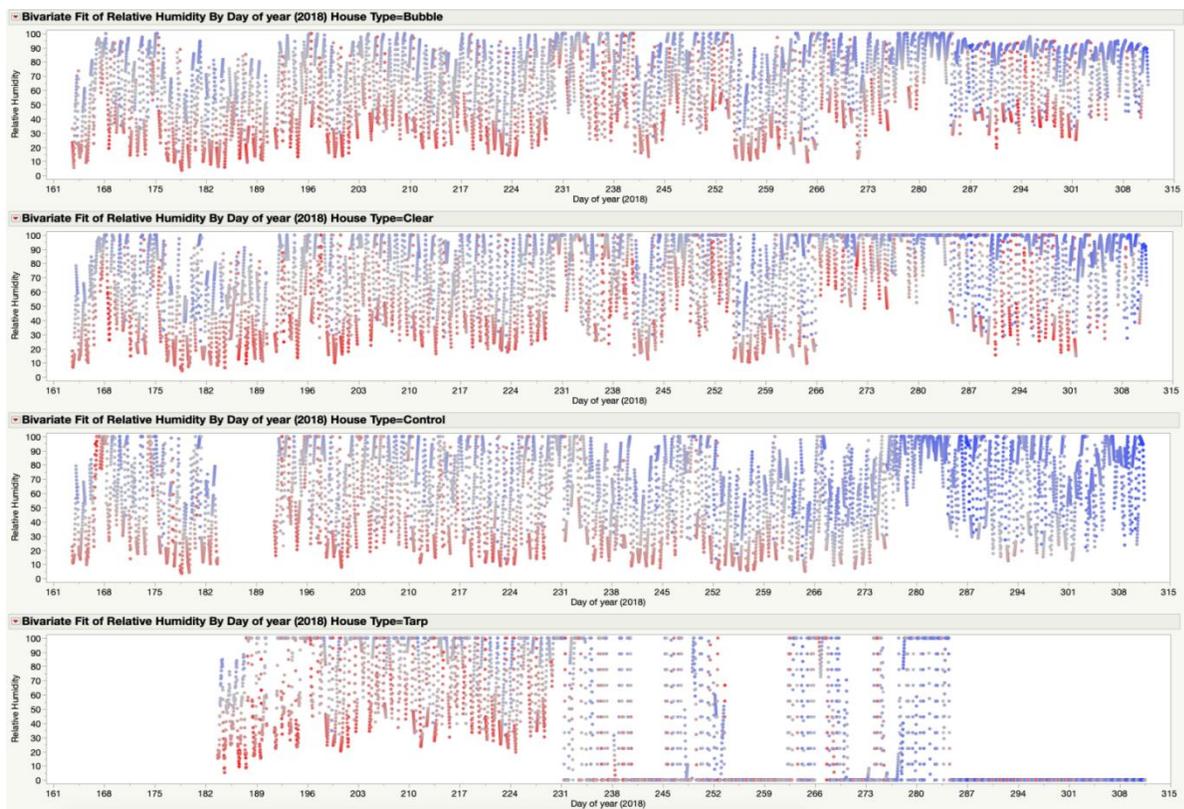
Figure 5. Differences in residual temperature across the different house types separated by month of year during harvest interval. November is not shown because freeze had already set in. Blue points highlight nighttime measurements and red points highlight daytime measurements. These plots show that differences between the Control and all of the house

types are more pronounced during the day than during the night in these two months. Other months do not show this day-night dichotomy.

The data show a transition from largely overlapping residuals in June and July to August, September and October, when Control residuals are relatively much lower than the other residuals (Fig. 3) – especially during the day (Fig. 5). This highlights the importance of hoop houses in maintaining viable growing conditions into late summer and early autumn in Laramie, Wyoming. The data also indicate that the Bubble house type keeps temperatures higher than both of the other house types in addition to the Control (outside conditions) (Fig. 4). Finally, in summer 2018, the Bubble house type kept temperatures above freezing for more than two additional weeks, compared to both of the other house types and the Control.

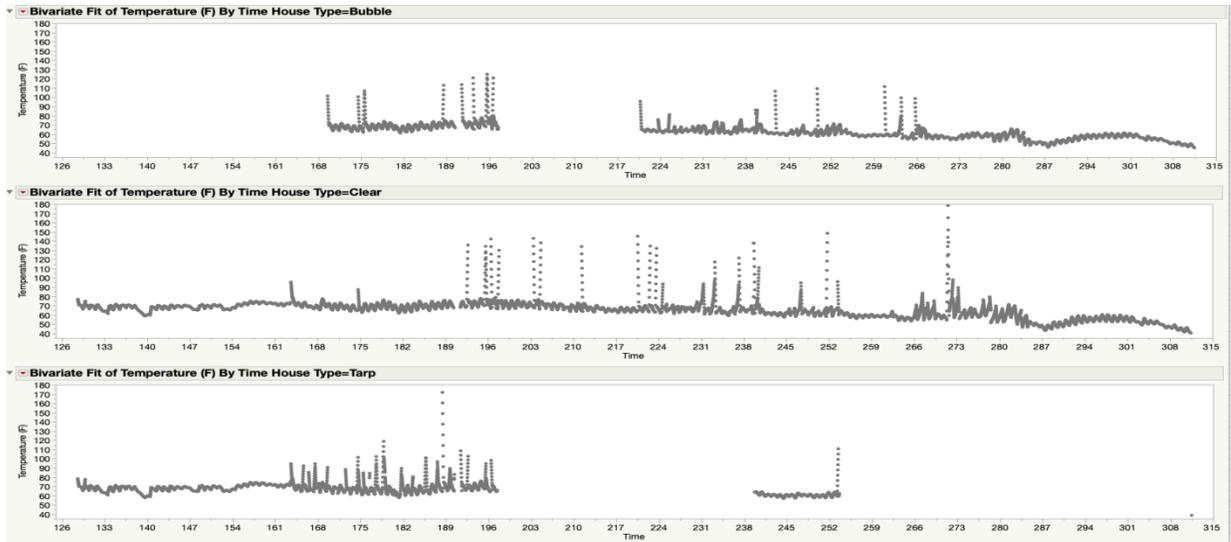
Relative Humidity as a function of Time Separated by House Type

Figure 6. Relative humidity as a function of time for all four air probes. Colors represent temperature: Reds are relatively hot, and blues are relatively cold. Like the temperature data (Fig. 1), the relative humidity shows some data gaps. In particular, Tarp has a long period after day 230 where no reliable data was collected. However, the Bubble, Clear, and



Control probes have near complete records from July through November. Relative humidity varies widely from nearly 0 to 100% in all of the probes. Relative humidity is generally

higher in autumn when temperatures are also colder. This reflects the fact that cold air holds less moisture; for given moisture content in the atmosphere the relative humidity will be higher for colder air masses than for warm air masses. This same phenomenon explains why relative humidity is higher during the night when temperatures are generally lower. In addition, the hottest house (i.e., Bubble) has generally a relatively lower relative humidity because it is warmer. The extended period of high relative humidity around day 275 to 290 (October 1 through October 16, 2018) reflects the first cold snap that led to



widespread freezing conditions (Figure 1).

Soil Temperature as a function of Time by House Type

Figure 7. Soil temperature as a function of time for the three soil probes. Data from the Clear house are nearly continuous from May through November, in contrast, the Bubble house has a substantial gap in June and July, and very little data is available after end of July for the Tarp house. No Control data are available. The soil data has many more obvious outlier temperatures than the air temperatures. It is estimated that roughly 500 of the temperature measurements from the soil would need to be excluded from the analysis because they are unrealistically high. In contrast, only 18 of the air temperature measurements were excluded because they were unrealistic. The large number of outliers in the soil data and the large gaps, particularly for the Tarp house, suggest that cross-house comparisons would be fraught with uncertainty. It is therefore advisable to refrain from drawing conclusions from this data set.

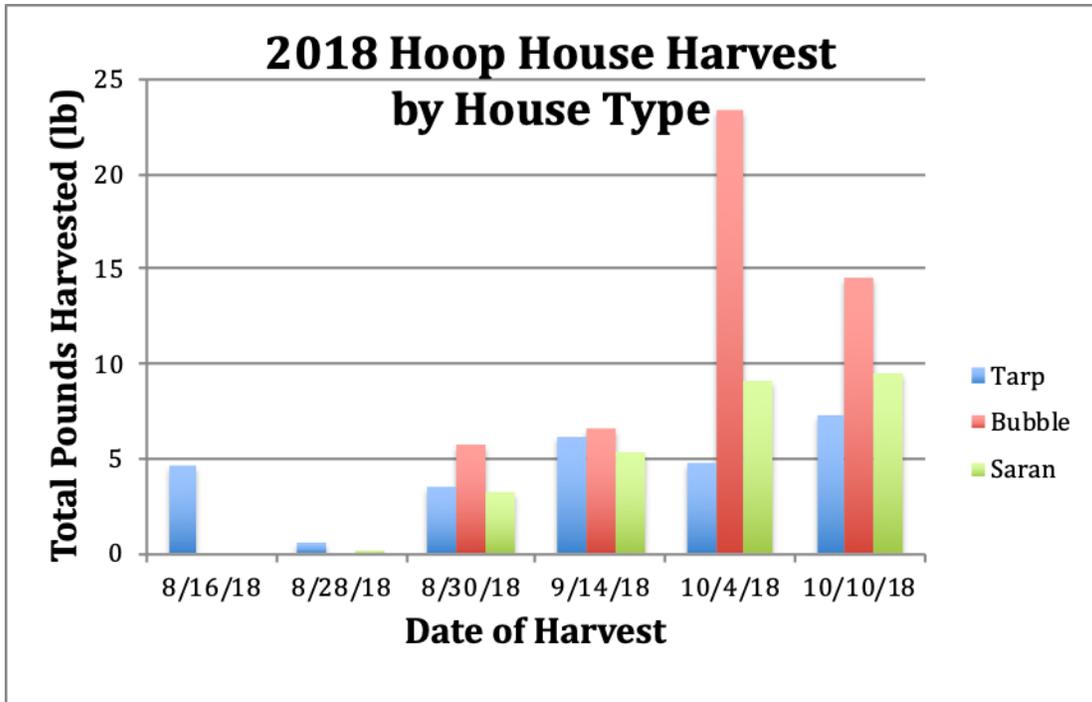


Figure 8. Total pounds of produce harvested in all three hoop houses. Identical varieties of each crop were planted in each of the hoop houses, in identical locations within the hoop house. Production from each hoop house was weighed and recorded according to specific specialty crop. The total amount of produce for all hoop houses was 104.46lb. The Tarp house yielded 26.71lb (25.57% of total yield); the Bubble house yielded 50.43lb (48.28% of total yield); the Clear house yielded 27.32lb (26.15% of total yield). Note that while the Bubble house yielded a greater percentage of the overall harvest, additional data is needed in subsequent growing years before a degree of confidence can be given to the causation of greater yield in the Bubble house.

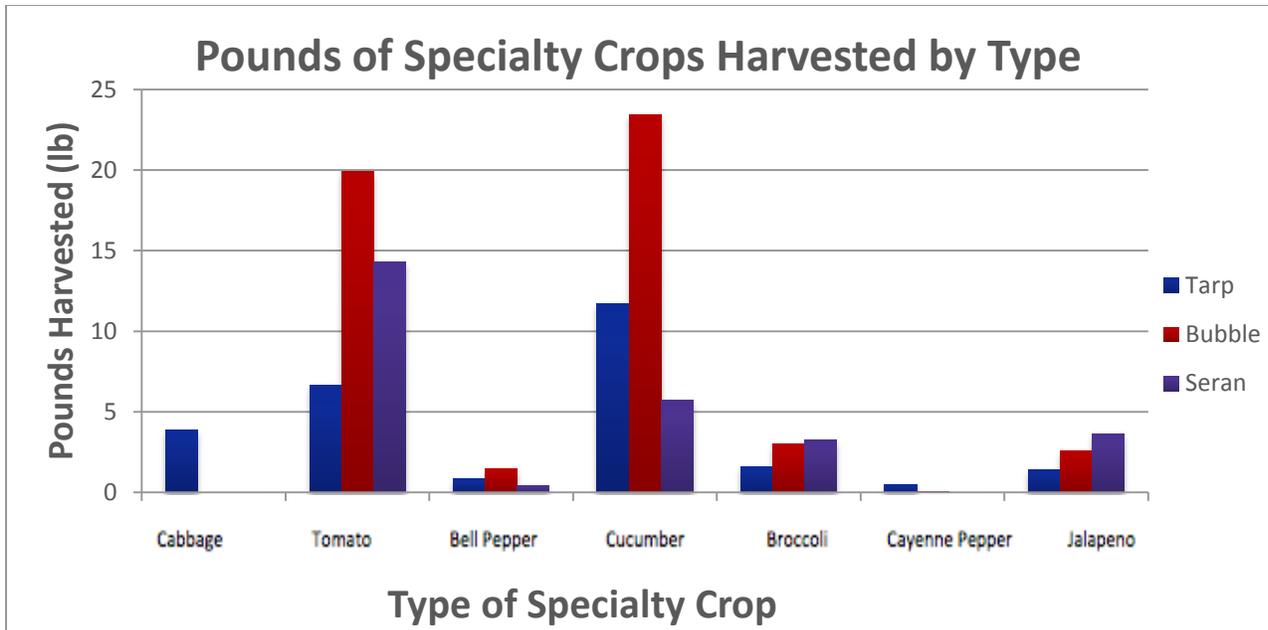


Figure 9. Amount of each specialty crop harvested in each hoop house per pound. The data show that tomatoes and cucumbers produced the highest amount per pound than the rest of the specialty crops (cabbage, bell pepper, broccoli, cayenne pepper, and jalapeños) combined. This observation is expected since tomatoes and cucumbers are of significantly larger weight than cayenne peppers, jalapeños, etc. The cabbage yield was successful in the Tarp, but unsuccessful in the Bubble and Clear houses. Cayenne Peppers were most successful in the Tarp, less so in the Bubble, and no harvest from the Clear. Jalapeños were most successful in the Clear, then the Bubble, and finally the Tarp. Okra was unsuccessful in all of the hoop houses, and not included in this histogram. Note that the broccoli had a narrow window of harvesting in the hoop houses. The flowering rate of broccoli in all three hoop houses was very rapid (about 2-3 days), leading too much of the broccoli becoming inedible before it was able to be harvested. It is suggested that broccoli may not be an appropriate specialty crop to grow in hoop houses.

The variance in amount harvested, seen in Figure 9, is difficult to compare. However, when paired with amount harvested per house type (Figure 8), the Bubble appears to have had a higher success rate for crop production. Additional research is needed to establish which hoop house yields higher harvests over time.

Data was analyzed with the aid of Dr. Cliff Riebe, a University of Wyoming geology professor to ensure accuracy. Four educational signs were posted in the Feeding Laramie Valley farm at the Albany County Fairgrounds, one at the entrance of the farm, and the other three in front of each hoop house. Tours were prepared for the Albany County Fairgrounds Family Night and the Higher Ground Fair weekend.

Over the course of the season 205 people had educational exposure to the project. Educational exposure is defined here as having an in-depth tour and/or presentation of the research project. Those who had educational exposure include: 1 member of the Wind River Development Fund, 1 County Commissioner, 5 University of Wyoming professors, 87 University of Wyoming students, 14 Higher Ground Fair attendees, 12 members of the American Baptist Women's Group, 45 FLV volunteers, 1 Action Resources International (ARI) board member, 4 permanent FLV staff, 5 AmeriCorps VISTA members, 4 FLV interns, 4 AmeriCorps VISTA Summer Associates, 2 Food Production Supervisors, 18 AmeriCorps NCCC members, and 2 AmeriCorps NCCC Field Advisors.

Surveys, in the form of oral exit interviews, were conducted with the intent to determine degree of increased knowledge of hoop houses and different skin covers. Of those who received educational exposure, approximately 18.05% completed a survey. Interviews revealed an increased interest and understanding of knowledge as opposed to a specific quantifiable pre- or post- measurement. Dissemination of information on this project was limited to the findings to date, using the ongoing information to engage and inspire the community's future growing efforts. As a result, disseminating the information will also be ongoing as the findings increase. Additional time and research will be needed to establish a structure to more reliably measure knowledge base.

GOALS AND OUTCOMES ACHIEVED

Goal 1: Determine the effects of greenhouse covers on season extension.

Benchmark: The rule of thumb in Wyoming is that a covered hoop house in 11mm clear plastic will extend the growing season one month on either side of frost-free days.

Target: By comparing the 3 covers, we hoped to see if an additional 20 growing days are possible before frost damage occurs.

Outcome:

- Soil was amended in 2018 for all hoop houses with a 4-6" layer of aged llama manure prior to planting. The location of both the Tarp and the Bubble overlapped with soil from previous garden plots. This meant that the soil in both houses had been previously amended prior to 2018. The soil in the Clear house had not been amended prior to 2018.
- Crops were planted on June 13, 2018. All crops were transplanted to the hoop houses with the exception of okra and cucumber (half transplanted, half planted by seed). There were no replants. The crops were watered daily and weeded as needed (typically semi-weekly). Harvesting was done as needed.
- While air temperatures varied wildly in a given day, we were able to detect tiny differences between each hoop house because of an abundance of air temperature data by fitting an extremely flexible spline to the air temperature data.

- Analyzing temperature as a function of time by each house type (see Figure 1) it became clear that the Bubble house was generally better at retaining heat. As seen in Figure 1 the Bubble house kept air temperatures above freezing until October 5, 2018, approximately 15 days longer than the ambient temperature (Control) or Clear house, and roughly 14 days longer than the Tarp house.
- While the Bubble did not reach our target of 20 added growing days, it was able to protect the crops for approximately 2 extra weeks.
- Further analysis using ANOVA (see Figure 4 and 5) confirmed that hoop houses have a markedly significant effect on air temperature, particularly during September and October, and was especially prominent during the day. The Bubble house contained the most marked difference, compared to the ambient temperature, the Bubble house was able to maintain approximately 5°F higher temperatures in the hoop house than the ambient air (Control).
- The Tarp and Clear hoop houses were not statistically different from each other with regards to maintaining air temperature.
- After analyzing the relative humidity in the air, the Bubble house, as expected, was able to hold more moisture than the Tarp and the Clear, and significantly more than the Control.
- The total crop yield from the hoop houses in 2018 was 104.46lb. The Bubble house generated the highest amount of harvested produce (50.43lb or 48.28% of total yield), despite a severe bug infestation mid-July. The Clear house generated 27.32lb (26.15%) of produce and the Tarp generated 26.71lb (25.57%).
- Tomatoes and cucumbers yielded the most harvest (in pounds) across all three hoop houses.
- Soil temperatures and relative humidity measurements were insufficient and unreliable.
- Additional data will be needed to confirm this year's findings.

Goal 2: Increase knowledge of specialty crop growers on season extension.

Benchmark: Growers indicate that cost of cover is the determining factor in skin cover purchases.

Target: We hope to increase the knowledge of 100 growers as to the relative season extension value of the three different covers.

Outcome:

- The hoop houses were on display with detailed, educational signage during the Albany County Fairgrounds Family Night and the Higher Ground Fair. Approximately 2,000 people attended Family Night and 2,500 people attended the

Higher Ground Fair. Feeding Laramie Valley staff and volunteers were on-hand for more in-depth tours and education, in which about a dozen people participated.

- Approximately 205 people directly received educational exposure to the hoop houses including volunteers, students, professors, community groups, FLV staff (temporary and permanent), and other miscellaneous members of the community and around Wyoming.
- 100% of people exposed to the project provided feedback of having increased their knowledge of how different hoop house skin covers have a different effect on growing specialty crops.
- Oral surveys were conducted with the intent to determine degree of increased knowledge of hoop houses and different skin covers during exit interviews for approximately 18% of people who received educational exposure.
- There was no tool in place to measure baseline knowledge; however, those interviewed expressed interest in learning more about season extension and growing specialty crops in Laramie, Wyoming. Many also expressed having a more clear sense of which covering they would use for personal gardening. Many cited cost as the determining factor, particularly citing costs of replacing the hoop house skins.
- A blog post and an informational brochure with the aforementioned results will be extended for broad public distribution. The blog post will be posted on the FLV website December 24, 2018.
- Additionally, the results and continual performance measures will be posted on the Feeding Laramie Valley and Higher Ground Fair website January 1, 2018 and on the associated social media pages (Facebook, Instagram, and Twitter).
- Dr. Cliff Riebe will utilize the analysis and results of this research as real-life examples for future students in geology and environmental analysis labs (typically 30-40 students per class per semester).
- Finally, inquiries are being developed for potential publication of this research in food systems related journals.

BENEFICIARIES

- Beneficiaries include Laramie residents who were in the Feeding Laramie Valley Summer Shares Program, where individuals and families receive a weekly bag of fresh produce at no cost. The majority of specialty crops harvested went directly into the weekly Summer Shares bags. As of October 13, 2018 there were over 200 community members each week in the Shares Program. Specialty crops that were not distributed for the Summer Shares participants were donated to Laramie Interfaith Good Samaritan, and used the Feeding Laramie Valley Summer Food

Program, Kids Out to Lunch. Using the Laramie Farmers Market average pricing of \$3.22 per pound produce (based on a study conducted by Feeding Laramie Valley in 2015), the hoop houses produced approximately \$336.36 worth of food. food systems related journals.

LESSONS LEARNED

There were several unexpected outcomes from this preliminary research, mainly the performance of the fiber reinforced skin, or Tarp house. The Tarp house, which had been built in 2017, had had soil amendments twice prior to this research. The resistance to tearing made the Tarp an ideal match for the high Laramie winds, and came highly



recommended. The additional years of soil amendment was expected to give the Tarp house an advantage. The clear skinned unit or Clear house, performed as anticipated, and is



predicted to have to be repaired in less than a year. While the 2018 data reflects that the bubble encapsulated skin, or Bubble house, was more effective at retaining higher temperatures and had a higher yield than the other houses, at this time we cannot make a definitive decision as to what type of hoop house would contribute to the longest, most favorable growing environment as well as being cost effective without follow-up research in subsequent years. There were several challenges throughout the course of this research including pest infestations, temperamental crops, and irregular and suspect sensor records. Mid-July saw an outbreak of gnats in the Bubble house that spread rapidly and was not resolved for several weeks. As a result, this may have reduced the amount of harvest that was available throughout the rest of the season. Since pests can spread easily in a confined space such as a hoop house and can become a large problem, we must remain vigilant about pest control. As aforementioned, broccoli was not ideal for growing in the hoop houses. The rapid flowering rate of the broccoli (about 2-3 days) made it difficult to harvest in time before flowering. The biggest challenge we faced, however, was the sensors themselves. As seen in the charts above, there were several gaps in the data where sensors had stopped working for several weeks causing the analysis to be less robust than would be preferred, particularly for any analysis on soil temperatures. The high degree of outliers, as seen in extreme hot temperatures (120°F and up) in the air and particularly the soil

temperature measurements leads to uncertainty in the degree of accuracy of the sensors. Additionally, there was a high degree of uncertainty in the reliability of relative humidity measurements, particularly seen in the Tarp house. In the future, the sensors should be tested prior to their placement in the hoop houses. For a more robust analysis of the soil temperature, there should be an additional sensor that records soil temperature outside of the hoop houses. Finally, to increase certainty in the harvest yield, an additional plot of identical size should be planted without a covering to act as a control for production. Determining a specific hoop house type after one year of research is difficult to establish. Broadly, this research confirmed that having any hoop house, regardless of the type of covering, is more beneficial for growing warm-weather specialty crops. The rapidly changing weather in Laramie means that any cover of a hoop house will help prevent weather-caused damages such as hail, heavy rain, and high winds. However, with regard to cost effectiveness, the fiber reinforced covering, or Tarp, is recommended above the clear skin and the bubble encapsulated covering. This is due to the relatively low cost (\$350) compared with the Bubble house type (\$700), and the high resistance to tearing. This recommendation also takes into account the cost of less frequent skin replacement, as compared to the Bubble and Clear skins. Subsequent research will need to be recorded and analyzed over several years before a final conclusion is established.

Assessing the degree of increased knowledge of season extension was also challenging to measure. There was no easy way to establish baseline knowledge of participants prior to or after tours and/or presentations about the research project. For future research, it is recommended to establish an optional written survey for those who were directly exposed to the research. Surveys may be disseminated in person or sent out in an email. We will need additional time and research to better determine the degree of increased knowledge on season extension, particularly with the new findings established in the research project. Ongoing efforts of disseminating the information and results gained from this research through the Feeding Laramie Valley websites, blog and social media posts, publication, and other efforts will significantly increase the number of people aware of season extension options in the Laramie Valley. Continued efforts and research will also increase the robustness and confidence of our results. .



Figure 11. Photos of sensors used to record temperature and relative humidity. Left-most photo shows the sensor recording outside temperatures (Control). Note the probes in the soil are not shown.



Figure 12. Left – Two AmeriCorps VISTA members admire the newly transplanted crops inside the Clear hoop house. Right – Full view of all three completed hoop houses at the Feeding Laramie Valley Farm.



Figure 13. Left – Close up of 2 of the 4 educational signs at the FLV Farm. Right – Founder Gayle M. Woodsum gives a tour to a new team of AmeriCorps NCCC members July 13, 2018.



Figure 14. - Tomatoes from the Bubble house. Right – Clear house specialty crops. Note the broccoli has already flowered.



Sign #1

Hoop Houses

The Wyoming Department of Agriculture Specialty Crop Grant is funding our Hoop House Project! We are measuring 3 different types of plastic to see which is best for growing in this region. The materials used for the hoop houses are lumber, PVC pipe and rebar. We are recording the air temperature, soil temperature, relative humidity, and production in each

hoop house. We have planted cabbage, cucumbers, tomatoes, okra, bell peppers, broccoli, jalapeño peppers, and cayenne peppers in identical locations in each hoop house.



Sign #2

1st Hoop House

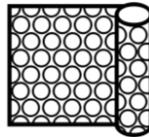
This hoop house has an 8-mil plastic cover with UV protection. This plastic is the cheapest of the three. ***Fun fact: Plastic covers need UV protection; otherwise the sunlight will break down the hoop house cover and affect the growing process.***



Sign #3

2nd Hoop House

This hoop house has a plastic cover that is similar to bubble wrap. The plastic has a layer of air for insulation. It has a higher protection than the other hoop houses and the plastic lets in less light. Out of the three plastics, this one is the most expensive.



Sign #4

3rd Hoop House

This hoop house has a woven poly plastic cover, which is similar to a tarp. It is much stronger than the other two plastic coverings. This type of plastic is used in hoop houses partly because the price is more affordable.



CONTACT INFORMATION

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FEEDING LARAMIE VALLEY

PROJECT SUMMARY

Feeding Laramie Valley (FLV) is a nonprofit organization located in Albany County, Wyoming. It was awarded this project in late 2015. The project was designed to create a large site specialty crops production garden, in order to greatly increase the amount of fresh fruits and vegetables available to food insecure individuals and families in Albany



County. Grant funds supported the design and establishment of a one-acre specialty crops site, for food that to be shared in the community. Based on local research data collected from 2012 - 2014, it is anticipated that this project will be capable of producing 16,000 pounds of fresh produce annually, valued at over \$56,000. In addition, the project will take a solid step in the direction of sustainable local food security by providing an array of opportunities for gardening education, utilizing sustainable and specialized high altitude gardening procedures intended to guide, encourage and benefit constituents experiencing food insecurity, local gardeners, and agencies dedicated to food security and the overall health of the community. The project is timely and important as Albany County Wyoming now faces a poverty rate nearing 30%, which threatens to further increase food insecurity here.¹

PROJECT APPROACH

Through this project, Feeding Laramie Valley has been able to establish two new food production sites, successfully moving the food production aspect of its program work into large site specialty crops production. The two new areas include a large, double lot in a Laramie neighborhood a couple of blocks from the FLV central office (which we are calling

¹ Wyoming demographic, economic and food security statistics are drawn from various studies as reported in the American Community Survey, 2013, and Mapping the Meal Gap, 2014.

the 8th Street Garden), and about an acre of land located at Albany County Fairgrounds (known as the FLV Farm).

The 8th Street Garden is a privately owned piece of property donated for use by its owners. Positive key features for this specialty crops grant are six existing raised beds simply needing soil amendments and a few repairs, an existing well on site with a spigot, excellent sun exposure, good wind protection and an excellent location near the university and other high traffic areas for educational outreach.

The FLV Farm is the most ambitious specialty crops production undertaking for FLV to date. Positive key features here are full sun exposure throughout the day, city water provided by the fairgrounds, and a large, level, open site. This piece of land is set on the edge of the Albany County Fairgrounds, which also makes it an ideal educational setting – in particular because Albany County Extension’s office is located at the fairgrounds and many of its classes and activities are conducted there. Also, FLV’s new regional education and tourism event, the Higher Ground Fair, is conducted every year (beginning in 2016) at the fairgrounds, with multiple displays, presentations and hands-on workshop offerings held at the farm site. FLV is highly active in extending outreach and education through social media as well – from its Facebook page at <https://www.facebook.com/FeedingLaramieValley>, and its website page at <https://www.feedinglaramievalley.org/>.

Project Activity
created large site specialty crops production garden plan; ordered specialty crops seeds
Implement seedling development
Researched, designed & built season extension devices including hoop house/high tunnel, and other appropriate wind protection and season extension components
Selected site's most suitable debut garden location
Build perimeter/wildlife safe & friendly fencing
Prepared & amended soil for growing specialty crops
Designed & implemented garden irrigation system
Planted, maintained & harvested production garden
Distribute produce to increase equitable food security
Conducted Higher Ground Fair for community tour/food sampling and educational presentations
For educational purposes implement recipe exchanges/cooking & food preservation instruction and community sharing to increase food security
Implemented late season specialty crops production in high tunnel
Prepared specialty crops production site for winter beds, including cover crop planting

Conducted meetings with Cent\$ible nutrition participants; interns maintained food production journals,

Shared outcomes and outputs on a regular basis with community members through its website, www.feedinglaramievalley.org, social media pages on Facebook, Instagram, and Twitter, as well as by conducting site tours and other community events.

In addition to the immediate benefits provided by the development and use of the 8th Street Garden and the FLV Farm, this project is serving to help FLV establish the capacity and experience for providing long-term training programs for beginning and disadvantaged farmers and ranchers, youth and development of legacy and estate planning for farmers and ranchers anticipating retirement. FLV is also in the midst of planning for major specialty crops production, research and education in partnership with the City of Laramie, for which this project is helping to serve as a credibility base.

GOALS AND OUTCOMES ACHIEVED

Outcomes Achieved Toward Overarching Goals

Goal #1: increase Albany County food security through sustainable specialty crops food production, distribution and education

Target: create increased capacity to grow between 10,000 - 16,000 pounds/year of fresh fruits and vegetables on a large gardening site, with a value of \$35,000 - \$56,000, that can be shared with Albany County individuals, children and families experiencing food insecurity and/or limited access to fresh, healthy produce

Outcomes Overview (see details in Performance Measures Outcome section): The scope of this project seemed to expand as it unfolded, as has its effect and reach. As a result, two large-space gardening sites have been established with planting and harvesting taking place in 2016 and 2017 (planting has begun in 2018 as well) in both places – in particular at the FLV Farm. Direct beneficiary numbers have more than tripled since the project began, and general community awareness has increased greatly through the educational and outreach components of the project.

Goal #2: increase community knowledge of and participation in sustainable local food production

Target: launch community and constituent-involved food production advisory council to help design, support and evaluate production garden project; provide local food production involvement and benefits, related education and opportunities for practice to at least 2000 people in Albany County each year

Outcomes Overview (see more details in Performance Measures Outcome section): FLV has established multiple advisory teams to benefit and guide its food production and distribution practices in general and specifically for this project. All of them contribute an essential perspective on and for this project. They include: a community and university advisory council for gardening and healthy choices for community members living with chronic illnesses and disabilities; a team made up of constituents, volunteers and FLV staff

members to discuss and advise on matters specifically connected to local food access and need, types and amounts of specialty crops to be included in the FLV Shares program and its Summer Lunch program; the advisory council of Laramie Square has expanded its participation to include specialty crops production and distribution coming out of this project.

Education and opportunities for practice abound with FLV as a result of this project. In 2017, FLV staff met with 10 - 15 Cent\$ible Nutrition (a program of the University of Wyoming Cooperative Extension) participants at the FLV Farm on a weekly basis to help them learn about growing, harvesting and use of specialty crops in an interactive, hands-on way. At each of the 2016 and 2017 Albany County 4-H Fairs (25 – 50 visitors at the farm each fair) and the FLV regional Higher Ground Fairs (200 – 250 visitors at the farm area at each fair), the FLV Farm site was also utilized as a site for a hands-on high tunnel construction workshop, general tours, and an interactive educational presentation on composting in Southeast Wyoming. The FLV Farm and 8th Street Garden are now regular sites for student intern, apprentice and service learning opportunities for individual programs, small and large group educational opportunities. Since 2016, FLV has hosted 16 season-long apprentices/interns (14 weeks @ 35 – 40 hours/week); and more than 250 service learning volunteers working in stretches of work time ranging from 4 hours to 12 weeks (35-40 hour work weeks).

Outcomes Achieved Toward Performance Measures

Goal 1.1. Establish one acre of new food production space capable of producing between 10,000 - 16,000 pounds of fruits and vegetables during each Laramie growing season, for community members living with food insecurity

- monitoring plan: keep records of community and constituent involvement in advisory council; create maps, diagrams and gardening journal of all planting, maintenance and harvesting practices (including successes and failures); record weights and types of all food harvested; weights and types of food distributed and where

Outcome:

Food Production

The FLV Farm site had been growing field grass for the last 30 years or more, making site preparation painstakingly difficult, and requiring grass removal, initial plowing, soil amendments and rototilling to just get started. This was accomplished, including the addition of 300 cubic yards of high quality compost being added to date. Because the FLV Farm is located on the edge of town and on prairie land, high and steady winds are an expected challenge to specialty crops production there. As provided for in this project's plans and budget, a full-scale windbreak fence was built along the west and south sides of

the farm. Field fence as protection from deer and antelope that frequent the area, encloses the east and north sides of the farm. Additional weather protection on the north side is naturally created by a mature living snow fence demonstration site between the FLV Farm and other areas of the fairgrounds.

On the FLV Farm, pipeline and three water spigots were installed connecting to the fairground’s city water access, and drip water irrigation systems have been installed throughout the specialty crops production areas. Three large high tunnels have been installed and put into production and also for use in research regarding best practices for growing specialty crops in Zones 3 and 4 (and in particular in the special needs area of Laramie’s high plains with mixed soil challenges).

At the 8th Street Garden, a broken well pump has been replaced, and four new raised beds have been added. In-ground soil amendment and preparation is being prepared for summer, 2018 planting.

As of the spring of 2018, a full acre of food production land is available for FLV specialty crops production. Two thirds of that land is located at the FLV Farm, and 1/3 at the 8th Street Garden. There is an additional 1/3 acre available to FLV at the Albany County Fairgrounds for use as the organization’s capacity reaches its ability to put that additional land into specialty crops production.

Types of Food Grown in FLV Production Sites 2015 -2018



- | | | |
|---------------------|---------------|-------------------------|
| Arugula | Beets | Celery |
| Strawberries | Broccoli | Swiss Chard |
| Radishes | Cabbage | Bok Choy |
| Lettuce | Cauliflower | Kohlrabi |
| Spinach | Green Onions | Bell Peppers |
| Mixed Greens | Pumpkins | French Breakfast Radish |
| Chard | Basil | Oregano |
| Red Speckle Lettuce | Parsley | Lemon thyme |
| Squash | Snow Peas | Tomatillo |
| Cucumber | Colored Chard | Serrano Pepper |
| Cilantro | Jalapenos | Yellow Squash |
| Beans | Summer Squash | Cherry Tomato |

Peas	Saucer Squash	Pole Beans
Zucchini	Africa Squash	Chili Pepper
Tomatoes	Green beans	Spaghetti Squash
Kale	Buttercup Squash	Purple Radish
Carrots	Peppers	Chives
Patty Pan	Garlic	Cherry Bell Radish
Turnips	Leeks	Dill
Corn	Mint	Crook Neck Squash
Potatoes	Lemon Cucumber	
Onions	Eggplant	

Food Distribution

2015 – 69 people/week

Summer Shares began 7/4/15, ran 15 weeks

Numbers remained relatively steady

unduplicated people served = 69

of days FLV provided the USDA recommended daily servings of fresh fruits and vegetables = 2587.5 (shares bags for 69 people x 15 weeks = 1035 x 2.5 days)

2016 – 100 people/week

Winter Shares began 1/23/16, ran 14 weeks

Summer Shares began 7/4/15, ran 16 weeks

Recipient numbers remained relatively steady

unduplicated people served = 100

of days FLV provided the USDA recommended daily servings of fresh fruits and vegetables = 7500 (shares bags for 100 people x 30 weeks = 3000 x 2.5 days)

2017 – 125 people/week average

Winter Shares began 1/14/17, ran 16 weeks

Summer Shares began 7/4/15, ran 16 weeks

New each week averaged 5 (160 new added to 125/week)

unduplicated people served = 285

of days FLV provided the USDA recommended daily servings of fresh fruits and vegetables = 10,000 (shares bags for 125 people each week x 32 weeks = 4000 x 2.5 days)

2018 – 218 people/week

Winter Shares began 1/14/18, ran 16 weeks

Summer Shares began 6/30/18, ran 16 weeks

New each week averaged 10 (320 new added to 218/week)

unduplicated people served = 538

of days FLV provided the USDA recommended daily servings of fresh fruits and vegetables = 17,440 (shares bags for 218 people each week x 32 weeks = 6976 x 2.5 days)

Goal 1.2. Install and utilize season extension materials on site where feasible

- monitoring plan: keep weather related records as part of ongoing gardening journal, indicating when season extension and weather protection materials or efforts are utilized and to what effect

Outcome:

Six raised beds have been constructed so far at the FLV Farm as well as the 10 now available at the 8th Street Garden, all of which assist with season extension by offering warmer soil earlier and later in the growing season. The first high tunnel supported by this project was constructed in 2016 at the FLV Farm and was successfully planted and harvested that year, with a second one built in 2017. One of them did not survive the harsh winds of the winter of 2017-2018. Two new tunnels were constructed in the spring of 2018 with new skins on all three. These will now be used in a specialty crops research project as well as for expanded specialty crops production, education and use.

By 2018, construction of location-appropriate hoop houses was mastered. Space, light and protection from wind was found to be most advantageous on the northwest edge of the one-acre area of FLV's Farm, located at the Albany County Fairgrounds. Three hoop houses were constructed (one in 2016, two in 2018), with a different type of skin covering each hoop house (the mix was part of an ongoing research project to determine which skin was most successful in season extension capacity). Not only did the addition of these hoop houses increase food production capacity and actual food production the very season of their installation, lessons learned continuously from previous challenges as well as ongoing improvements contributed to organizational as well as public learning.

Crops grown inside the FLV Farm hoop houses were: cabbage, broccoli, cayenne peppers, jalapeño peppers, bell peppers, cucumbers, tomatoes, and okra.

With the advent of the improved construction quality of the triple hoop houses at the FLV Farm site, more reliable records of season extension effectiveness became possible, while methodologies for collection and recording continue to need improvement (in particular, more reliable and durable temperature and humidity sensors are needed).

Of the reliable season extension data collected in 2018 from the triple hoop houses, the following season extension information was learned²:

1. Between June 4 and November 7, 2018 (156 days), there were 48 frost free days at the FLV Farm site in south Laramie, Wyoming.
2. During the same time period, inside the triple hoop houses at the same location:
 - a. translucent tarp-covered hoop house had 22 frost-free days
 - b. clear-cover hoop house had 24 frost-free days
 - c. bubble-cover hoop house had 18 frost-free days

Goal 1.3. Establish at least two perennial food crop garden beds (such as rhubarb, asparagus, and berries)

- monitoring plan: include perennial food crops in garden design and installation, record production weights and types as part of ongoing record keeping

Outcome: Raspberries were started at the FLV Farm in 2016, strawberry beds established in 2017, and plans for a large scale asparagus bed to be established at the FLV Farm are in place for 2019 (see more details below). All specialty crops produce, including that coming from perennial beds grown or collected and distributed by FLV are weighed and recorded according to site and final destination/use.

Final Project and Monitoring Results

Fruit

In 2016 and 2017, a great deal of work was required to prepare the largest FLV site (the newly acquired FLV Farm) for agricultural use. The entire area had been planted in field grass for decades, and much of the soil composition was clay. Once the grass was removed, many tons of organic compost matter and top soil were used to amend the soils. Early planting of a few bushes of raspberries were planted as trial bushes in 2017, and one medium raised bed (4' x 8') of strawberries was established in 2016. The first raspberry bushes did not survive the winter. The raised-bed strawberries produced less than a quart of strawberries in 2017, and double that in 2018, in spite of half the plants being lost to poor moisture from high winds on the west side of the bed.

At the FLV LaBonte Park office site in the summer of 2016, an in-ground patch of strawberries of about 16 square feet was established, along with a 36 square foot raised bed raspberry patch (custom designed with supports for the bushes) was also established. There was minimal production of berries during the 2017 season, and improved production in 2018, with several quarts of strawberries and raspberries each harvested.

Much was learned from the success of the health, growing and harvesting of the FLV LaBonte Park office site, as well as from the challenges of the fruit crops at the new FLV Farm. Lessons learned from both sites – a better understanding of soil, water and wind protection needs, combined with data collected regarding bed sizes and yield – positioned FLV farmers to establish larger raspberry and strawberry crops capable of resulting in greater success and higher yield.

In 2018, six raised beds were prepared for larger scale strawberry crops, and 25 raspberry bushes were planted along about 40 feet of south facing land supported by fencing to the north of the bushes, and wind protection afforded by an established living snow fence approximately 20 feet to the north of that.

Asparagus

Small test beds for planting asparagus from seed were established at both the FLV LaBonte Park office site and the FLV Farm in 2015 and 2016, with some success in plant establishment, and an opportunity for learning about this rarely grown vegetable in the Albany County, Wyoming area. With weeds being a primary challenge to successful asparagus crop growth, the project time for larger scale asparagus production was spent in grass/weed eradication and soil amendments using organic practices. Size of the asparagus bed was increased to about 20 square feet in 2018, and soil preparation is underway to establish a minimum 500 square foot asparagus bed, with plans to plant the bed in asparagus crowns, rather than seed, in the spring of 2019.

Monitoring

Planning and design maps are created and kept up to date by FLV staff for each food production site. As detailed above, perennial crops were planned for and started in multiple locations within FLV's food production areas.

As with all FLV food production, the monitoring plan of perennial crops included the key method of recording production weights. Because of the slow development of these crops as described above, production weights through 2018 of this project were negligible. This monitoring will be implemented as production increases and becomes more successful.

Increase in Knowledge

Garden journals were kept and shared by the entire FLV Shares team, including full time staff, full-time seasonal staff and full-time seasonal interns/apprentices. Observations included the tracking of what crops were grown where, daily record-keeping of harvesting by variety, location and weight, along with notes on weather, watering, general crop maintenance and results. Included was narrative data collection on what the annual full-time apprentices learned during their time on the team. The vast majority of FLV apprentices (4 paid apprentices each season) began each 14-week season with little to no direct gardening or farming experience. Their learning and general experiences were collected and recorded through their personal journals, their daily and weekly contributions to FLV Shares data collection tools, weekly meetings with FLV Food Production Coordinator and assistants, mid-term interviews with ARI-FLV CEO, and formal one-one-on exit interviews with FLV Food Production Coordinator. One hundred percent of the apprentices who worked during this project, reported that they had a 100% increase in knowledge on the following skills: garden preparation, planting, maintenance and harvesting; tool identification and use; garden/farm infrastructure construction and maintenance; produce handling safety, preparation for distribution and distribution;

understanding of and response to local food insecurity and access needs; personal confidence and community connection.

Two days each week, detailed notes were kept by a local gardening expert who provided watering and mentoring services two days each week, at each FLV food production site. Notes and recommendations were made on soil and plant condition; pests; watering effectiveness; weather damage and plant protection needed; weeding, thinning and harvesting. These services are in the process of being transferred into a standard design for quantitative data collection by all members of the Shares Team.

Goal 1.4. Create at least two raised bed gardens designed for accessibility for gardeners with disabilities gardening in large food production sites

- monitoring plan: keep photo-narrative records of accessible raised beds usage and evaluation by individuals with disabilities

Outcome: Three accessible garden beds supported by this project were constructed and put to use in 2016 and 2017. One is a raised bed designed with access points specific to individual with mobility issues. One is a raised bed design with attached seating for individuals who have greater access to working in their garden with this kind of set-up. A third design is a free-standing, circular high tower design that makes gardening more accessible for individuals who have trouble crouching then rising, especially on a frequent or regular basis.

Final Project Results

Feeding Laramie Valley began designing a program with the focus on gardening and farming for people living with multiple chronic illnesses and other disabilities, called the FLV Garden ability project. In 2015, an apprentice living with disabilities conducted research and wrote a report that included recommendations for FLV. Those recommendations along with an evidence-based literature review and consultation with local health care providers, were all used as the basis for more fully launching the Garden ability component of this project. As a result, the three raised beds mentioned above were built and put into use, along with purchase of several standing and wheelchair-height beds, and a unique vertical planter on wheels. By way of one-on-one mentoring and teaching opportunities using FLV's accessible raised beds specialty crops production, this project also contributed to FLV's Gardens for Health and Healing (GH & H) program, with direct service to people living with multiple chronic illnesses that required accessible garden spacing for growing specialty crops for personal use. Each gardener successfully planted, harvested and ate from a minimum sized garden plot of 32 square feet as supported in part by this project, and in part by other funding sources, including a University of Wyoming INBRE research grant.

Beneficiary Numbers

Outreach and general education to local health care providers: 77

Numbers of people using and learning from accessible raised beds and associated education:

2015: 7 GH & H participants

2016: 13 GH & H participants

2017: 19 GH & H participants

2018: 8 GH & H participants

General FLV Community Participants from ARK Regional Services

2015 – 2017 = 4 participants each year

2017 – 2018 = 6 participants each year

2018 – 2 additional participants

Total beneficiaries:

Total Unduplicated 2015: 11

Total Unduplicated 2016: 17

Total Unduplicated 2017: 26

Total Unduplicated 2018: 16 (decreased numbers as a result of temporarily decreased GH&H support funding)

Total unduplicated, 2015 - 2018: 70

Additional Garden ability components to the work of FLV and its direct and supported production of specialty crops, is the 2018-2019 installation and opening of a new community garden in the City of Laramie's Kiwanis Park. The garden in general is designed for full wheelchair access (including ADA parking and access to the entrance of the garden), and includes an area of the garden designed with multiple raised beds that have wheelchair and general disability accessibility.

Monitoring: photo-narrative records of accessible raised beds usage by individuals with disabilities were recorded by FLV staff and FLV beneficiaries, and photo samples have been submitted as an attachment to this report; evaluation was conducted through conversations with participants utilizing accessible garden beds, gathering information on the value of having gardening components with greater accessibility from the participants themselves and, in some cases, from caregivers of the participants, and receiving feedback as to how improvements can be made.

Goal 2.1. launch community and constituent-involved food production advisory council to help design, support and evaluate production garden project; provide local food production involvement and benefits, related education and opportunities for practice to at least 2000 people in Albany County each year; provide recipe exchange and cooking class opportunities and on-site tours and learning opportunities.

- monitoring plan: pre- and post- educational surveys, focus group and individual interviews (pre, during and post project) will be conducted with participants. FLV will share outcomes and outputs on a regular basis with community members through its website, social media pages on Facebook, Instagram, Twitter and site tours and other community events.

Outcome:

Feeding Laramie Valley is community-based and community driven, with the design and implementation of its services strongly informed by community members who are living with the problems the organization’s programs are working to address. Each component of this project was guided by its own advisory group made of a diverse representation of local gardening experts; university researchers and/or extension staff; FLV staff; community members living with chronic health issues, insufficient access to healthy food and food insecurity; student interns and apprentices.

Advisory Council Participation

Advisory Council Members: 7

Laramie Wellness Group Advisors: 40

Shares Team: 6

Monitoring: Minutes of each advisory council, wellness group and shares team meeting were recorded and distributed for corrections and acceptance. These minutes include notes on participant reflections, lessons learned and recommendations for future goal setting, strategic community planning and meeting process.

Monitoring for Overall Specialty Crops Production and Distribution

Project-related education/learning opportunities came in a variety of ways and from a variety of venues, each with its own method of evaluating knowledge gained. Specific sub-project programs with education/learning opportunities included the following: FLV keeps annual maps and diagrams of each food production site, with journal notes on maintenance and harvesting practices and achievements. Spreadsheets are on file for each site, each specialty crop and weekly weights of each type of food produced as well as distributed (and where). Specific journal entries on a weekly basis include weather notes, implementation of season extension protection such as cover during early frosts, lifting and lowering hoop

house covers according to temperature, etc., and whether or not crops were protected/saved from hail, frosts, wind, and so forth.

This kind of record keeping not only informed each subsequent year of the project and beyond, it is utilized and supplemented by community and student interns, apprentices, seasonal staff, and backyard gardeners as an educational tool that is archived over the years for comparison purposes. In this way, variety types that do well in this location, disease outbreaks that affect small or large areas of the community from time to time, management of challenges that works (and what doesn't), become part of the ongoing history of specialty crops production, distribution and promotion. In addition, for apprentices and students at FLV, weekly journals they're required to keep and submit to the organization, also include individuals' impressions and responses to what they learn throughout the season they participate with FLV. Beneficiaries that include community members living with food insecurity and/or poverty likewise contribute to this body of knowledge through journaling, personal interviews, and in several cases video stories now made available on the FLV video and photo link, promoted on the FLV website: <http://gayle80.wixsite.com/fooddignity>.

Project Component: Gardens for Health and Healing

Gardening Participants: 47

FLV Specialty Crops Project Component: installation, teaching and support for backyard gardening

Specialty Crops Teaching Method: one-on-one mentoring, minimum 1 hour/week x 12 weeks; options for food preservation were introduced during the harvesting component. About 30% of these participants expressed an interest in learning to do some kind of food preservation, with the most common form actually undertaken (by about 20% of the participants) was freezing. Community partners Laramie Local Foods and the University of Wyoming Extension offered regular food preservation workshops, and FLV participants were encouraged to attend.

Evaluation Collection Tools: exit interviews with FLV Staff, confidential in-person interviews with UW researcher

Results: 100% of the 47 gardening participants working with one-on-one mentors reported a 100% increase in their knowledge of backyard/personal gardening skills in working with specialty crops in their first year of participation. Of the 22 participants who received support and mentoring for a second year, all gardeners reported that their second year of gardening was easier, larger and more successful than the previous year. Note: final and more extensive health-related research results conducted in partnership with the University of Wyoming are still pending.

Cooking and Recipe Exchanges with Specialty Crops Participants: 6

FLV Specialty Crops Project Component: weekly cooking classes and recipe exchanges held at FLV LaBonte Park Building

Specialty Crops Teaching Method: local, experienced cooks/teachers conducted 2-3 hour classes each week, featuring locally grown specialty crops as primary ingredients; participants also shared and discussed specific cultural and health needs regarding ingredients, and worked with cooks to adjust recipes to match those needs. Every week, recipes featured in the cooking classes were shared with participants and through FLV social media outlets, along with versions of each recipe as adjusted for health and cultural needs.

Evaluation Collection Tools: informal conversation during classes and formal interviews at the end of the course series.

Results: All participants reported that by participating in live, in-person cooking classes and sharing the prepared meals afterward, helped them appreciate the ease with which it's possible to cook in healthier ways that taste delicious.

Project Component: Kids Out To Lunch Garden Club

Gardening Participants: 2017 – 10; 2018 – 20

FLV Specialty Crops Project Component: a free gardening club open to children attending FLV's USDA-supported Summer Food Program

Specialty Crops Teaching Method: master gardeners/members of Laramie Garden Club designed and delivered a weekly garden club, during which time they taught an average of 10-20 children (at least 50% living with poverty and/or food insecurity) for an hour each week x 10 weeks, how to develop, plant, care for, harvest and help prepare specialty crops including: tomatoes, broccoli, spinach, kale, carrots, turnip, potatoes and radishes. The gardens totaled approximately 80 square feet in size.

Evaluation Collection Tools: informal conversations with the children during club meeting time

Results: 75 – 80% of the children who joined the club within the first or second week of the KOTL program continued with it throughout the 10-week session, with an average 70% attendance rate. 100% of the children talked about learning things they didn't know before joining the club, and 100% said they liked the taste of vegetables they grew themselves better than vegetables bought for them from another location.

Project Component: (2) Farmers' Markets – Laramie Downtown Market; Thursday Local Market

Farmers' Markets Participants: 15 unduplicated visitors/week at the two markets, x 14 weeks/year – 2015 – 2018 = 840 total unduplicated participants reached by this component of the project

FLV Specialty Crops Project Component: general public outreach and education on specialty crops production, harvesting and use, as well as public outreach on FLV community gardens

Specialty Crops Teaching Method: informational/educational brochures; staffed booth

Evaluation Collection Tools: knowledge increase was not formally measured at these markets, but questions about gardening in the Albany County area were commonly asked of market booth staffers

Results: 420 visitors to the markets signed up to receive ongoing information and outreach from Feeding Laramie Valley over the course of the project

Project Component: Food and Fun in the Park

Participants: 2015 – 150; 2016 – 298; 2017 – 302; 2018 – 804

FLV Specialty Crops Project Component: FLV's annual, free community gathering held the third or fourth Saturday each August is an educational and celebratory event with a primary focus on local food production, including a meal provided with the primary ingredients being grown locally and featured with labels that include the source and type of specialty crop used. Typical specialty crops included at each annual meal: onions, tomatoes, peppers (green, red, jalapeno), spinach, swiss chard, sweet potatoes, white potatoes, raspberries, watermelon

Specialty Crops Teaching Method: the entire event is highlighted by narrated and guided FLV garden tours; educational signage on the meal table and in all the on-site FLV gardens and infrastructure (including roof-top water collection system, watering systems, hoop houses, various types of raised beds, labels and descriptions on all specialty crops grown on site); an FLV booth and partner booths including High Plains Seed Library and University of Wyoming ACRES Student Farm

Evaluation Collection Tools: FLV mailing list sign-up sheets at meal table and FLV informational booth; informal conversations between participants and FLV staff – while increase in knowledge gained is not formally measured at this outreach event, the leap in numbers of participants and the primary focus on local foods and food production serves as a unique event in the area that ensures an ongoing increased interest in and understanding of the value of locally grown specialty crops production and consumption.

Results: attendance at this event grew from 150 people of all ages in 2015 to over 800 people in 2018; each year, 15% - 25% of attendees participate in the guided, educational garden tours

Project Component: Higher Ground Fair

Participants: Overall Fair #s: 2016 – 1500; 2017 – 2000; 2018 – 2500; Participants at Specialty Crops Project-related workshops and displays: 2016 – 80; 2017 – 110; 2018 – 150; also participating in overall event: 250 volunteers, of which more than 70 participated in this project's related components

FLV Specialty Crops Project Component: FLV established the Higher Ground Fair (HGF) in September, 2016 as a unique event meant to celebrate both tradition and innovation of the Rocky Mountain Region, and to do so in a creative, fun, educational environment that brings together agriculture (workshops and exhibits on ranching, farming, gardening); music; art and folk arts; animals and the environment; shelter and energy; presentations and displays on health and wellness and social action; regional foods and more. The format provides an inviting space for a broad range of audiences of all ages, and with diverse interests. The event provides an opportunity to introduce a diverse general public to the benefits and how to's of raising and consuming specialty crops. The HGF is held at Albany County Fairgrounds, which is where the FLV Farm is located, making for an ideal location to feature the work being done there.

Specialty Crops Teaching Methods: project-related activities conducted at the fair include: hands-on workshop on how to build a large hoop house; guided and self-guided (with extensive informational signage) farm tours; an interactive composting and recycling exhibit (includes event-based composting and recycling); informational and hands-on exhibits on gardening with exhibitors that include FLV; Growing Resilience presentations and exhibits from gardening research conducted in Laramie and the Wind River Indian Reservation; High Plains Seed Library; ACRES Student Farm; draft horse alternative farming and large scale gardening methods demonstrations.

Evaluation Collection Tools: written surveys; fair-based conversations; follow-up telephone interviews

Results: Each year, there has been a 3% return on written surveys provided to all fairgoers (45 in 2016; 60 in 2017; 75 in 2018). Of those returned, 90% indicated a favorable response to the fair overall, and 85% indicated having learned something new about rural Rocky Mountain living. Follow-up telephone interviews were conducted in 2018 on 70 fair participants, of whom 75% were specifically drawn to the fair because of its agricultural components, in particular the aspects of the fair that were related to specialty crops production and distribution, and 100% of those people said their knowledge was increased by a range of 50% - 100% as a result of being part of the fair.

BENEFICIARIES

In addition to the details on participants and beneficiaries detailed above, the specialty crops production area supported by this project are currently producing about 6000 pounds of specialty crops each season. It is fully expected that the sites are capable of reaching the target yield noted in the project summary of this report, and expect to do so (based on current development rates) by the fall of 2020.

As the result of the expansion of FLV food production of specialty crops, the organization has been able to more than triple the number of individuals receiving fresh, healthy foods through our FLV Shares program, and expects to double that again within the next 16 months. The amount of food shared is being tracked on a weekly basis. Beneficiaries reached are especially children, families living with high food insecurity and poverty, elders, people living with disabilities and chronic illness, and individuals challenged by social and economic disenfranchisement.



LESSONS LEARNED

Scope of Work

The scope of work involved with shifting FLV's food production into a larger scale, was greater and more demanding than even expected. The learning curve has been a challenging one for our food production team, in particular in regard to the amount of resources, materials and sweat equity involved in the initial preparation of the land. We continue to revise our approach to planning and implementation, and have expanded our use of research materials and local gardening and farming mentors to help the organization increase its capacity for success in producing high yield, high variety specialty crops. As we have begun to master season extension designs suitable for Laramie, Wyoming's weather and growing season, along with the ability to amend soils to their greatest growing advantage, we are increasing variety and yield. This is also aided by more knowledgeable and selective selection of seed varieties that do well in our part of the world. And one of the best lessons learned over recent years is to ensure that a substantial number of seedlings are started by us and for us at our base operational site (utilizing grow tents and careful tending.) We have been especially grateful for the ongoing generosity of time, knowledge and assistance being provided by our Wyoming Department of Agriculture, Agricultural Grants Manager, Ted Craig. He continuously shares resources and expertise with us that are invaluable as we build our knowledge, skills and capacity.

Theory of Change and Collaborative Pathway Program Development and Evaluation Work

Through the years of working on this project and all aspects of FLV's work, methods of gathering results and conducting evaluations on those results, has continued to evolve. Quantitative data on food production and distribution is relatively straightforward. FLV's system for recording crop varieties, amounts grown by type, pound and location, and when and where it's distributed, is well established and effective.

Qualitative data, not unsurprisingly, is both harder to gather and to capture with consistency given the combination of food production and social change goals (food access, food security, food justice) in all of projects. This challenge includes attempts to measure increases in knowledge. FLV continues to improve the level of sophistication in its tools for gathering qualitative data (in-person and exit interviews, informal event-based conversations, telephone follow-up interviews, etc.), by providing standard guidelines for interviewers and outreach workers.

Action Resources International, the 501(c)(3) parent organization for Feeding Laramie Valley, has developed and continues to expand work on a method of data collection and

evaluation called Collaborative Pathway Modelling (CPM), that identifies and tracks the complex web of participants, resources, activities, objectives and goals that make up a theory of change – including both quantitative and qualitative data – and most importantly, reflects a true picture of who and what is needed for success to be achieved. A basic CPM for FLV was developed in 2015. A new rendering of FLV’s work in sustainable community food production, distribution, sovereignty and justice (and how they do or don’t intersect), is slated for early 2019, and will in part reflect specific components of the work accomplished through this project. Public availability of that CPM and its related narratives is anticipated by mid-2019. (Additional specific lessons learned are included in each reported section above.)

The high tunnel constructed in 2016 did not survive the heavy snows of the difficult 2016-2017 winter season, which cut down on our food production yield. This high tunnel did not have a high enough arch on the hoops to withstand the wet snow load.



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LOCALFEST BACK TO SOIL CAONFERENCE

PROJECT SUMMARY

The demand for locally grown food in Fremont County completely outstrips supply. Local Fest local food event focused on enhancing the supply side of the equation through public education and collaboration opportunities among consumers, growers, and retailers. The goal was to rebuild local food economies, and this will be accomplished as more of our citizens gain sufficient knowledge in what this entails. This was accomplished by the 2016 Local fest conference. The event increased public awareness of current small agricultural enterprises and help attendees develop practical, and philosophical, understandings of the role food plays in the health of our bodies and our communities.

Local Fest included providing hands-on horticultural training with a leading gardening expert (Mr. Jeff Lowenfels). This training was designed for market/truck gardeners with a focus on organic practices that build soil and minimize the need for petro-chemical and other expensive inputs. Local Fest was focused on horticulture, will enhance over time, the competitiveness of (farmers markets, farm to school programs, CSAs, etc.).

PROJECT APPROACH

The SCBG funds supported the intensive horticultural training curriculum (soils, plants, growing techniques, green house operations, etc.,) and Mr. Kirschenmann's attendance as the event's keynote speaker (which reflected the UN's "Year of Soil" theme.)

Meet our speakers for LocalFest 2015



DR. FRED KIRSCHENMANN
 - longtime leader in sustainable agriculture - Distinguished Fellow for the Leopold Center
 - President of Stone Barns Center for Food and Agriculture - oversees his family's certified-organic farm in North Dakota - professor in the Iowa State University Dept. of Religion and Philosophy
 - ethics and agriculture writer - helped found Farm Verified Organic, Inc. - author of Cultivating an Ecological Conscience: Essays from a Farmer Philosopher



JEFF LOWENFELS
 - international proponent of Organics - weekly garden columnist for Anchorage Daily News
 - award winning author of "Teaming With Microbes: The Organic Gardener's Guide to the Soil Food Web," - consultant who has converted thousands to the no-chemical way to grow plants - founded Plant A Row for The Hungry, a program that encourages gardeners to plant one row to feed the hungry

Project Activity	Who did the work?
Tickets sales were tracked and admission fees to the event were collected.	Steering committee members
Horticultural Soils Workshop was conducted	Two key individuals (Jeff Lowenfels and Fred

	Kirschenmann), both whom provided insight and training on soils management for specialty crop production. Topics included soil health and balance, microbes, how to compost, compost tea
Developed a survey and collected data during Local Fest to help measure the effectiveness of the event in encouraging participation in our local food network and success in inspiring people to grow and sell specialty crops.	Steering committee members
The Lander and Riverton farmers markets took vendor counts over four successive weeks	Steering committee members
The Lander and Riverton community gardens will collect this information	Steering committee members
Verified CSAs operating in the county in 2016.	The steering committee will use its network of people engaged in the local food movement in Fremont County
Performance data collection & dissemination through the Local Fest website, with Facebook and word of mouth during Farmers Markets and other local food events.	Steering Committee members

Two of America’s leaders in the new agrarian movement: Mr. Jeff Lowenfels and Mr. Fred Kirschenmann were highlighted at the conference. Jeff is a renowned author, penning two books, “Teaming with Microbes” (2006) and “Teaming with Nutrients” (2013), winning the prestigious Garden Writers of America’s Gold Award. Jeff has had a weekly column in the Anchorage Daily News for 36 years where he shares his knowledge on composting, greenhouse operations, and soil nutrition for commercial sized ventures as well as backyard gardeners. Mr. Kirschenmann is one of the world leaders in sustainable agriculture. He is a professor at Iowa State University, and is the visionary behind the Stone Barns Center for Food and Agriculture, a nonprofit farm and education center located in Pocantico Hills, New York. Fred’s has a 2600 acre organic farm in North Dakota that serves as a model for organic farming and has been featured in many prominent magazines including National Geographic and Business Week.

LOCALFEST 2015 AT A GLANCE					
FROM SOIL TO SUSTAINABILITY					
Weds Oct. 14th	Thurs. Oct. 15th	Fri. Oct. 16th	Saturday Oct. 17th		Sun. Oct. 18th
Free Film Fest & Discussion	Free Film Fest & Discussion	Banquet & Gardener Intensive	*General \$10 Pass Workshop Sessions & **Exclusive Intro to Cheesemaking		Farm, Ranch & Tour d'Coop
Double Feature: My Father's Garden & Ingredients. Potluck: bring soups, bread & appetizers to share at the Lander Bakeshop!	Double Feature: Symphony of the Soil & PBS Farm to Fork Wyoming "Food Freedom" episode. At the Lander Library!	Gala Banquet & Keynote: From Soil to Sustainability by Dr. Fred Kirschenmann & five course local harvest!	Horton Heard a Who - Jeff Lowenfels shares a grand overview of the microbial world in your soils	CHEESE MAKING INTENSIVE NOTE: Special \$45 Admission Intensive with: May Wichers, atrisan cheesemaker.	Farm and Ranch tour of Spear 5 Produce in the beautiful Red Canyon.
			Stewart (Wyomatoes) and Brandon (Kelp4Less) share wisdom on conversion from conventional to Certified Organic for profits!	Plant a Row for the Hungry. Jeff Lowenfels shares the power and success of this simple approach to increasing local food security.	
		The art of vegetable growing in Wyoming Kim shares his wisdom on selecting garden varieties for success.	Sausage making -Putting the microbes to work with the age old art of curing meat.	Tour d' Coop run, walk or bike tour featuring Lander's coops, hoops, and hives.	
		Certified Nutritionist Poa, explains the effects of fermented foods in the gut, and the impacts of good and bad microbes on our mental and physical health.	Farmer's Market, visit vendors supporting local and sustainable food. Local-raised lunch, snacks and baked goods also!		
		Gardener Intensive with Jeff Lowenfels, acclaimed author of "Teaming with Microbes". Focus on composting and compost tea. Lunch included.	Discussion: forming a Wyoming Raw Milk Association.	Haderlie Farms shares the intricacies and rewards of running an integrated farm operation.	
			Raw Milk Discussion- Monitored Q&A	Food Freedom Act Panel Discussion	
			Beer and Food Pairing - Wind down with Lander Brewing Company's Master Brewer Nate Venner!		

* \$10 General Pass gives access to all Saturday events except Cheesemaking Intensive (16 and under free).

GOALS AND OUTCOMES ACHEIVED

Goal 1: Motivate and inspire people to grow specialty crops and to sell specialty crops.
Performance Measure: Performance measures will include the number of people attending Local Fest, Local Fest event surveys, number of people participating in community gardens, number of specialty crop vendors at local farmers markets and the number of new CSA's

Targets: 300 Local Fest attendees, Specialty crop vendors in Riverton and Lander Farmer's markets to 40, participants in Lander and Riverton's community gardens in 2016 to 255 and increase to 3 CSAs between Riverton and Lander in 2016.

Performance Monitoring :Steering committee members tracked tickets sales and collected admission fees prior to and during the event and developed a survey to collect data during Local Fest to help measure the effectiveness of the event in encouraging participation in our local food network as well as our success in inspiring people to grow and sell specialty crops. Steering committee members who run the Lander and Riverton farmers markets took vendor counts over four successive weeks during the 2016 growing season. Steering committee members who run the Lander and Riverton community gardens collected information in spring 2016. The steering committee used its network of people engaged in the local food movement in Fremont County to tally and verify CSAs operating in the county in 2016.

Results

Survey results collected during Local Fest (measuring effectiveness of the event in encouraging participation in our local food network.) 20% of attendees stated their primary goal as networking with local producers and another 20% were there to develop their gardening skills. 40% were seeking professional development. All attendees appeared satisfied with the classes in general, with highest ratings going to Jeff Lowenfels gardening intensive class. A general dissatisfaction was noted on Local Fest's failure to provide hands on training.

The demographics of the Local Fest attendees could be broken down as follows: Local Food Consumers: 27%; Producers: 21%; Community Activists: 9%; and Backyard Gardeners: 36%.

As designed, Local Fest drew a good mix of people with a diverse background of interests and occupations which, as relationships are formed will help nurture the local food movement and increase in specialty crop production.

Farmers Market information. Lander Valley Farmers Market has increased its average vendor numbers from 23 in 2015, to 27 in 2016. Riverton's Farmers Market saw an average of 43 vendors during the busy summer months in 2016, a 25% increase from the previous year.

Farmers Markets in both Lander and Riverton saw very strong growth in both the number of vendors and customer. The number of specialty crop producers has, perhaps, doubled in Riverton. Though no data points prove it, relationships were built at Local Fest between producers and customers and this was reflected in the dynamic growth of our markets.

Lander and Riverton community gardens. Lander has 48 beds and 100% occupied with more plots being built for next year. The gardens, it should be noted, are well maintained by boy scouts, cub scouts and National Outdoor Leadership School. Riverton's Community Garden continues to sell out all 90 of the available sites each spring. According to the garden manager there is no need at this time to expand the gardens further.

Both community gardens are popular features and well used. In terms of specialty crops, the gardens serve the backyard gardening community very well. The larger issue, in terms

of developing specialty crop production, is connecting would be market gardeners with landowners.

CSA Developments. The single CSA in operation in Fremont County closed up shop soon after Local Fest. Despite this disappointing turn of events we remain optimistic. Two new large greenhouses have been recently built, and both farmers are regulars at the area's farmers markets. It is easy to envision these farmers establishing CSA's to supplement their farmers market sales.

Social Media. A meeting between Lander Valley and Riverton's farmers' market managers was held recently. Among other topics discussed was the need to develop and maintain a robust social media presence. It is anticipated that Fremont Local Foods' website will serve this purpose and host information to help inform local food consumers, producers and entrepreneurs.

The Local fest committee in Lander has scaled back to doing a Local Taste event each spring. Local fest was targeting the market producer and there is still interest in hosting workshops and 'Meet the Producer' events, in Lander. A second Local fest conference planned for Casper in 2017 was canceled. An

Popo Aggie Conservation District Garden Expo

It was decided the Annual Garden Expo in Lander which attracted 1522 people filled the educational needs for backyard gardeners, producers and market gardeners. Two specialty crop workshops, one on native perennials were attended by 163 people and the other on heirloom apple trees had 81 in attendance. The increase in knowledge for the Perennials workshop was an average of 31% and for the heirloom apple workshop .40%

BENEFICIARIES

Wednesday night Local Fest had a screening of 'My Father's Garden' (featuring Friday night's Gala Keynote Frederick Kirschenmann) followed by the film 'Ingredients' 27 in attendance.



Thursday, at the Lander Library Carnegie Room, Farmer/Philosopher Frederick Kirshcenmann joined us for discussion and free screenings of 'Symphony of the Soil' followed by Farm to Fork Wyoming's 'Food Freedom' episode. 7 in attendance.

Friday - Jeff Lowenfels, acclaimed author of "Teaming with Microbes: The Organic Gardener's Guide to the Soil Food Web" and educator on soils and composting offered a day long intensive on Composting and Compost Tea. 11 workshop participants.

Friday Farmer/Philosopher Frederick Kirschenmann, National leader in re-thinking our food systems, presented 'From Soil to Sustainability'. 15 in attendance

Saturday - The 'International Year of the Soil' in the world of Microbes with workshops and presentations on Soils, Composting, Fermenting, and Food Pairing.



For the Garden Expo 244 people had an increase in knowledge by attending the workshops. These were individuals that were in some way involved in growing specialty crops.



The Annual Garden Expo in Lander impacted 1522 people that included producers, master gardeners, backyard gardeners and consumers.

LESSONS LEARNED

There is no good time for a conference in Wyoming. If producers are not preparing to plant, harvesting or sell their produce the weather in Wyoming doesn't cooperate. The window of opportunity to get people to travel is never easy to determine. Working with all volunteer nonprofit organizations presents additional challenges as the board members can change rapidly. There are always the champions on a board but eventually they become overworked and burn out. It is best to be prepared with a plan B incase changes to a plan are needed as was the case with the Localfest conference. The individual that was the main contact for the Local fest is no longer as involved at this time,

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INCREASING THE QUALITY OF SPECIALTY CROPS AND POLINATOR HABITAT IN A COMMUNITY GARDEN SETTING

PROJECT SUMMARY

The project strove to educate individuals and visitors to of the North Platte River Valley on the use of hugelkultur practices for specialty crop production and pollinator habitat. The project was important and timely as Saratoga has an average annual rainfall of just over 10 inches but is often at the mercies of a flooded North Platte River. This style of production provides the needed knowledge in alternative gardening methods to produce more local specialty crop fruits and vegetables for our needy and elderly. A second benefit was educating the public and governmental agencies such as Wyoming Weed and Pest, and the Town employees responsible for mosquito spraying on pollinator habitat to help the European honeybee industry in the North Platte Valley. A collection of data on local pollinators in Carbon County, Wyoming has never been documented. Developing a high-quality-pollinator habitat requires that flowers bloom early in the spring and continue late into the fall. To do this requires an abundant and diverse array of flowering plants. These include a wide variety of annual and perennial forbs/herbs and legumes, shrubs, vines, and fruit trees. These diverse plant communities provide food to our bees from spring until fall to make honey and pollination of many specialty crops including the brassicas, beets and other chenopodiae, alliums, and squash. Some of these crops have monoecious flowers (male and female flowers on same plant - squash, cucumbers) and some have dioecious flowers (male and female flowers on different plants - asparagus, spinach). In general, each flower must be pollinated by another flower's pollen (or another plant's flower pollen) to produce food. Honey bees are a vital component of the biologically diverse plants which are critical to healthy specialty crop production. They provide the essential pollination. By providing pollination, they are a service to the specialty crop industry. Many wasps, flies, beetles, and other insects also are pollinators, but they are not nearly as efficient as bees in moving pollen from flower to flow or do they produce the specialty crop honey. The project constructed hugulkultur permaculture structures in three locations. Within the Community Garden a hugulkultur large vegetable bed, a large standard raised bed, and a hugulkultur pollinator bed were built. We also assembled two hugulkultur pollinator beds at visible spots in the Town of Saratoga. In these three pollinator fenced mounds we planted native perennials including some not previously used in Saratoga to provide more pollinator habitats. They were very popular to pollinating insects, including non-native honeybees, and hummingbirds. This helped to educate the residents who live in the North Platte River Valley, visitors and hundreds of others through social media as well. These structures were used to measure growth and production of a variety of specialty crops, the project counted pollinators within the garden and on pollinator beds to examine quantity and diversity.

PROJECT APPROACH

Workplan

Build and plant hugelkultur and raised beds

Build deer proof fenced pollinator mounds with access for weeding

Develop the Facebook page for results and upload and share with the local community and all others interested.

Photo documentation of project and pollinators. Photographs used for genus/species identification when required.

Measure and record produce harvest comparison between hugelkultur and flat raised bed

Observe germination times and length of growing time for each production method.

Activities

2016

Built and planted a large hugelkultur and raised flat bed.

Built and planted a pollinator bed at community garden and Hot Spring Pool sites

Added additional wood structure to hoop house for wind stability protection.

Installed PVC and emitter hose for watering hugelkultur and flat bed.

Maintained pollinator bed perennials in regular raised beds in the Saratoga Community Garden for transplantation to pollinator beds as needed.

Added a west side tarp to help new

transplants at Hot Spring Pool pollinator bed.

Raised perennials at the Saratoga Community Garden site for transplantation to new pollinator bed built in 2017.

More planting of large beds and pollinator beds in July, left the temporary fencing and wind resistant tarping for the bed attached to the Community Garden due to our high winds.



Recorded harvest from the hugelkultur and flat bed.

2017

Four students were hired part time for summer to help with beds, pollinator counts and face book.

The Hugelkultur and the regular raised bed were prepared, seeded and planted.

White cabbage, Swiss chard, calendula, basil, 3 sizes of spaghetti squash, lettuces, parsley, celery, and many other vegetables were grown in the two beds and measurements and observations were recorded observations every 7 to 10 days.

Testing of high altitude seeds: Penn and Cord Parmenter's high altitude Candy sweet corn, pumpkins and twelve 60 to 70 day determinate, semi-determinate and indeterminate

tomato strains that were grown and seeds collected after several years at 8,120 feet above sea level by Penn and Cord.

The corn was both started indoors and transplanted and direct seeded into the hugulkultur versus flat bed. The direct seeded corn germinated 3 days earlier on the hugulkultur than the flat bed. Using the Navaho Three Sisters method, when the direct planted seeds were 4 inches high we planted pole beans next to each plant and several squash among the corn rows. Like the corn the beans had a more consistent germination on the hugulkultur bed. The top picture is the flat bed; the bottom is the same date but a shot of the hugulkultur. You can see the consistent bean plants between the corn.



The Hoop House on the big flatbed was replaced after 70 pus mile winds blew it down last winter. Penn and Cord tomato plants and bush bean seeds were planted inside the hoop

house. The tomato plant strains planted in the hoop house will be compared to the same strains same aged plants transplanted into the large containers in the greenhouse.

The students have had mini lessons in entomology to distinguish between pollinating flies and bees. Our flowers attract hummingbirds too.

The students entered 10 minute observations on the Wild Pollinator Count site (The data from these almost 17 hours of observation will be entered soon; we are still accurately identifying some of the native and exotic plants studied. (www.wildpollinatorcount.com)).

The data was posted to on The Saratoga Wyoming Community Garden Facebook page with 258 friends, as well as on the Wild Pollinator Facebook page, thus increasing our educational reach to more people.

The students were required to write a short science paper on some empirical observation they have measured or were interested in from the Community Garden using the APA journal style of scientific writing. As our youngest student has yet to take biology, much help was needed in Linnaean and scientific nomenclature and style, and a data presentation will be offered. It is hoped this will encourage the high school students to enter science poster contests if they have an organized piece of data.

We build the third pollinator bed which was placed at a picnic area near the North Platte River on South River Street and 1st Avenue, with educational signage.

Began to transplant mature largely native perennials propagated last year in the Community Garden.

We will continue our measurement of vegetable growth on flat bed with and without a hoop covering, on the hugulkultur and in the greenhouse in pots.

2018 Activities: In November of 2017 we had constructed a third pollinator bed on a small Town of Saratoga park located between popular restaurant Firewater and the North Platte River. The Odd's Fellow Park is maintained by The Odd's Fellows, and Bridge Street Bargains, a local non-profit entity that puts all of its profit into schoolchildren, supporting other NGOs and for Town beautification. Many of the donated bubs in the fall of 2017 did not flower because they were raised too high and the composting of the hugulkultur interior didn't get a start. It was also a dry winter. We replanted the new bed in May of 2018 with pollinators, annuals to fill bare areas and squash.



Building pollinator beds

The new replanted pollinator bed attracted many pollinators like the above hummingbird moth [we planted angel hair spaghetti squash as they climb, and attract butterflies, moths and hummingbirds]. We introduced many zone 5 flowers to Saratoga such as coral reef bee balm, red hobbit columbine, Rocky Mountain blue and scarlet penstemons, cardinal aquilegia, Cheyenne Spirit Echinacea, and red flax. Few



of these were available in our 2 small local greenhouses or places that don't use nicotinamides or other weed suppressants that could harm pollinators. We added more chokecherry, cherry and elderberry bushes to provide earlier spring flowers. Our will plums are still the best for early flowers. This also fulfilled our goal of increasing a more diverse pollinator habitat.

Increased tomato production: We planted 18

large pots of tomatoes in mid-June in outside pots and then moved them into the greenhouse in late September. We used the same replaced humus and top soil and bone and iron meals as in 2016 and 2017 but added layers of coffee grounds from a local barista. The production was remarkable. All of our 18 full-time gardeners from late July through later



October could stop by and pick what their families needed. They were flavorful and wonderful. We will add an automatic watering system next year to these tomatoes and our 18 outside private raised beds.

GOALS AND OUTCOMES ACHIEVED

Goal 1: Increase awareness of the hugelkultur as an alternative method of growing crops by constructing a hugelkultur berm planted with various fruit trees including heritage apples and a mix of vegetables and pollinator flowers.

Benchmark: There is no data on specialty crop production on hugelkultur in high altitude Wyoming.

Target: Of the citizens in the North Platte Valley we hope to increase the awareness of 10% or 250

Performance Measure: The garden managers will record the number of individuals involved in construction, planting and harvesting. The project Scientist will develop the Facebook page with student #1. It will be updated on a regular basis with information and pictures of the project. The number of hits will be monitored and recorded. The number of people attending community events will be documented and by using a simple survey before the hugelkultur is built and after it has been reported upon.

Performance Monitoring: The goal of increasing awareness of the hugelkultur permaculture as a gardening alternative was achieved through reports to the Town Council, education programs at the garden, visitors and events held at the garden, and our Facebook page. A total of 22 individuals and students were involved in construction, planting and harvesting of the berm. A Facebook page was developed and monitored with information on the project and maintained by students and project manager. A community educational event will be held to increase the awareness for local town people and visitors using the survey. Since the building of the hugelkultur the project was displayed on our Facebook page, in articles in the Saratoga Sun, and on our local Bifoot99 radio station. A UWUO survey indicated that approximately 750 small acre landowners are interested in information on pollinator habitat in Carbon County. The same survey indicated that 41% of small acre landowners grow fruits and vegetables for either personal consumption or sale.

Goal 2: Determine if hugelkultur berm agriculture is a viable growing method for high altitude specialty crop production.

Benchmark: The benchmark will be growth on the raised bed without the bermed pine and compost.

Target: It is anticipated that hugelkultur berm method will outperform a traditional raised bed by 25%.

Performance measure: Bimonthly photos will be taken from 8 aspects on the hugelkultur mound and traditional raised bed. They will be saved and uploaded to Facebook.

Additionally, produce was measured and recorded when it is harvested from both areas by student. Germination times and length of growing season for different specialty crops for each production method was noted.



Plant growth on the hugulkultur pollinator beds are striking in their larger plant size and flowers.

Performance Monitoring: The survival, growth rates and harvest volumes were documented for both production methods. The Navaho Three Sisters method – corn and beans germinated more quickly on the hugulkultur beds than flat bed. Beans were somewhat covered and squash almost completely covered. In the future corn needs to be planted further apart as the steep sides of the hugul bed provided too much shade. Many of the tomato strains were early and prolific, but most preferred larger tomatoes. The goal of filling the Community Garden with perennials as well as 2 hugulkultur pollinator beds in



distant areas increased habitat for local pollinators. We harvested hugulkultur and the comparison raised flat bed and reported the differences in plants and production achieved. Hugulkultur bed outperformed the flat raised bed for root crops but the results were mixed for other specialty crops.



Harvest comparison of the hugulkultur and flat raised bed.

Vegetable harvest in pounds and ounces (italics, harvest ongoing)	Low Bed (with and w/o hoop)	Hugulkultur bed	Comments
Beans	5 lbs. 8 oz.	3 lbs. 3 oz.	Much earlier beans in hoop house
Beets	<i>5 lbs. 11 oz.</i>	<i>16 lbs. 5 oz.</i>	
Cabbage - green	12 lbs.	12 lbs. 8 oz.	
Cabbage - red			Did not form heads, weighed plants anyway
Cucumbers	3 lbs. 15 oz.	4 lbs.	Hugul > than cucumbers in hoop
Spaghetti squash	<i>45 lbs. 3 oz.</i>	<i>37 lbs. 13 oz.</i>	Longer season in hoop house
Zucchini	6 lbs. 6 oz.	8 lbs.	Liked hugul
Tatsoi	<i>1 lb. 14 oz.</i>	<i>5 oz.</i>	Still harvesting
Mizuna	1 lb.	4 oz.	Still harvesting
Kale	<i>6 oz.</i>	<i>6 lbs. 15 oz.</i>	Still harvesting, but Hugul pants much larger and thicker
Bok Choi	<i>3 lbs. 10 oz.</i>	<i>4 lbs.</i>	Still harvesting
Potatoes	10 lbs. 12 oz.	18 lbs. 1 oz.	Despite only 4-5 inches soil over wood on hugulkultur, grew much better
Fennel	In hoop		Preferred hugulkultur
Basil	In hoop		Much preferred hugulkultur, plants on top in wind 3X as tall
Peppers	In hoop		Much preferred hugulkultur
Tomatoes	In hoop		Grew much faster in hoop (see picture below) but we pulled and hung green tomato plants from hugul so weight comparison difficult. Still growing in hoop

Goal 3: Increase and qualitatively and quantitatively measure the amount of pollinator activity at the community garden and around Saratoga.

Benchmark: The 10x10 range land plot will become the benchmark.

Target: Increase pollinator counts by at least 100% by building four additional 100 square foot fenced hugulkultur pollinator mounds planted with pollinator friendly plants.

Performance Measure: We compared the number and varieties of pollinators on the hugulkultur mounds.

Performance Monitoring Plan: Bimonthly photos were taken of the 100 square foot pollinator mounds plus 100 square foot range land plot. Pollinators on mounds were counted for a set time period. Photographs were used for genus/species identification when required. (www.wildpollinatorcount.com). The students entered 10 minute observations on the Wild Pollinator Count site (The data from these almost 17 hours of observation will be entered soon as we are still trying to accurately identifying some of the native and exotic plants studied).



This was a favorite plant of pollinator bees and flies, a non-native called tall fern leaf fiddlehead.

The pollinator counting analysis by Excel proved to be inadequate. Almost 1000 measurements with the variables of plant species, time of day, numbers of each pollinator like honeybees, small black bees, bees that look like flies etc. proved to be too much data to examine in anything but a simple x-y graph. The SPSS is out of date, expensive and therefore was unavailable to use. That would have been the best way to examine data with many variables in a timely and effective manner.

Photos were uploaded to Facebook and shared with the local community and all others interested. <https://www.facebook.com/groups/198072987230245/?ref=share>

The students were required to write a short science paper on some empirical observation they have measured or were interested in from the Community Garden using the APA journal style of scientific writing. As our youngest student has yet to take biology, much help was needed in Linnaean and scientific nomenclature and style, and a data presentation will be offered.

BENEFICIARIES

The 4 students and 18 community garden members helping with the project were directly impacted. Data was posted to on The Saratoga Wyoming Community Garden Facebook

page with 258 friends, as well as on the Wild Pollinator Facebook page, thus increasing our educational reach to more people. Other specialty crop beneficiaries of the project were the 1465 small acreage land holders in Carbon County, citizens of the North Platte River valley in SE Wyoming and visitors including the 2500 citizens in the Valley. The project goals benefited the citizens and tourists with educational pollinator mounds and pollinator activity they can see at the Community Garden and pollinator mounds in other Saratoga locations. Other stakeholders and beneficiaries are the area schoolchildren, visiting Teton Science Camp, the Master Gardeners in the state, the Wyoming Farmer's Market Association members, and the University of Wyoming Extension division in Rawlins, WY, all of whom had access to our garden or interact through social media. One of our student interns, Robin Gloss entered the Floriculture and Horticulture categories at the county fair and came home with 10 blue ribbons, 8 red ribbons, and 3 white ribbons in the under 18 classification. Three towns people built hugukultur beds in their yards. We had an end of the harvest day this September where town folk came and harvested what they wanted.



LESSIONS LEARNED

The hoop house plastic should be either removed in the winter or strapped down more securely. It didn't survive 75 mph wind in 2017. The pollinator counting analysis by Excel is inadequate. Almost 1000 measurements with the variables of plant species, time of day, numbers of each pollinator like honeybees, small black bees, bees that look like flies etc. was too much data to examine in anything but a simple x-y graph. The SPSS is out of date, expensive and therefore unavailable. That would have been the correct way to examine data with many variables in a timely and effective manner. Although initial Face book set-up is not time consuming, providing data, linking the site to other hugukultur, permaculture, heritage fruits and vegetables, and pollinator sites took a significant amount of time.

Paid students and many volunteers are necessary to affect these sorts of goals. The 18 active gardeners (from nothing before USDA grant) included young families, as well as a few over 65 who could not help with the harder physical labor. In the future we would like to build wheelchair accessible beds for our senior citizens. Having the town as the fiscal agent was difficult as the reimbursement process for funds spent was slower than expected. Working with elected officials in small towns can be challenging for research type projects. It helped that a Community Garden was cited by many in a survey developed for our Town's Master Plan. We are now a non-profit titled "Saratoga Community Projects", but lack the upfront funds needed to purchase supplies and then be reimbursed as needed for

federal grants. Until we are able to build up a cash reserve we are unable to apply for federal grants in the near future. We will miss having students help with the community garden projects.

CONTACT INFORMATION

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WYOMING SPECIALTY CROP AGRICULTURAL INNOVATION, MARKETING AND EDUCATION CONFERENCE

PROJECT SUMMARY

This project provided an opportunity for specialty crop project managers to present their findings and to review what has been accomplished in Wyoming for specialty crop production. This effort included sessions that focused solely on specialty crop production, innovation, latest marketing trends and new technology for specialty crop production. The conferences also provided an opportunity for specialty crop stakeholders to express their opinions on the challenges and opportunities that agricultural producers face and to help guide the goals and activities of the specialty crop program over the next several years. Although WDA have been able to utilize existing conferences to provide information on specialty crop production, season extension, processing food safety, marketing and consumption there had never been a State conference focused solely on specialty crops. The project was timely in that the industry is constantly changing and information is needed for our specialty crop producers to remain competitive in a globalizing economy. The purpose of the Wyoming Department of Agriculture Specialty crop program is to increase the availability of specialty crops within Wyoming. By providing information on marketing, research, product distribution and food safety production and consumption was enhanced. The program funds helped to further 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.

PROJECT APPROACH

Project Activity	Who did the work	Activity accomplished
Pull together a conference planning group	Grants manager	June 2016
Agenda and speaker development	Planning Group composed of WDA and University of Wyoming	July- August 2016
Marketing materials developed	University of Wyoming Extension and WDA Specialty Crop Grants Manager	August 2016
Conference Agenda finalized and speakers committed	WDA and UWYO Extension	September 2016
Conference Administration	WDA, UWYO Extension and Master Gardener Volunteers	November 2016
Surveys on topics completed	WDA grants manager and UWYO	December 2016

and analyzed	Extension	
2017 Project Activity	Who did the work	Activity accomplished
A list of workshops was developed	Grants manager and planning committee.	July 2017
Workshop agenda finalized and speakers recruited	Planning Group composed of WDA and University of Wyoming	July- August 2017
Marketing materials were developed	University of Wyoming Extension and WDA Specialty Crop Grants Manager	August 2017
Workshop Agendas finalized and speakers committed	WDA and UWYO Extension	September 2017
Workshops Administration	WDA and UWYO Extension	November 2016
Surveys on workshops analyzed	WDA grants manager and UWYO Extension	December 2016

2018

Four additional workshops were organized in Gillette, Wheatland, Casper and Fort Washakie

GOALS AND OUTCOMES ACHIEVED

Goal 1 - Increase the awareness of Wyoming's specialty crop industry on the research results of prior activities and on emerging marketing, production and processing trends.

Target - Bring together project managers to disseminate specialty crop project results and industry experts in order increase the knowledge of 100 potential or existing specialty crop producers and processors.

Performance Monitoring - Attendance will be tracked by conference organizers and stakeholders will be surveyed at the conference to determine if the information presented increased their knowledge and will be useful to their operation.

Outcome -The number of people who attended the conference was 60 producers and 8 students. The average total increase in knowledge for the conference was 35.2%.



2016 Farm to Market Conference November 11 to 12, Cheyenne WY

Food Acidification with Brian Nummer PhD

Level of knowledge on topic before (a scale of 1-10). 4.85

Level of knowledge on topic after (a scale of 1-10). 8.4

Comments: Very helpful information, presenter is obviously extremely knowledgeable and easy to understand. Thanks for making this available and affordable too! Fantastic Presentation.

Market Manager all day track for Farmers Market Managers

Level of knowledge on topic before (a scale of 1-10). 3.0

Level of knowledge on topic after (a scale of 1-10). 8.6

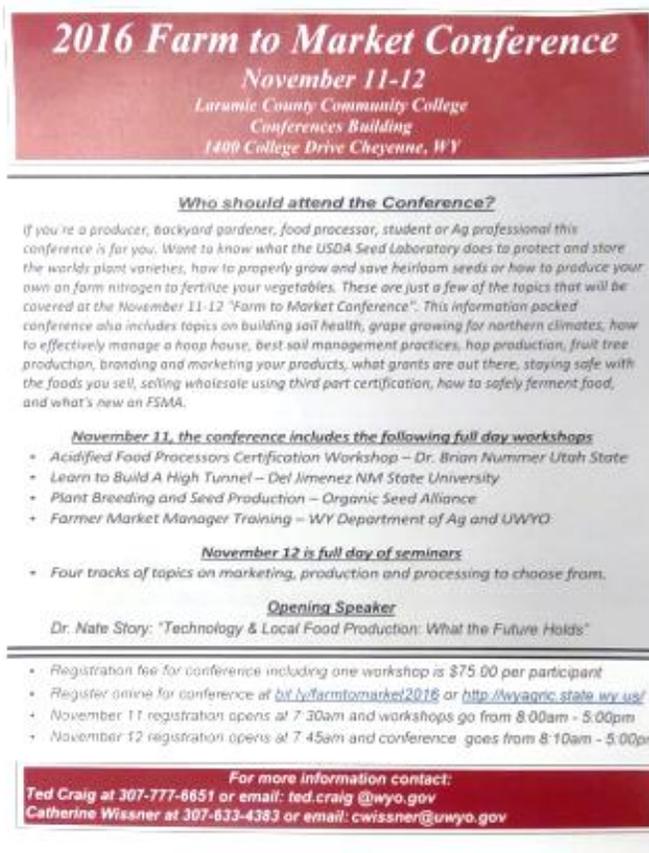
Comments: I very much enjoyed the ethics speaker.

Colorado State University specialty crop research update with Mark Uchanski

Level of knowledge on topic before (a scale of 1-10). 3.5

Level of knowledge on topic after (a scale of 1-10). 6.9

Comments: Hearing the results of current research was very helpful



2016 Farm to Market Conference
November 11-12
Laramie County Community College
Conferences Building
1400 College Drive Cheyenne, WY

Who should attend the Conference?
If you're a producer, backyard gardener, food processor, student or Ag professional this conference is for you. Want to know what the USDA Seed Laboratory does to protect and store the world's plant varieties, how to properly grow and save heirloom seeds or how to produce your own on farm nitrogen to fertilize your vegetables. These are just a few of the topics that will be covered at the November 11-12 "Farm to Market Conference". This information packed conference also includes topics on building soil health, grape growing for northern climates, how to effectively manage a hoop house, best soil management practices, hop production, fruit tree production, branding and marketing your products, what grants are out there, staying safe with the foods you sell, selling wholesale using third party certification, how to safely ferment food, and what's new in FSMA.

November 11, the conference includes the following full day workshops

- Acidified Food Processors Certification Workshop – Dr. Brian Nummer Utah State
- Learn to Build A High Tunnel – Del Jimenez NM State University
- Plant Breeding and Seed Production – Organic Seed Alliance
- Farmer Market Manager Training – WY Department of Ag and UWYO

November 12 is full day of seminars

- Four tracks of topics on marketing, production and processing to choose from.

Opening Speaker
Dr. Nate Story: "Technology & Local Food Production: What the Future Holds"

- Registration fee for conference including one workshop is \$75.00 per participant
- Register online for conference at <http://wyfarmtomarket2016> or <http://wyagric.state.wy.us/>
- November 11 registration opens at 7:30am and workshops go from 8:00am - 5:00pm
- November 12 registration opens at 7:45am and conference goes from 8:10am - 5:00pm

For more information contact:
Ted Craig at 307-777-6651 or email: ted.craig@wyo.gov
Catherine Wissner at 307-633-4383 or email: cwissner@uwyo.gov



Organic Seed Alliance- Plant Breeding for Seed Saving, with Laurie Mckenzie

Level of knowledge on topic before (a scale of 1-10). 3.0

Level of knowledge on topic after (a scale of 1-10). 6.4

Comments: This was a very enjoyable course. I learned a lot about pollination.

Hops with Natalie Yoder.

Level of knowledge on topic before (a scale of 1-10). 2.6

Level of knowledge on topic after (a scale of 1-10). 7.1

Comments: Very informative class – thoroughly enjoyed speaker!



USDA ARS Seed Saving at Colorado State University Facility, Gayle Volk

Level of knowledge on topic before (a scale of 1-10). 3.5

Level of knowledge on topic after (a scale of 1-10). 7.5

Comments: Great Presentation and very interesting.

Food Safety, Julie Balzan and Kentz

Level of knowledge on topic before (a scale of 1-10). 5.8

Level of knowledge on topic after (a scale of 1-10). 8.6

Comments: Thanks!

Creating a Logo with Jill VanOverbeck

Level of knowledge on topic before (a scale of 1-10). 4.5

Level of knowledge on topic after (a scale of 1-10). 7.25

Comments: The actual presentation was good, but perhaps could have been more in depth. However; I found the individual help invaluable so excited to put it into practice. We are trying to go from hobby to business.

Selling Wholesale with Seaton Smith

Level of knowledge on topic before (a scale of 1-10). 2.8

Level of knowledge on topic after (a scale of 1-10). 7.4

Comments: Good Points. Good Information.

Marketing with Mike Lambert

Level of knowledge on topic before (a scale of 1-10). 6.0

Level of knowledge on topic after (a scale of 1-10). 9.0

No comments.

Growing Grapes in Wyoming with Sadanad Dhekney

Level of knowledge on topic before (a scale of 1-10). 3.8

Level of knowledge on topic after (a scale of 1-10). 6.6

Comments: The presenter did really well. I think for my purposes, the information was a little advanced and I'm not really sure that grapes are something that'll work for me. I do want to say that there was a lot of information and it was present well. Great information with clear presentation.



Using a Hoop House with Del Jiménez.

Level of knowledge on topic before (a scale of 1-10). 4.3

Level of knowledge on topic after (a scale of 1-10). 8.5

Comments: Excellent information, thank you for having handouts.

CSA with Cole Ehmke

Level of knowledge on topic before (a scale of 1-10). 5.5

Level of knowledge on topic after (a scale of 1-10). 8.0

Comments: would have like to hear from actual CSA Farmer. I appreciated the breadth of the presentation – options – objectives.

More than Just Kimchi with Dr. Brian Nummer

Level of knowledge on topic before the seminar (1-10) 3.7

Level of knowledge on topic after the seminar (1-10) 7.1

Comments: needed a little more time, dynamic extremely knowledgeable –I think I need to study more – this is complex, wow! Wish this was a full program, a little difficult to understand concepts it was intended for a more knowledgeable audience (this person gave themselves a 1 going in and a 3 after)

Hoop House construction



Level of knowledge before the workshop on a scale of 1-10. 3.4

Level of knowledge after the workshop on a scale of 1-10. 9.1

Comments: Had fun, Excellent Class, Awesome, Excellent Program, This is great, but I do need info on paper, I can't remember it all, Awesome experience-a lot of instruction in the beginning & then kind of petered off & had to just follow directions, good to see

techniques specific to building a hoop house, instructors did an excellent job.

Where's the Money, grant panel

Level of knowledge on topic before (a scale of 1-10). 4.6

Level of knowledge on topic after (a scale of 1-10). 6.6

Comments: thank you for the information.



Building Soil Health taught by Dr. Caitlin Price Youngquist

Level of knowledge before the seminar (scale of 1-10) 5.5

Level of Knowledge after the seminar (scale of 1-10) 7.8

Comments: None other than one person rated themselves a 9 going into the seminar and a 8 coming out.

Fruit Production and varieties with Scott Skogerboe

Level of knowledge on topic before the seminar (1-10) 4.0

Level of knowledge on topic after the seminar (1-10) 8.0

Comments: Top shelf instructor, informative entertaining historic and useful! Very good information, presenter was very entertaining, great attitude history lesson and passion! Best speaker of the day, very informative exciting and inspiring,



Goal 2 - Provide an additional opportunity for stakeholders to guide the future of the specialty crop program.

Due to the packed nature of the conference and the limited amount of time we felt a survey after the conference would be the best way to accomplish this goal.

For 2017 the feedback we received was that the workshops were the most valuable for individuals as the level of information they provided was extremely helpful in understand the various topics. With that in mind the four topics chosen for 2017 were

Acidified Foods Certification

Fermented Foods Workshop

2017 FARM TO MARKET WORKSHOPS
PATHFINDER BUILDING
LARAMIE COUNTY COMMUNITY COLLEGE
CHEYENNE, WY

NOVEMBER 10, 2017
ACIDIFIED FOODS CERTIFICATION
NOVEMBER 11, 2017
1. FERMENTED FOODS WORKSHOP,
2. HOOP HOUSE BUILDING WORKSHOP,
3. ORCHARD DEVELOPMENT & HERITAGE
APPLE PRESERVATION WORKSHOP

COST \$45 PER ALL DAY WORKSHOP
\$75 FOR BOTH DAYS
REGISTRATION
www.eventbrite.com
<https://2017farmtomarketworkshop.eventbrite.com>

WYOMING FARMERS' MARKET ASSOCIATION
ANNUAL MEETING
12:00PM NOVEMBER 11, 2017
PATHFINDER BUILDING LCCC

UNIVERSITY OF WYOMING EXTENSION
WYOMING FARMERS' MARKET ASSOCIATION
WOMEN SPECIALTY CROP PROGRAM

Hoop house Building Workshop

Orchard development & Heritage Apple Preservation workshop

Acidified Foods Certification had an average increase in knowledge of 74% Fermented Foods Workshop had an average increase in knowledge of 79% Hoop house Building Workshop had an average increase in knowledge of 68%

Orchard development & Heritage Apple Preservation workshop 35%

There were 17 attendees and 14 acidified food certificates were awarded. On day two the total number in attendance was 43.

In 2018 there was no centralized conference but workshops were supported in Sheridan, Wheatland, Casper, and Fort Washakie. The Sheridan acidified workshop had 23 in attendance and surveys indicated that the average increase in knowledge was 41.3%.

The Wheatland hoop house workshop had 23 with an average increase in knowledge of 53%

The Casper dome workshop had 10 individuals with an average increase in knowledge of 61% and the Fort Washakie workshop had 14 people in attendance with an average increase in knowledge of 47%

Goal 2 - Provide an additional opportunity for stakeholders to guide the future of the specialty crop program.

Due to the packed nature of the conferences and workshops and the limited amount of time we felt a survey after the conference would better way to accomplish this goal. A pole at the 2017 Farmers Marketing Association meeting indicated that its members were interested in more workshops on production, season extension, food safety, and marketing.

A University of Wyoming survey of 440 people had the following results

Row Labels	Windbreaks	Ornamental trees & shrubs	Landscaping to conserve water	Landscaping with native plants	Increasing soil quality or health	Weed identification & control
Have some interest in	144	140	138	140	140	142
Very interested	196	188	188	187	187	192
Grand Total	340	328	326	327	327	334

Row Labels	Edible gardening	Gardening season Extension	Wildlife damage control	Plant insect & disease control	Growing alternative crops	Garden produce preservation
Have some interest in	140	140	135	138	135	140
Very interested	188	180	185	189	177	181
Grand Total	328	320	320	327	312	321

The results indicate that there is continued interest in all areas of specialty crop production.

BENEFICIARIES

198 individuals were impacted by the specialty crop conference and workshops. These included producers, processors, market venders, master gardeners, backyard gardeners and students.

LESSONS LEARNED

Winter can be a challenge with weather. Attendance was lower at the conference and workshops than we had hoped. The forecast for snow always affects attendance. We also go up against several winter farmers markets in the later fall. A 2018 survey by UWYO shows there is continual interest in workshops on a wide variety of topics on specialty crop production. Requests to present the acidified workshop again in 2019 have already been received. There is a general criticism that Cheyenne is a long way to travel to from most areas of the State and that that we continue to provide opportunities at various other locations that are easier to travel to.

CONTACT INFORMATION

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