

**Wyoming Department of Agriculture
Specialty Crop Block Grant Program - Farm Bill
Agreement Number 12-25-1105
Final Performance Report**

Wagon Wheel Incubator 3

Project Summary 3

Project Approach 3

Goals and Outcomes..... 4

Beneficiaries 5

Lessons Learned..... 5

Wyoming Potato Marketing and Enhancement..... 6

Project Summary 6

Project Approach 6

Goals and Outcomes..... 7

Beneficiaries 8

Lessons Learned..... 8

Season Extension, Education and Promotion of Specialty Crops 9

Project Summary..... 9

Project Approach 9

goals and outcomes..... 10

beneficiaries..... 17

Lessons learned 17

Technical Assistance Position..... 18

Project Summary 18

Project Approach 19

Goals and Outcomes..... 19

Beneficiaries 20

Lessons Learned..... 21

Farm to School Intern.....	21
Project Summary	21
Project Approach	22
Goals and Outcomes	22
Beneficiaries	23
Lessons Learned	23
High Tunnel Construction and use for specialty crop production.....	24
Project Summary	24
Project Approach	24
Goals and Outcomes Achieved	25
Beneficiaries	26
Lessons Learned	26
Utilizing the land for specialty crop organic small fruit production.....	27
Project Summary	27
Project Approach	27
Goals and Outcomes	28
Beneficiaies	30
Lessons Learned	31
Vetable crop production & variety selection inside and outside high tunnels.....	31
Project Summary	31
Project Approach	32
Goals and Outcomes	33
Beneficiaries	47
Lessons Learned	47

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PROJECT SUMMARY

Wyoming's isolation and lack of facilities in rural areas provide the motivation to pursue the idea of enhancing county facilities for value added food production. The issues, problems and needs included: limited facility options for food processing in Wyoming, underutilized state and county facilities that remain unused for a majority of the year, a growing concern over food safety stimulating a demand by consumers for locally produced food products and the need to develop diversification strategies that will keep specialty crop producers viable now and in the future. The overall purpose of this project was to develop a shared use kitchen for small business development to provide an opportunity for local specialty crop producers to add value to their produce by preserving the harvest and expanding the potential income from their operations. The upgrade of the processing and packaging at the County Fair facility provides an opportunity for Specialty Crop producers to start value added business and allows for growth for the already existing small businesses. The producers, processors and food service providers of interest are able to value add products in a cost effective manner. It allowed for processing classes and seminars as well as providing a location for groups to prepare food items in larger volumes. Our purpose was to provide a production area available at affordable rates. The plan was to benefit the local economy through supporting the development of small value added specialty crop food businesses. Wyoming continues to be one of the most rural states in the nation. As such the State lacks much of the infrastructure found in more urban environments.

PROJECT APPROACH

To develop a Kitchen Incubator Program for Small Business Development the Goshen County Fairgrounds needed to upgrade the kitchen to handle specialty crop products adding processing and packaging capability to the already certified kitchen and work area. The kitchen already contained commercial grade cooking and cleaning equipment and after upgrade be marketed for use. The overall purpose of this project was to provide an opportunity for local specialty crop producers to add value to their produce by preserving the harvest and expanding the potential income from their operations. The producers and processors of interest are now able to value add products in a cost effective manner. It allows potential for classes and seminars and provided a location for business and nonprofit groups to prepare food items. To that end the Goshen County Fair Association established an Advisory Committee for the incubator. The initial planning meetings were held in the spring of 2011 to discuss equipment needs, rules and regulations that would need to be put in place for vendors. The manager, with the help of the committee developed and refined the necessary rules, regulations, performance monitoring, marketing and food safety issues for the shared use kitchen facility and took a food safety course to help with this. A review of Wyoming rural kitchen incubator manual provided information needed on supplies and equipment most needed in preparation of specialty crop foods. Most of the larger equipment such as walk in cooler, commercial dishwasher, stoves etc were already in place at the Wyoming and FDA approved facility. The kitchen was not certified by USDA or Wyoming Consumer Health for further

processing of meat products. It had existing equipment such as proofers and ovens that were suitable for bread making, grills for cooking meat for catering of meals but items need for specialty crop processing were not available. These included steam jacketed kettle, label maker, bottle filler and a dehydrator and represented less than 20 percent of the value of the previously existing kitchen equipment. Research and cost comparisons were done before any purchases were made. In order for the kitchen to be more efficient several pieces of existing equipment were relocated and a vendor storage shelving unit was installed. Needed supplies were then purchased to upgrade the kitchen for value added vegetable and fruit processing. The fair manager traveled to the Grand Junction Incubator for a training with their kitchen incubator manager on best management practices a shared use kitchen facility. A Servsafe class, two preserving the harvest seminars and a Recipe to Reality workshop were held at the facility.

GOALS AND OUTCOMES

Goal: Increase the knowledge and skills of local specialty crop growers so as to promote safe healthy and efficient canning practices.

Outcome: In order to increase the knowledge and skills of local individuals on safe processing practices six ServSafe courses, two preserving the harvest seminars and a Recipe to Reality workshop were conducted. Hands on preserving the harvest seminars were targeted at local producers interested in value added processing of fruits and vegetables through use of the Wagon Wheel incubator. The seminars included hands on making of products and also a



demonstration on how to make a label. The Recipe to Reality was an intensive day long course targeted at existing companies and those interested in taking the next step in commercializing the value added products. This seminar was sponsored by the Goshen County Economic Development Association, the Farmers Marketing Association in partnership with the Wagon Wheel Incubator to help market the incubator.

Goal: To increase the total number of local specialty crop products available locally.

Outcome: According to the Torrington farmers market manager there were 6 vendors selling 15 value added products. One vendor from Nebraska that had 5 value added specialty crop products did not return to the market this year. In spite of that the target of 50% increase in products was realized although the total number of local producers at the market remained the same. These products included jams, jellies and dried herbs. The shared use kitchen has also had an impact in that small agribusinesses who are able to produce non acidified products at home for sale direct to the consumer under the Wyoming Cottage law are continuing to expand because of trainings offered at the incubator. A producer who attended the preserving the harvest seminar began producing jams to sell at farmers market this summer. Producers have also benefited from servsafe classes offered at the facility aimed at improving food safety. Several producers who attended the Recipe to Reality workshop indicated in the course evaluation that they are considering expanding into value added food to diversify and extend their specialty crop offerings. This workshop had producers from Wyoming and Nebraska.

Goal: To increase the number of existing value added specialty crop producers who are able to sell wholesale by using the licensed and inspected shared use kitchen facility.

Outcome: This goal has yet to be fully realized although we continue to work toward it. Six businesses and two non profits utilized the kitchen during the last year to prepare fresh food. A value added specialty crop processor is presently working in the incubator developing products able to be sold on the wholesale market. They plan of offering 7 flavors of jams and jellies as well as 4 acidified products. A strategic partnership has been developed between the Wagon Wheel Shared Use Kitchen and the Goshen County Economic Development Corporation and they continue to work towards the goal of helping specialty crop producers venture into value adding the harvest for sale through direct marketing and in grocery stores. They are finalizing an entrepreneurship marketing strategy that includes the kitchen program and will help realize this goal.

An outcome that was not part of the original goals was the interest that the idea of kitchen incubation has stimulated in other communities looking to encourage the development of local value added specialty crop products. At the present time five communities are exploring developing shared use kitchens. They include Douglas, Wheatland, Sheridan, Osage and Laramie. Douglas is presently renovating a kitchen to allow producers to value add packaged products.

BENEFICIARIES

14 individuals attended the preserving the harvest workshops planned at the facility for interested producers. 30 individuals attended the Recipe to reality workshop. The serve safe courses at the facility trained 101 individuals on food safety. The following businesses and non profits utilized the shared use kitchen a combined total of 63 times: Stan's Catering Service, Bucking Horse, Let'er Buck BBQ, Pineapple Grill, Alice & Company Cottonwood Catering, United Church of Christ and Chamber of Commerce. A total of 66 people involved in these businesses and non profits benefited from the use of the kitchen.

LESSONS LEARNED

A problem encountered was the amount of time needed to market the shared use kitchen and to train new businesses. The lack of time for marketing/cold calling by fair management made for a slow start on goal two and three. This situation has been remedied by enlisting the help the Goshen County Economic Development Director of the down town Torrington business incubator. The amount of time needed to teach new business skills and food safety requirements is quite extensive. Just one example of this is the use of the label maker that was purchased. Individuals with limited computer knowledge can easily be frustrated by the program that comes with it. In the end it was decided to house the label maker at the GCED incubator where a staff member would be available to help teach individuals on how to use it properly. Company marketing and business development are being handled by GCEDC as well. Scheduling training was also a challenge in that the most convenient time for training is often evening and weekends. These times being the hardest to schedule in the Fair building because of conflicting events. As more communities explore Shared Use Kitchen Incubators for their communities the lessons learned at the Goshen County Fair kitchen incubator will be extremely helpful. Marketing, pricing structure, scheduling, trainings and equipment needs are key components that must be planned for.

This project continues to go on even though the funding has ended. The following preserving the harvest workshops have been scheduled for March 19 @ 9-11:30 a.m. (Quick Pickles), April 7 @ 9-11:30 a.m. (Jams and Jellies) and May 21 @ 9-11:30 a.m. (Salsas). It is the intent of the workshops to provide information on how to prepare foods for sale? Wyomingites can, at this time, only sell canned jams and jellies (not low-sugar), legally. The Goshen County Economic Development is also developing an overall entrepreneurship marketing strategy that incorporates the shared use kitchen incubator.

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WYOMING POTATO MARKETING AND ENHANCEMENT

PROJECT SUMMARY

This proposal sought to further the marketing of Wyoming potatoes that will either enter the United States Potato Seed industry or the export markets of Mexico as a fresh-market table potato. Both marketing strategies required numerous tests and certification provided by the Potato Certification Association of Nebraska. Steve Marquardt of the PCAN oversaw all seed documentation, field inspections, and winter test trials that were performed. The Wyoming Department of Ag followed up with nematode surveys that are conducted each fall. Each seed lot is given a specific lot number by seed variety and geographic location. The lot then can be traced from plant date thru harvest and shipping. The testing and documentation provided by PCAN are vital to marketing Country Pride's and other Wyoming potatoes. Without this resource Wyoming potato growers would be unable to obtain phytocertificates for export or the proper seed documents to market seed potatoes domestically.

PROJECT APPROACH

Wyoming potato growers were seeking new markets and to maintain existing ones in an environment that has become taken over by the "big boys". The specific issue was to be able to continue the contract with PCAN. This project allowed for PCAN to conduct specific tests and bin inspections that were vital to raising seed and exporting potatoes to Mexico as well as other countries and to sell certified seed domestically. When the initial contract was signed between Wyoming and Nebraska, numerous growers were involved so the cost per acre was minimal. In 2010 only two potato growers were involved in growing certified seed potatoes. Country Pride's in conjunction with Brown Enterprises purpose in obtaining this grant was to further the market share that was available to the growers in Wyoming



through the certification of the potato crop. LaGrange and Pine Bluffs are prime locations for marketing seed domestically as well as table stock into Mexico. Because the locations are relatively remote, they provide excellent disease control and proximity to approximately 40,000 acres of commercially grown potatoes in Colorado Front Range, Texas, Kansas, and Nebraska areas. It also provided a freight advantage over many rivaling seed producers helping to enhance growers' market share. In Wyoming Country Pride Potato, LLC planted 230 acres of certified seed potatoes and Brown Enterprises planted 49 in May of 2010. The fields were entered for certification to Mr. Steve Marquardt of PCAN per the protocol required. Mr. Marquardt then performed three visual inspections of the crop during the summer growing season and documented his observations for each lot to a Potato Field Inspection Report sheet. Each lot was also subject to a leaf sampling test for virus screening of PVY and PVYN. A final inspection of all fields was made prior to fall harvest and storage. Country Pride Potato was then responsible to provide the post-harvest sampling to PCAN by no later than October 15, 2010. All seed lots intended for recertification in Nebraska or any other state must have a post-harvest test. PCAN then oversaw the planting, visual inspections, and virus sampling done both in Florida and Arizona. Although not mandatory, very few commercial growers will purchase seed without a winter test. Test results were received back for review and processing. PCAN then provided a North American Certified Seed Potato Health Certificate for the 2010 crop year on each lot entered and passed. Bin inspections of lots shipped for seed were provided by an employee of PCAN on January 25, 2011. A random tuber inspection was completed for each lot shipped with data entered on a reporting sheet. All lots were found to be in excellent condition. Polly Cross of the WDA completed the external and internal bin inspections on February 25, 2011. This inspection allowed the WDA to provide us with Lot Inspection Certificates. The Lot Inspection allows growers to be in compliance with federal regulations and APHIS standards.

GOALS AND OUTCOMES

Overall Goal: Expand seed and export shipments from the state of Wyoming.

Goal 1: Expand seed market sales through contacts with previous and prospective customers.

Outcomes: Approximately 123,400 ctw of potatoes were shipped in 2009 most of which were as table stock. The average price of table stock was \$6.14 per ctw and the average price of certified seed was \$12 per ctw. The target was to expand Wyoming seed market sales of certified potatoes to either new or existing customers by 20%. Brown Enterprises reported that average yield in 2010 was reduced by 2/3 due to a potato psyllid infestation that was carried on the winds from Mexico. These potatoes were sold domestically as certified seed. Country Pride reported that in 2010 they harvested only 68,484 ctw. This was only 52% of 2009 crop but they were able to sell 75% of their crop as seed at an average price of \$15 per ctw verses \$6.14. The operations total sales increased by 14%.

Goal 2: Expand Mexico market share with contact of previous customers and prospective clients

Outcome: In 2009, 26,580 ctw of certified seed potatoes were shipped to Mexico. This was approximately 20% of Country prides Wyoming potato crop. Of the 2008 and 2010 certified crop Brown Enterprises sold no Wyoming potatoes into Mexico. In 2010 Country Pride sold only 1239 ctw



or 1.8 percent of their crop to Mexico. The price domestically for seed potatoes was substantially higher than potatoes shipped to Mexico so most seed stock was sold in the US. There was no price advantage between table stock sold in the US and that exported to Mexico.

BENEFICIARIES

With the certification process, Wyoming growers have the ability to enter the domestic seed market or meet the criteria in order to export to Mexico. Over the last nine years, 70% of Country Pride's sales have either been seed sales or export product. Each year is unique. Seed sales may be prevalent one year with a higher net return but the following year may be just the opposite. The certification program allows Wyoming producers to be versatile in the market place with the possibility of extended growth. The beneficiaries of this project include Country Pride Potato, LLC, LaGrange, WY, Brown Enterprises, Pine Bluffs, WY, numerous employees of both entities, (approximately 25), potential new potato growers and local Wyoming vendors from who inputs are purchased. The potato growers also benefited from the project by their ability to value add their crop through certification.



LESSONS LEARNED

Wyoming potato growers were very fortunate in 2011 to be in possession of the seed varieties that were in demand nationwide. County Pride and Brown Enterprises made the business decision to stay with domestic certified seed shipments verses exports strictly because of the bottom line. Potatoes sold for seed in the US were returning a significant net return over export shipments sold as table stock. Seed growers are leaning a little heavier into other strains but there was a strong demand for standard Norkotahs. Standard Norkotahs yield better and have higher quality returns with pack out. Thus, this variety was a better fit for Country Prides marketing strategy of seed shipments or table export shipments better than other varieties. Country Pride is continuing to gather data from seed growers as well as export brokers. At this point Country Pride is not planning to expand acreage in that successful marketing strategies are more important than expansion. By investing in high quality, disease free, low generation seed Country Pride was able to provide the final product that commercial seed customers and export buyers were looking for. Country Pride feels very confident in its export contacts but diligently continues to make new connections in the seed industry. One possible consideration has been investing seed with a reputable grower in the Kansas region in order to take advantage of the summer price run.

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SEASON EXTENSION, EDUCATION AND PROMOTION OF SPECIALTY CROPS

PROJECT SUMMARY

Through previous USDA specialty crop grants, Wyoming has offered small grants to producers and nonprofit organizations to develop and promote methods that will extend or increase specialty crop production and consumption in Wyoming. The program has been incredibly successful and has been deemed as “the most productive way Wyoming can enhance the specialty crop program in the state”. Since the inception of the program, 25 grants have been awarded for high tunnels and irrigation systems. Two high tunnel workshops have also been facilitated in several areas around the state and a course held at the Wyoming State Fair in 2009. The results of these high tunnels built in Wyoming have been longer growing seasons, increased quality and quantity of product. These tunnels are being built to withstand Wyoming wind, temperature and hail. The results also reduced water usage through drip irrigation. This funding opportunity complimented a project submitted by Cooperative Extension Service (high tunnel workshops) by providing grant opportunities to participants of those workshops. This project allowed small grants (not to exceed \$3,500) to be awarded to producers and nonprofit organizations to increase specialty crop education, production and consumption. Grants included high tunnel and low tunnel construction, water conservation, community gardens and other methods that extend or increase specialty crop production and consumption in Wyoming. Seven grants will be awarded with the requested funds. This small grant program enhanced the grant proposal by Cooperative Extension to conduct high tunnel workshops. This program offered grant opportunities to workshop participants who planned on building a hoop house or organizations that promoted specialty crops through community gardens.

PROJECT APPROACH

Small grants were awarded to producers and nonprofit organizations to develop methods for season extension/increased crop productivity, water conservation techniques, and other methods that helped increase the knowledge of specialty crop production including community gardens. Grants were awarded on a competitive basis from December 1, 2010 through September 30, 2013 or until funds were expended. Grant amounts were up to \$3500 per applicant. Grants were reviewed by WDA grants manager and director for allowable expenses and approved by the Wyoming Department of Agriculture and administered by the Wyoming Community Network. The application and guidelines were updated in November of 2010 and posted on the Wyoming Department of Agriculture web site (<http://wyagric.state.wy.us/>) and marketed through media releases at trade events meetings and conferences. Application process included submitting an application, budget, and letter of support from a local entity that can vouch for an applicant’s involvement in agriculture production. Producers were required to show that the project would have multiple impacts beyond their operation by holding farm days, having local school visits or be involved in helping increase knowledge of specialty crops by speaking at conferences and workshops. Non profits were required to identify stake holders and who would be impacted. Applications were reviewed for eligibility and successful applicants notified. Upon completion of the project the applicant was required to submit a request for reimbursement that

included invoices and proof of payment for allowable expenses and a report as outlined in the small grant application. See attachment. We increased our marketing efforts with high tunnel how to publications, local news articles, brochures and attending local events. A high tunnel photo article was published in the Barnyards and Backyards magazine.

GOALS AND OUTCOMES

Goal: Increase specialty crop education, production and consumption through season extension techniques, water conservation and cooperative gardens

Benchmark: Number of producers and organizations that that have received season extension grants in the past is 25.

Target: We expected the number of grants awarded in this grant cycle to increase by 7 and the number of people directly impacted to be 105.

Outcome: The target was to increase the number of grants by 7 and impact at least 105 by increasing the amount of fresh specialty crops through construction of hoop houses or community gardens. The target was not only reached but exceeded and number of people impacted were upwards of 1000 people (see individual projects for breakdown). The program continues to create opportunities to expand the knowledge of producers and consumers on specialty crop production and consumption. The grants have far exceeded the targeted direct impact as reported by grantees and are also estimated to have indirectly impacted over 35,000 individuals who have been exposed to the various projects over the grant period. By indirectly it is meant that they visited and/or walked through or in some way were exposed to the hoop houses or community gardens.

Goal: Increase the percent of vendors with specialty crops represented at early season, or winter farmer markets.

Benchmark: Presently specialty crop producers make up 25 percent of the vendors at early season, and winter farmers markets.

Target: Through the utilization of season extension techniques, we anticipated that this percentage would increase to 30 percent of the total number of specialty crop vendors during these seasons.

Hoop House Outcomes: Data was analyzed as to the number of people impacted to determine the success of the season extension and cooperative garden projects and determine changes to the program. A survey of farmers' market managers was conducted to analyze the effect of hoop houses on specialty crop availability early and last in the season. We had 12 public and 3 single producer private markets respond. The average number of producers with hoop houses at early, late season or winter markets ranged from 1 to 8. Various markets had different level of participation ranging from 4% to 66%. The Cheyenne winter market reported that all three of its specialty crop vendors had hoop houses. The Triple Crown on line farmers market reported that of its 27 winter vendors 5 had hoop houses as well. The weighted average was 32%. The twelve public markets that responded had a total of 52 hoop house vendors. A 100% of all single producer private markets had hoop houses. We are seeing an increase in the length of the season that specialty crops are available at markets around the state as a result of vendors realizing that they can command better pricing both early and late in the season with hoop house production.

Community garden Outcomes: Included in the grant was the funding of community gardens to increase the level of knowledge, production and consumption of specialty crops in Wyoming. During this grant cycle three gardens were funded. The Heart Mountain garden was a showcase garden of various specialty crops that were grown by the Japanese interned there during the II World War and directly impacted 167 students and adult volunteers and indirectly impacted over 7350 visitors. The Dayton and Cheyenne Alliance Church Community gardens were production gardens dedicated to helping local citizens grow their own food. These gardens directly impacted 195 people. Not data on indirect impacts was tracked.

The following projects were funded in this grant cycle.

Golden Rule Produce Hoop house Project

Goal: Increased production and consumption of fresh local grown produce to Buffalo and surrounding areas.

Outcome: At last year's farmer's market, we typically sold out in the first hour. This year my season increased to March to October from June to September and my production increased by 35%. The purchase of the hoop house has been the first step in increasing the production of local produce. Further steps will include raised beds, which will allow for earlier planting, less soil compaction and less time expended upon weeding. The addition of a full drip irrigation system will allow for less water waste, less weeds, and less chance of fungal diseases, which will all increase the production and in turn, local consumption.

Goal: To help educate local population as to where local produce comes from through local tours/field day.

Outcome: Three tours were conducted after the hoop house was constructed. Two high school classes visited. The first class was 18 students and the second one was 12. I also had an elected official tour of 10 individuals. Furthermore, every on-site sale included a mini tour. I answered a lot of questions as customers selected their produce directly off plants.

Heart Mountain Educational and Historical Garden:

Goal: Living History – The Heart Mountain Agriculture Department basically ran similarly to today's experimental stations. They sampled the soil and grew what was best suited for the soil types and climate. From 1943-1945 they grew 45 different crops. Some of these varieties still grow in the area today and some like Carter peanuts; we would never think to grow here. The purpose of the garden was to grow some of these plants and show how they were grown drawing on the uniqueness of the overall agricultural efficiency.

Outcome: From June to October, 7350 visitors visited the garden. Heart Mountain Interpretive Center is hoping to receive around 20,000 visitors per year. These visitors and school groups are the target group.

Goal: Collaborate with the school systems to provide educational opportunities by involving teachers and students from local high schools and Northwest Community College. Students will grow and transplant plants to Heart Mountain. In the process they will learn about plant science, the importance of



agriculture, the history of Heart Mountain, and the importance of agriculture to Heart Mountain. Heart Mountain staff will plan both on-site and classroom presentations.

Outcome: From September 2011 through February 2012, Heart Mountain interpretive staff presented 22 adult and student educational programs to a total of 617 participants. Many of these participants were interested in learning more about the agriculture at Heart Mountain. This group continues to be our target audience and we had 60 students donating a total of 502 hours this year.

Goal: Engage the hearts, minds, and support of the local communities. The Heart Mountain Wyoming Foundation is blessed with a solid group of volunteers. These dedicated volunteers have become amazing ambassadors for the Interpretive Center. This garden will be one of many projects that will help us build a bigger volunteer base and a way for community members to become more involved.

Outcome: We had 107 volunteers donating 686 hours of time of time to the garden. This project will continue to increase our volunteer numbers and reach out to those community members that are interested in gardening and nature to diversify our predominately history based volunteer group. There are three main goals the Heart Mountain Wyoming Foundation would like to accomplish with the Historic Garden. The first is to create the garden in such a way that is illustrates the vegetables and growing techniques used to extend the 109 day growing season at Heart Mountain during WWII. Second we would collaborate with schools by asking them to adopt sections of the garden. They would grow, transplant, and winterize their plots. They will learn about plant science, the importance of agriculture, and the history of agriculture at Heart Mountain. Finally we hope to engage the public – visitors and volunteers – to take ownership and pride in the historic garden by holding educational talks and presenting volunteer opportunities to work in the gardens to ensure this project continues into the future. In addition, The Key Ingredients Exhibit from the Smithsonian Institute will be at the Interpretive Center August 2013 – October 2013. The historic garden will be a major piece of this exhibit.

Cheyenne Alliance Church Seed N feed Community Garden:

Goal: the purpose of the project was to build a model community garden (raised beds, irrigation equipment, shed, fencing and tools) that is a nurturing (through education and occasional meals), supportive (through mentoring) space for new (& not-so-new) gardeners to plan, plant, tend and harvest healthy organic vegetables for personal consumption and local charity donation. Encourage organic gardening ethic and entrepreneurship. Cooperation through individuals/groups in the church and community developed unbroken land into raised bed plots; provided well water and mentoring for a model community garden on church property in Cheyenne.

Outcomes: The response by the community and the church was one of great interest for 2012 and 2013 gardens, due to Traders ad, canvassing and a noticeable sign on the street. The soil amendments produced amazingly productive gardens even for first time gardeners. Horticulturist, Catherine Wissner provided three classes and free seeds. A core committee of volunteers donated hundreds of hours of preparation, set-up, help with individual gardeners, and much good will with several garden picnics. Gardens were esthetically pleasing during production. A donated shed was very necessary for storing tools and hoses and the message board was used to



communicate information. Twenty two raised beds were constructed half them 10X20 and half 5X20. These garden plots directly impacted over 66 individuals and indirectly over 200 in the church. Produce was weighed for the first year with over 2000 pounds being recorded. Groups that benefited included: community members, church members, new gardeners, and other churches that met and were encouraged to collaborate on more community gardens, Master Gardeners who were given hours for help and advice, Cheyenne Botanical Garden referrals and overflow from their gardens. Materials were purchased from local vendors helping local business.

Wyoming Farmers Marketing Association Fremont County Hoop House Workshop:

Central Wyoming's weather makes it challenging to grow wind and cold sensitive specialty crops. The demand for locally produced high quality specialty crops fruits and vegetables is increasing. High tunnels have the ability to increase the growing season for specialty crops by approximately 60 days. The purpose of this grant is to educate the public on the use of high tunnels in Wyoming for the production of high quality, locally grown specialty crops. Attendees at the Fremont County Fair were able to see that it is possible to produce specialty crops in the Riverton area.



GOAL 1: Educate local producers on how to construct high tunnels from commonly available materials.

GOAL 2: Provide an opportunity for master gardeners to showcase hoop house production of specialty crops during Fremont County Fair.

OUTCOMES: During the 2012 Farmers Marketing Association Conference in Riverton a 15X36 hoop house designed for Wyoming weather was constructed by 15 volunteers that included work shop leader Del Jimenez of New Mexico Cooperative Extension, master gardeners, and other volunteers at the Fremont County Fair Grounds. Construction was performed in an educational setting with materials that were purchased at the local hardware stores. The exception to this was the plastic covering as this is only available through green house suppliers. The overall outcome of this project was to stimulate public interest in the use of high tunnels and encourage the adoption of their use for the production of fresh specialty crops for farmers and specialty crop markets in Wyoming. The unit was used as displays for horticultural specialty crops during fair times. It was also available for use by local master gardeners to further the goals of the specialty crop program. The hoop house display also indirectly impacted the estimated 25,000 attendees to the Fremont Count Fair and Rodeo. This number does not include the other events that are hosted at the fairgrounds.

University of Wyoming Sheridan Research Center Dr. Sadanand Dhekney High Tunnel Project:

Goal: Grants obtained from this project will be used towards the construction of a high tunnel for evaluating growth, development and yield of elite grape cultivars that can be targeted for wine production and as fresh fruit in farmers' markets. The project is to study the possibility of table and wine grape production in high tunnels as an alternative to traditionally cultivated agronomic crops.

Outcome: The project continues to provide science-based information on cultivar selection, optimized, production and management practices



and post-harvest handling for successful grapevine production in WY. We continue to gather data on the performance of individual table and wine grape cultivars under high tunnel conditions. Seedless table grape cultivars that have been planted will ultimately provide information on which varieties perform well under such conditions. Ultimately such cultivars grown with minimum chemical inputs will increasingly consumers of farmers market with locally produced, high quality fruit in contrast to fruit that in imported from other countries and has been produced under extreme chemical management conditions.

Goal: Standardize grapevine production techniques in high tunnels, which will offer the advantage of maximizing profits from production on a small area of land.

Outcome: Information generated from the project greatly benefited producers engaged in grape production and associated industries such as wineries, juice, jams and jelly processing units and citizens exploring the potential for investing in WY agriculture. Viticulture in WY continues to grow rapidly as producers explore viable alternatives to traditional farming of agronomic crops.

Overall Outcomes Achieved: The high tunnel was constructed by staff of the Sheridan Research and Extension Center. One year old grapevines of table and wine cultivars were planted in the high tunnel. Flowering and fruiting during the first year were discouraged by clipping of any inflorescences that were produced by vines. Information on high tunnel cultivation of grapevines was highlighted at a number of talks, conferences and workshops. Presentations that involved providing information on high tunnel production were made to producers, homeowners, industry professionals, students and faculty from the university on various occasions. Presentations were made on grape production at the following locations for updating grape growers and interested homeowners in research activities being carried out for expanding viticulture activities in Wyoming 9/15/2012 directly impacting 120 people.

Talk were given on grape production in Wyoming at the 2012 HortFest Extravaganza conducted by Jeff Edwards in Torrington, WY 10/09/2012. I met with local grape growers, winemakers and gave talk on grape production at the Cody Extension County office, Cody WY.2/14/2013. Talk were also given at the Wyoming ground keepers and growers association on grape production including high tunnel research 2/18/2013. An overview of high tunnel grape production was given at the UW AES planning conference 02/23/2013. We gave a talk on grape production at the "Living on a few acres" workshop organized by UW Extension in Cody WY 03/06/2013 and on current grape research at the Sheridan College seminar series. Two pruning workshops were also conducted at the Sheridan Research and Extension Center in 2012 and 2013. Participants were provided with a tour of the high tunnel and information on growing grapevines under high tunnel conditions.

Dayton Wyoming Community Garden:

Goal: To give local community members the ability to grow their own vegetables.

Outcome: Thirty 4'x8' boxes were rented out to community members. We contacted the school and were able to utilized students from the Tongue River High School to build the boxes for raised beds. Four of these raised beds were rented to people living outside city limits. One of the rental beds was used by the



Community Cupboard Food Bank. Approximately 87 people (29 boxes x 3 people) received benefits from the Community Garden. The Food Bank reached about 20 people of for a total of 107. Some of the families rented an additional space and there is a waiting list with three to four people on it at this time. As there is no space left to expand the number of raised beds this year the plan is to limit the number of spaces rented to one per family so that more families are able to benefit. All ages groups were involved in the garden ranging in age from children as young as 6 to adults in their 70's.

Eastern Community College Hoop House Demonstration Project:

Goal 1: To educate Eastern Wyoming College Students on sustainable crop production practices through hands on experiences in soil fertility, pest management and specialty crop production utilizing two high tunnels at the EWC Agricultural Technology Education Center.

Benchmark: The courses that have incorporated the use of the high tunnels into the course curriculum include Agroecology (AECL 1000), Applied Soils (SOIL 2200). The EWC Agriculture programs including Farm and Ranch Management (FRCH.AAS), Agri Business and Sciences (AGBSS.AS), and Rangeland Ecology and Watershed Management (REWM.AS). New students majoring in FRCH.AAS or AGBSS.AS are scheduled to take SOILS 2200 and/or AECL 1000 during their freshman year, while students in the REWM.AS program take AECL 1000 during their sophomore year. During the 2012-2013 school year, 40 agriculture students participated in building the high tunnels. During the spring semester, there were 15 students enrolled in the SOIL 2200 course and 13 students enrolled in the CROP 2200 course. Both these courses utilized the high tunnels for lab work. The AECL 1000 course has an enrollment of 33 students for the fall 2013 semester. The spring 2014 course schedule will include the SOIL 2200 and CROP 2200 courses. Total majors for the Agriculture programs for fall 2013 are 59 students. The Agriculture programs underwent a major curriculum change this past year, so the 2013-2014 school year will be the first year to gage whether or not the target of educating 100% freshman and 50% sophomore will be met. The incorporation of the high tunnels as part of the lab settings for the AECL 1000, SOIL 2200, and CROP 2200 courses will add a broader range of hands-on experiences for the agriculture students. The expanded growing season provided by the high tunnels will allow improved curriculum by increasing coverage of agriculture topics with demonstrations of modern techniques. All students within the EWC Agriculture programs will be able to experience a hands-on lab whether they take these courses during the fall or spring semesters.

Goal 2: To educate 15 regional producers on how to construct high tunnels and their potential use for specialty crop production in Wyoming.

Outcome: There were six regional producers who spent approximately 77 hours participating in the High Tunnel Construction Workshop. All six producers have completed at least one high tunnel for their operations. The high tunnels will lengthen the growing season and provide protection from the Wyoming wind and hail storms. The use of the high tunnels will also help producers become more sustainable in their operations and increase productivity. Three high tunnels were constructed with the help of 40 EWC Agriculture students.

Goal 3: To educate consumers on sustainable agricultural practices and horticulture production.

Outcome: A High Tunnel Production Conference sponsored by EWC and the University of Wyoming had 21 attendees. Educators from around the region presented on topics including Season Extension, Weed Control, Organic Soils & Fertilizer, High Tunnels-designs, workshops, resources, Insects as Disease Vectors & Control Options, Soil Preservation, High Tunnels. Management, Preservation of



Pollinators, Irrigation Tactics, Grape Production, NRCS Grants, Seed Saving, Vegetables & Cut Flowers, Preserving the Harvest, and WY Dept of Ag Specialty Crop Grants. Residents who attended the conference are more knowledgeable about the benefits of using high tunnels and the benefits of organic gardening including fertilizer, weed and pest control. This knowledge will help them practice more sustainability in their gardening practices.

Dr Valtcho Jeliakov Sheridan Research Center High Tunnel Project

The purpose of this project was to construct a high tunnel to develop a successful production model for using high tunnel (HT), low tunnel (LT), and low tunnel within the high tunnel (LTwHT) in Wyoming that can be shared with current and future Wyoming specialty crop producers, homeowners and students. This project was a partnership between the University of Wyoming's Sheridan Research and Extension Center and Sheridan College's Department of Agriculture. Specifically, Dr. Valtcho Jeliakov, Associate Professor of Plant Sciences and Dr. Ami Erickson, Dean of Agriculture will collaborate and share resources in developing and successfully carrying out this project. The specific goals for this project were:

Goal: Comparison of three extended season production systems: high tunnel (HT), low tunnel (LT), and low tunnel within the high tunnel (LTwHT).

Goal: Optimization of transplanting time for selected vegetables and herbs for early spring and late fall season production systems for Wyoming under conventional and organic system.

Goal: Education and training of Sheridan College and UW students.

Outcomes: The beneficiaries of this project were and continue to be the students involved in the ShREC program the numerous homeowners in the Sheridan

area and other regions with similar climate. We expect that in the ShREC region (which include Sheridan, Johnson, Campbell, Crook, and Weston counties), between 100 and 500 people were impacted. This number was estimated based on: (1) the attendance of



individual producers and homeowners at the Sheridan Local Foods Expo in April 20, 2013, and in previous years, and (2) on the Specialty Crops Survey conducted in 2012 by a team lead by Dr. Jeliakov. The project also continues to provide important information on which vegetables and herbs could be grown in early spring or late fall under different systems: low tunnel (LT), low tunnel within a high tunnel (LTwHT), and high tunnel (HT). It is expected that over a period of years the (LTwHT) will provide the greatest season extension for the tested vegetables and herbs. Subsequently, this will result in extended availability of fresh vegetables and herbs and improved nutrition. The findings will also benefit some commercial vegetable growers and provide them with tools for further extending growing season and possibly improved pricing and marketing options.

Other measurable outcomes include:

- Specialty crops growers and UW/Sheridan College students were able to observe various aspects of the three systems for early spring and late fall season production of the selected vegetables and herbs at ShREC at Sheridan. This will decrease the risks associated with the adoption of new production systems.
- The project provides ongoing information on how different planting dates in the three systems influence marketable yields and produce quality.
- This project further supports the collaborative efforts of UW and Sheridan College in research, teaching, and outreach.

Bright Agrotech Hoop House Project

We are a local CSA and restaurant supplier that required additional growing space to meet our local demand. Building a high tunnel in addition to our current one was a necessary development to keep up with demand. We are actively involved in the community of local growers as well as consumers and needed additional knowledge for our operation, but also show other that season extension was possible in Laramie, Wyoming.

Goal: Increase production capacity.

Outcome: We now are able to produce more for our CSA and supply more local markets. With the new high tunnel increased our numbers this summer and bring in more customers. They loved the produce and regularly toured the facilities. So far this year all 46 of our CSA customers have seen the building of the high tunnel through our updates and newsletters. We're also using the high tunnel to give talks on vertical agriculture. So far this year 40-50 people at the



Laramie Rivers Conservation District Expo turned out for a talk on vertical agriculture and the use of hoop houses for vertical production. We also gave a talk about the high tunnel project at the Wyoming Farmers Market Conference in Laramie in April, with 20-30 attendees. We have done around 12 private tours of the high tunnel as well, and brought two University of Wyoming organizations (Agroecology Club and ACRES), and three classes totaling around 150 students through the current hoop house and discussed the building of the new hoop house with them. We've also been getting some attention on our YouTube Channel, as we detail the construction of the new high tunnel for our aquaponic production- We have around 2000 subscribers who watch our shows regularly and anticipate that over the course of the next 6 months between 5,000 and 20,000 viewers will watch our series on building the high tunnel. We were able to continue our production through the end of November in the high tunnel. We are delivering to two different restaurants at the moment- they're feeding between 25 and 50 people per day using our produce. Our production increased dramatically, primarily because of season extension. We went from 3-4 lb shares in the spring to 10-12 lb shares in the summer, with a significant amount of produce (50-70%) being contributed from the high tunnel.

BENEFICIARIES

Overall beneficiaries of these projects included producers, researchers, students, master gardeners, and consumers. The total of direct beneficiaries of these projects are upwards of 1000 people. Indirect beneficiaries are almost 35,000 in just three projects Heart Mtn Garden, Fremont County Fair and Rodeo, and Bright Agrotech's YouTube subscribers. This project continues to have the largest impact of all sub projects. This is largely due to the variety and profile of many of the subprojects.

LESSONS LEARNED

Of the grants awarded one did not complete the hoop house within the grant period and this producer was informed that they would have to reapply in order to obtain grant funds. Another producer was selected as a replacement and they completed their project on time. As more individuals with small acreage look to becoming producers they are interested in the hoop house program but do not meet the

USDA definition of a producer. They are encouraged to contact us again when they are eligible. The program has been very popular in Wyoming as many areas are challenged by adverse growing conditions. We are seeing a greater interest by schools, and non profits who want to develop after school programs for students, conduct classroom research projects or in the case of non profits provide garden related activates for their clients. As such we are seeing the need to increase the knowledge of grant writing and management by producers and organizations. As time goes on we are seeing the benefits and drawbacks of varying designs of hoop houses structures. Many of the kits sold by green house suppliers have issues with the covers blowing off in Wyoming wind. The lighter gauge metal hoop house structures also do not stand up to the wind or snow load unless reinforced over and above what comes with a kit. Two inch schedule 40 PVC hoops also have their limitations with snow and we know of three that were damaged last winter by heavy snow loads. Repair of hoop houses made with the PVC hoops has proved to be much simpler than those made of metal. Producers reported that with those built using PVC it was relatively easy and inexpensive to replace or repair the PVC hoops. Those that were made from metal required an extensive amount of time and expense to repair.



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TECHNICAL ASSISTANCE POSITION

PROJECT SUMMARY

The development of produce and horticulture products continues to be a vital goal of the Wyoming agricultural economy. Wyoming ranks 44 among all states in crop production and 38th for all agricultural production. In 2008, the farm gate value of all crops for Wyoming totaled 273 million dollars. As traditional commodity producers look to specialty crops to increase their bottom line, this position provided much needed assistance. As a goal the WDA continues to be committed to increase the availability of specialty crops within Wyoming. A Specialty Crop Technical Assistance position was developed to assist in this goal. Funding from this grant allowed for continued promotion and education of specialty crop opportunities in Wyoming. No other federal or State grants were applied for to support the Wyoming specialty crop technical assistance portion of the position. The specialty crop portion of this position was approximately 36% of the total cost of the position while the time spent on specialty crops exceeded 50% of the time. Other funding comes from Wyoming general funds to promote production, marketing and consumption of all agricultural products and a portion of the positions time and funding, (approximately 8%) was to provide support for other grants awarded to the WDA and its partners.

Other grant projects are not specific to specialty crops but may have them as a component. The position also coordinates with other State agencies, the University of Wyoming, Community Colleges, and producer groups to expand specialty crop production in Wyoming.

PROJECT APPROACH

Technical Assistance Position The contract employee was hired in February of 2009 to manage and promote the Specialty Crop Program. The following were efforts were undertaken by the contractor in order to expand specialty crops in Wyoming. The position worked with other agencies and organizations to help develop the specialty crops industry in Wyoming. Partnerships with the following organizations were maintained or developed for expansion of Specialty Crops in Wyoming: the Wyoming Rural Development Council, University of Wyoming the Wyoming Business Council, UW Cooperative Extension in Torrington, Casper, Sheridan and Laramie, Rocky Mountain Farmers Union, Main Street Program in Saratoga, Pushroot Community Gardens in Lander, Wyoming Bee Keepers Association, Sheridan College, Wyoming State Fair, UW Master Gardeners Program, Wyoming Farmers Marketing Association, UW Sustainable Agriculture Research and Extension Center Torrington, University of New Mexico Cooperative Extension, High Tunnel Program, Powell Research Station, Wyoming Growers and Grounds Keepers Association, Wyoming Lodging and Restaurant Association, Wyoming Grape Growers Association, Goshen County Fair, Laramie County Fair Carbon County Fair, Niobrara County Fair, Platte County Fair, Arapaho Ranch, Cheyenne Botanical Gardens, UWYO Sustainable Agriculture Research and Extension Center, NRCS, Rural Development FSA and NASS. The specialty crop manager provided information, promotion assistance and technical assistance to individual growers, producer groups and educators through out the duration of the grant. This was done in in a multi pronged approach. Using the WDA website,talks at trade events, specialty crop booths at conferences, hoop house workshops, displays at the Wyoming state fair, through publications, emails, brochures and face to face meeting the position actively reached out to the University of Wyoming, community colleges, nonprofits, and producers.

GOALS AND OUTCOMES

Through education and marketing efforts, this person continued to provide the expertise and oversight necessary for the expansion of the specialty crop program in Wyoming.

Goal: Increase the number of Wyoming Specialty Crop Producers

Benchmark: The base line for 2010 is 210

Target: Increase the number by 5% to 220

Performance Measure: 8 individuals were identified as either new to production of specialty crops or expanded their growing potential. Wyoming Ag Statistics reported that cash receipts of specialty crop producers in 2011 increased 24% over 2010 receipts to \$70 million.

Goal: Increase the number and quality of grant proposals for Wyoming Specialty Crop Grant Program

Benchmark: The base line for 2010 was 14 of which 8 are included in the State plan.

Target: Increase the number of proposals by 20% to 17

Outcome: Through the outreach activities of the Specialty Crop Technical position the number of SCPG proposals increased to 21 of which 12 were funded.

Goal: Promote the Specialty Crop Grants program on the WDA website

Benchmark: The average monthly hits are presently 175 and will be used as the baseline.

Target: Increase the number hits to the specialty crop pages by 25%

Outcome: The number of hits per month has increased to 2256 exceeding our target. The video page has received an average of 236 hits per month.

Goal: Promote the Specialty Crop Grants program through media outlets

Benchmark: Baseline is 5 articles/publications for 2010.

Target: Increase the number by 25% to 7

Outcome: Two high tunnel manuals were updated and printed, the Specialty Crop Grant application process was updated and advertized, 3 brochures were updated, printed and distributed, one for the Producer Season Extension Grants, the Non Profit High Tunnel Grants and the Scholarship Grants. A video was developed and post to web on hoop houses and a power point on specialty crop grants was updated for talks to producers and non profits.

Other activities accomplished: In order to increase applications to the specialty crop program, the online specialty crop application manual was updated and the data base of 350 economic development professionals, agricultural specialists and producers was updated for marketing the specialty crop program. Information on the Specialty Crop Program was also distributed through multiple articles in Tuesday Tidbits. A sample Wyoming Specialty crop application was developed online. Technical support was provided at three other high tunnel builds, at the following fair grounds: Lusk, Rawlins, and Douglas. Specialty Crop audits were conducted in Torrington, Lander, Casper, Douglas, Wheatland, Cheyenne, Sheridan and Laramie. Marketing of the Specialty Crop Program was done at the following events. The 2012 Wyoming Farmers Market Conference, UWYO Sustainability Conference booth, the Wyoming Beekeepers Winter Meeting, Wyoming State Fair Specialty crop display and promotion of horticultural exhibit, and booth space at the Agrifuture Conference. Other efforts to promote specialty crops to consumers in Wyoming included speaking engagements. Seminars were given at, the UWYO Coop Extension Conference and the Small Farm Conference in Riverton. Three out of State events were attended: the Organic Conference in New Mexico the National Small Food Manufacturers Conference in Nebraska and the NASDA national meeting. *As an advisor to the Wyoming Farmers Market Association, the position provided technical and marketing support on specialty crop topics presented at the 2011 WFMA convention that impacted 100 market managers and vendors. Support has been targeted to; education, season extension, research, food safety and product marketing/promotion.



BENEFICIARIES

The beneficiaries impacted by this position included over 200 specialty crop producers, non profits, schools, colleges and the University of Wyoming. In addition an estimated 50,000 consumers were impacted through education and marketing efforts. Requests for information on specialty crops is growing every day. UWYO Extension Offices report that they have also seen a dramatic increase in small

acreage producers interested in specialty crop production. The technical assistance provided by this program continues to be invaluable to the growth of specialty crop knowledge though out the state.

LESSONS LEARNED

The Specialty Crop Program presence will continue to be marketed by the WDA website. The position will continue to work to expand the specialty crop industry in Wyoming though outreach and technical assistance. As more producers embrace the idea of specialty crop plasticulture production the number of farmers markets, CSA's and value added products continue to increase. This is simulating additional demand for assistance in all phases of the program. One aspect which continues to require a sizable amount of time is season extension production. Consumers are looking for local specialty crops later and earlier in the season. We have been involved in some form in over 100 hoop houses to date. Some were through the grant program and some though UWYO workshops or a result of the workshops. We continue to learn the weather limitations on various designs. To date we have had three collapses under heavy snow load and several suffered damage from extreme winds. The one pictured above collapsed under 4 feet of snow. The good news is that it was repaired in an afternoon and had extra bracing incorporated inside the high tunnel for support. It survived a second snow storm with no problems. With more interest in the program we are finding that grant training on application, reporting and management is becoming more necessary. We are planning to develop web based training to alleviate some of the time spent on frequently asked questions.



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FARM TO SCHOOL INTERN

PROJECT SUMMARY

In order to meet the growing demand for locally produced fresh fruits and vegetables the Wyoming Specialty Crop Program has developed projects related to marketing, education, research, food safety and product distribution. To support the Farm to School effort an intern will be hired to help the program in the above mentioned areas. Funding from this grant will allow for expanded promotion and education of specialty crop opportunities for Wyoming Schools. The WDA is committed to increase the availability of specialty crops within Wyoming Schools. An intern will assist the Agricultural Program Coordinator to help develop marketing and educational materials for use in Farm to School activities related to the following areas; marketing, education, research, food safety and local availability. The

intern will research local regional and national materials related to Farm to School programs and develop a resource list for Wyoming schools.

PROJECT APPROACH

This position allowed for expanded efforts of the Specialty Crop Program by providing program support and to assist the Specialty Crop Coordinator with Farm to School marketing. The intern under the direction of the Agricultural Production Coordinator conducted research and compiled Farm to School information related to specialty crop purchasing, preparation/food safety, education, and marketing. The information was gathered from government sources, other Farm to School programs and other nonprofit organizations across the country.

The duties of the intern:

Compiled information for a Wyoming Farm to School website

Created a Wyoming commodities map by county

Assembly of a Farm to School: How to Resource Guide

Attended workshops for additional learning opportunities.

Helped develop a Farm to School pictorial display

Compiled a listing of County Assessments and separated them by county

Helped build a hoop house at the Cheyenne Botanic Gardens for the Jr. Master Gardener Program

The intern was instrumental in contacting schools and producers to gauge their interest in specialty crops. She worked with Survey Monkey to input her data for a cumulative summary of interest.



The intern was also involved in various office duties and assigned tasks as needed. The specialty crop intern is of great value to the Department as their focus is solely on the promotion and marketing of specialty crops in Wyoming. Our interns gather data about existing crops, work with current producers on ideas for growth and attend conferences and trade shows to promote the programs implemented by the Department.



The WDA specialty crop interns complete a variety of tasks from gathering data, developing resources, visiting with producers to reviewing and editing grant applications. Our goal is for the intern to leave with a well rounded foundation of knowledge about specialty crops and the capability for them to be grown and marketed successfully in Wyoming.

GOALS AND OUTCOMES

Goal: Increase the number of schools purchasing local products

Benchmark: Presently we estimate that only 1% of the schools purchase local foods.

Target –Increase the number of schools purchasing local food to 5% or 20 schools

Outcome - A resource guide for Wyoming schools on Farm to School resources and programs was completed to provide information to schools wanting to buy



local products. It was given out at two School Nutrition Conferences(25 people at each), at two Farmers Market Conferences(160 total), presented to the Wyoming Hospital Food Service Directors (15 people), at two Agrifuture Conferences (146 and 104 people) , Albin Farm Days, at three producer / food service buyer training, State Fair informational booth shared at the South West Marketing Network Conference (40 people), and is online at the Wyoming Department of Education Farm to School Website <http://edu.wyoming.gov/sf-docs/nutrition-publications/farm-to-school-resource-guide-final.pdf>. Of the 393 public schools three (3) have reported purchasing food directly and another 34 have been supplied with local food options by the south east distribution center. 32 producers have attended webinars on how to sell to schools.

BENEFICIARIES

The beneficiaries of the guide were food service directors, institutional buyers, producers, Ag professionals, teachers, non profits and interested local Farm to school advocates. Over 300 guides were handed out at the various venues.

LESSONS LEARNED

In developing these resources and attending the workshop and trainings, we have learned people are interested in Farm to School but become frustrated at a lack of knowing how to proceed. From the producer standpoint we have found our resources were very beneficial in educating the producers about the process necessary to sell to schools or institutions. We were able to educate them about food safety issues, procurement process and how to submit bids. Our efforts were also targeted toward the school food service directors. With the food service staff, we learned that they are working on very limited budgets with limited staff. Many of their food choices and decisions have to be made on purchasing at the lowest price, but not necessarily the highest quality. All products served in the National School Lunch Program must meet certain nutritional levels and the food service directors play a delicate balancing game between the best product and their budgets. Compiling these documents and working with both producers and food service staff gave us the opportunity to learn about both sides of the procurement process and target individual processes or questions that are not clear to one or both sides. Our experience in developing and distributing the Wyoming Farm to School Resource Guide provided us with the input and feedback necessary to take our education to the next level and begin the process of developing additional resources. We are also working on providing teachers with information school garden activities and how to publications. We recently found a publication by Slow Food that is an excellent manual for teachers. We continue to look for and provide information to schools.



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PROJECT SUMMARY

Fresh vegetable and fruit production in Wyoming is a challenge. Seasonal temperature fluctuations, wind, and hail can all negatively influence production of all and specifically specialty commodities. Wyoming and its residents would benefit greatly from a program designed to educate individuals on how to construct high tunnels and educate producers in their use. In addition to protection from the biotic factors listed above, high tunnels also offer season extension benefits both early and late. These benefits could greatly increase the production and variety of specialty crops available in the Wyoming food distribution channel. Production of fresh, locally or regionally grown produce and fruit is being demanded by more of the population. The use of high tunnels would allow local producers the opportunity to fill some of the needs. This proposal requested funding in order to support 6 (six) high tunnel workshops conducted throughout Wyoming. Workshops included the construction of one high tunnel per location and the education of producers on the reality and benefits of specialty crop production using high tunnels. It was the intention of this project to gain interest in the use of high tunnels and encourage the adoption of their use for the production of fresh commodities for the farmer's markets in Wyoming. The goal of the project was to develop and implement these hands-on workshops to educate participants in the how-to construction of high tunnels in Wyoming. These workshops would remove factors that can be intimidating in the construction process; use local materials when available in an effort to cut costs; and utilize simple yet sturdy designs that can survive Wyoming's challenging weather conditions. An economical, easy to construct, and durable, high tunnel/hoop house with the potential to increase crop diversity and local food production are currently top-of-mind areas of interest for the food producers of Wyoming.

PROJECT APPROACH

A request for workshops was distributed out around the State to increase variety of locations that workshops were to be available. Requests for workshops from around Wyoming were returned. Selection criteria were based on which build sites and workshops could reach the greatest number of individuals by evaluating the following information provided in the workshop applications - location, project ownership, & production history. A total of six high tunnel educational workshops were proposed by this grant and locations were identified

1. A total of six high tunnel educational workshops were approved to be funded by this grant.
2. Worked with local representatives to establish schedule and time line for construction.
3. Project owners were notified that their location had been selected for a workshop.
4. Promotional brochures were developed for each location.
5. Advertised and publicized events (Local representatives).
6. Project owners organized workshop participants.
7. Prior to each build - Purchased supplies for builds as needed.

8. Materials were transported to workshop locations.
9. The high tunnel structures were built by participants in a “learn by doing environment”.

GOALS AND OUTCOMES ACHIEVED

Goal: Implement 6 hands-on workshops to educate 120 participants in the how-to construction of high tunnels in Wyoming by end of 2012

Benchmark: 9 workshops built 12 high tunnels averaging 15 people per workshop had been done through a previous specialty crop grant

Target: Six additional workshops with 20 participants per workshop

Outcome: Nine workshops were done. Of these six were done for either schools, non profits or other public entities. One was done in Torrington as part of a hands on workshop as part of an ag conference and raffled off with the proceeds being returned to the high tunnel fund for use in future builds and two were done but had materials paid for by producers who had attended previous workshops.

Goal: Educate producers in the potential use of high tunnels for specialty crop food production.

Benchmark: NA

Target: Provide information to all participants of workshops on proper use of high tunnels

Outcome: During each of the six public builds, time was designated to discuss issues related to proper high tunnel management that included pest management, temperature and humidity control, irrigation techniques and fertilization. A total of 146 people attended workshops. 120 were at public property builds, 8 were at a conference workshop and 18 were at producer builds. When surveyed 114 workshop participants responded and 29 (ca. 25%) indicated they would build their own high tunnel within the next 24 months. **Workshop Comments:** “I think the [hoop house] project is a fantastic way to show Wyomingites that we can grow our own food without the outrageous cost of a commercial hoop house.”

Goal: Educate producers in the potential use of high tunnels for specialty crop food production

Date	Location	County	Project Summary	Other Funding Sources*	Participants	Estimated total hours	Value of Volunteer time @\$18.89/hr	Farmable Square feet
May-11	Lusk	Niobrara	Gothic Style 17 X 32	None	28	252	4,760.28	544
May-11	LaBarge	Lincoln	Traditional Hoop 12X32	NA	11	88	1,662.32	384
Jun-11	Sheridan	Sheridan	Traditional Hoop 12X32	NA	9	99	1,870.11	384
Jul-11	Rawlins	Carbon	Hard Sided High Tunnel 16 X 32	NA	17	272	\$ 5,138.08	512
Aug-11	Laramie	Albany	Traditional Hoop 12X32	NA	14	182	3,437.98	384
Aug-	Hawk	Goshen	Modified Hard Sided	Producer	10	120	2,266.80	480

	11	Springs		High Tunnel 16 X 30					
	Sep-11	Dubois	Fremont	Traditional Hoop 12X32	NA	23	230	4,344.70	384
	Sep-11	Torrington	Goshen	Modified Traditional Hoop 12X 12	Producer	8	48	906.72	144
	Oct-11	Worland	Big Horn	Traditional Hoop 12X32	NA	26	286	5,402.54	384
						146	1577	29,789.53	3600

BENEFICIARIES

This grant allowed for the continued implementation of hands-on educational workshops for Wyoming residents in the how-to construction of high tunnels. These workshops were able to remove factors that can be intimidating in the construction process, encouraged the use of local materials and utilized simple yet sturdy designs that would survive Wyoming's challenging weather conditions. 146 participants were exposed to hands on building of high tunnels using local materials. Public participation in the workshops and seminars has exceeded all expectations. This project encourages hands-on learning and the opportunity to discuss unexplored methods (by the general public) of crop diversity and production.



The possibility of building a low cost-high tunnel that provides protection against Wyoming's variable growing conditions and extends the growing season piques the interest of all frustrated backyard and commercial producers of food. These workshops last for 6 to 24 hours of hands-on instructional learning each, this time frame provides ample opportunity to not only educate participants on the construction of these structures, but other educational discussions have included: the benefit of extending the growing season; how-to-grow traditional and non-traditional crops (items not usually produced in a traditional Wyoming garden setting); pest control strategies. The project owners whether Master Gardeners, University Extension staff, educators, or individual producers who manage these structures for demonstration or production of crops benefit local communities. The local economy benefits via on-farm and local market sales. The general public benefits as these structures continue to be used for educational purposes. Of the public site workshops completed two structures were placed on county fairgrounds, one structure was placed at a school, and several were placed in locations where they are being utilizing them as a teaching/learning/and production tools

LESSONS LEARNED

Personal observations suggest that workshops where structures are built on public property have the greatest level of participation (broader audience) – but in certain circumstances and for a variety of reasons are the least utilized structures; whereas, structures and workshops for the private producer sector have the greatest impact on the project owners as these structures are utilized to their fullest potential. The degree of high tunnel utilization appears to be a matter of vested ownership.

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UTILIZING THE LAND FOR SPECIALTY CROP ORGANIC SMALL FRUIT PRODUCTION

PROJECT SUMMARY

The purpose of this project was to develop a cooperative effort between three entities to utilize idle land to provide both healthy food and educational benefits for several small communities. The available land, with a good water source, had not been used for several years. This project's new specialty crops brought an interest in healthy food incentives and helped to foster creativity for other small land owners to do the same. This project helped in providing good agricultural practices by demonstration. We planted fruit trees and bushes as our specialty crops, Apples, Raspberries and Choke Cherries. This is Indian Country, the land lies on the Wind River Reservation and since the drought period several years ago, there are few Choke Cherry plants, and many individuals had to travel to Montana to pick the berries in the summer. Traditionally speaking, American Indians relied on this fruit in many ways and today it is used in ceremonial gatherings as well as social events. "Choke Cherry gravy" is a standard at the Indian community feasts. Apples and raspberries do well in this area and are substantial fruits for healthy diets. Small community farmers continue to be interested in the most productive way to grow these specialty crops. With our low-income families of this area, are interested in saving money while providing good nutrition for their families. The goals of the project were as follows.

Goal #1 – To develop a new use for idle land, with adequate water resources, that would provide specialty crops of nutritional food for under-served communities

Goal #2 – Demonstrate through practice, an educational growing process for other small ranchers.

Goal #3 – Restore a traditional fruit food that has been lessened by drought and share the restoration process with community members

PROJECT APPROACH

During the progress of this project, records were kept of activities and subsequent results. Progress reports followed each planned and implemented activity, including, time; cost; problems and problem solving results.

Date Activity Implementer

Arapaho Ranch (AR); Blue Mountain Associates, Inc. (BMA); Wind River, Extension Service (WRE)
October 1, 2010 Award Notification

November 1-30, 2010 Prepared land, evaluate water AR and BMA system; lay out irrigation pipes

December 1-31, 2010 Planned planting site and spring ART, BMA, WRE duties; purchase tools and arrange storage; planned workshops and demonstration

January 1-31, 2011 Seasonal planning for spring AR and BMA

February 1-28, 2011 Designed fruit tree site, order plants;

March 1-31, 2011 as soon as frost was out of ground, BMA, AR prepared ground for setting up high tunnel

April 1-31, 2011 Continued working with planting BNA, AR areas and set up summer schedule

May 1-31, 2011 As soon as frost danger was over, BMA, AR set out plants. Recruit youth volunteers and set summer schedule

June 1-31, 2011 Maintained plant growth schedule, BMA monitor for reports

June-August 2011 Cultivated and replaced fruit BMA, WRE plants as necessary to maintain full coverage. Conducted demonstrations and workshops scheduled

September 2011 Planned and coordinated community BMA, WRE market dates; Continued to monitor plants.

The time line was well designed and followed with the exception of irrigation. The water rights for the land given to us to use are under the Arapaho Tribe and therefore we could only secure the water during their seasonal use. Another problem, was keeping the irrigation ditched cleaned in the spring and ready for use to our area. We did haul water several times in the late fall to supplement the water needed for our trees. In 2012 a much better system was developed.

GOALS AND OUTCOMES

Goal #1: To develop a new use for idle land, with adequate water resources, that will provide Specialty crops of nutritional food for under-served communities.

Outcome: BMA was very successful with this goal. The land given us to use was developed according to plans and the apple orchard is off to a good start. We also have several plum trees and have been testing raspberry bushes to determine which would be best in that soil. We have 12 bushes that are doing well and except for being invaded by pheasants for the berries at first, (we provided netting to keep them out) we will continue planting more each year.

Goal#2: To demonstrate through practice, an educational growing process for other small ranchers.

We have had many community visitors come to see what we have done and they in turn have been encouraged to make use of their idle land in home sites and small farms by planting fruit trees and berry bushes.

Goal #3: To restore a traditional fruit food that has been lessened by drought and share the restoration process with community members.

We have had many discussions with elders regarding traditional fruit, especially the berries and we now have the tribal people planting these types of berry bushes on their own land and adding them to their home gardens. We have about ten new gardeners in the various communities which are bringing fruit and produce to our Wind River Tribal Farmers Market.

Those items are quickly bought by tribal people and others. We now have several new greenhouses that are trying to plant more Native medicinal plants as recommended by elders.

Goal #4: To encourage participation by young people to assist in this project by volunteering to



work and learn.

Outcome: This goal proved difficult to accomplish and was a disappointment, except we, as an organization, learned from this experience. We found that stimulating interest in the youth to become involved in work experience that was volunteer status only was difficult. Never mind, that it was rewarding in other ways, educational and often a fun experience, if there was no wage there was very little interested.

The Boys and Girls Clubs were experiencing the same problem. They developed grants for gardens and then the staff struggled with lack of interest by the youth. We have to, in the future, find a solution to the apathy among our youth to move forward. We did work in 2012, with several families that had taught their children to work along with them each day and they were excited to be a part of the family projects. We need, as Tribal people, to return to this kind of family structure.

Goal: To have a community harvest gathering in the fall to share the new specialty crops.

Benchmark: No community harvest gathering exists at this time.

Target: 50% of the small ranchers/farmers to participate in the harvest gathering

Outcome: This goal did not become a reality, as there was not enough community effort at this time to put into the actual projects. But the benefits came from the amount of interest the tribal people began to show over the garden projects that were started on the reservation. There was a high percent of the garden participants who became Farmers Markets vendors all season and the people visited the home gardens and were excited about trying to raise their own in the coming year.

Goal: To have tribal members participate in a variety of workshops demonstrating the value of specialty crops

Benchmark: No workshops have been presented in the past

Target: A total 50 tribal members will be recruited to participate in the workshops

Outcome: This year the IJW Extension Office presented several good gardening and food preparation Workshops and most were well attended. BMA referred and encouraged our gardeners to attend these workshops.

Goal: To have youths volunteer to take part in various stages in the development of the specialty crop ground preparation and harvesting.

Benchmark: No cultivated organic small fruit production is presently available

Target: Up to 20 youth will be recruited

Outcome: BMA was unable to recruit any interested volunteer youths.

Goal: To create and implement a Farmer's Market through the cooperative effort of this project and community members.

Benchmark: No farmers market is presently on the reservation

Target: One market is planned for each month July through October with up to 20 vendors per market

Outcome: The Wind River Reservation Farmers Markets are in their third year here on the reservation under the sponsorship of BMA. Each year they have shown considerable growth and acceptance by the communities. This year, in 2012, twenty one (21) Vendors took part in the Farmers Markets from July 7, 2012 through October 11, 2012 saw 11 non-Indian vendors, 10 tribal vendors of which 12 were produce vendors. Some Vendors had multiple items that included, produce, baked goods, and crafts at times. The

consumer numbers were varied from site to site and were not counted as they came and went at different times. The markets became a social gathering at times, as people were comfortable in visiting with one another and the vendors.

Goal: To conduct five community workshops in the main reservation communities of Fort Washakie, Ethete, and Arapaho Crow Heart, and Kinnear to educate residents on the strategic planning of creative and production specialty crops.

Benchmark: Community workshops concerning the utilization of specialty crops on ranch and farm land have not been previously conducted on the Wind River Reservation.

Target: It is anticipated that 50 percent (at least half) of the participants will begin to utilize land for specialty crop production.

Outcome: BMA helped develop nine new gardens that were productive and well managed, and during their time of development the participants met several times to share ideas and suggestions. There was a consensual agreement to share equipment and assistance when needed. As the apple orchard progressed, there were visits to the area to discuss progress and information for others who might want to start their own orchards. A community group helped to start the building of the High Tunnel greenhouse, but high winds prevented completion. It is planned to complete the greenhouse next spring. Several others who started smaller greenhouse had the same problem and will finish them in the spring.

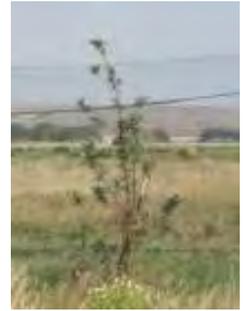
BENEFICIARIES

In low-income family communities, we continue to look for ways to be more conservative and more economically productive. All deserve good health, and this project will be of great benefit to the small ranch families who are continually looking for new ways to provide good nutritional food. It will at the same time create a way to utilize land that is not in full production. By combining the efforts; A) of a large ranch, with idle lands; B) an organization skilled in administration and financial management; C) another agency who is prolific in conducting on-site data collections of good practices and has the outlying resource to bring professionals in to assist with technical expertise, this project was beneficial in its own right, and helpful in leading the way for others to follow suit. As these specialty crops continue to be planted and are ready for harvest, the community will become a part of the project as they help in the harvest that will provide good safe and nutritional food for their families. It is expected that this project will continue to benefit the main reservation communities of the Wind River Reservation and surrounding areas in several productive and educational ways. Those receiving the most benefit will be the community members, approximately 50 percent of the 11,000 tribal members will benefit, both, through the educational process of learning a greater appreciation of healthy foods and the process of saving money through their own food production. We have a high percentage of diabetic ti-Thai members, and healthy foods are especially important to their health and wellness. There are fifty to one hundred small ranch owners on the reservation and surrounding areas, this is basically ranching and farming country and they are always interested in learning about being more productive with their land. With the high cost of groceries and particularly organic healthy foods, more people are interested in developing bigger garden projects for their own daily use and for winter storage and use. We plan to encourage and assist new gardeners with their endeavors. When the drought caused many of our choke

cherry bushes to disappear we encourage people to re-plant the choke cherry bushes on their own property and help the community to assure a generous helping of this traditional fruit for their social and ceremonial gatherings. This benefit alone, will reach approximately one thousand people, especially during the Sun Dance ceremonial time. Indian Health Service will benefit from this project, as they encourage clients to seek healthier foods as a preventative measure for good health.

LESSONS LEARNED

It is amazing to see abandoned weed-infested land being restored to a healthy productive state, with rows of healthy green growing plants that will produce healthy nutritious food for our tribal members. In caring for new fruit trees, people become very protective of the trees, as they face destruction from deer, and small burrowing animals. They need protection from the elements as well, since Wyoming has its share of inclement weather. We have many acres left to work with and it would be very rewarding to see this idle land put to use, knowing it would benefit all ages of our people. There is much work to be done in interesting our young people in these areas and we still have a lot of knowledge to gain from our elders who have been through the hard times of growing their own food for self-preservation during the long cold winters. Water can be a problem, as we are at the mercy of the weather. High winds and no rain always mean that water will become more of a premium.



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VETABLE CROP PRODUCTION & VARIETY SELECTION INSIDE AND OUTSIDE HIGH TUNNELS

PROJECT SUMMARY

Demand for fresh vegetables is increasing and the quality of those products is taking on greater significance. Many urban and small acre owners would like to take advantage of this situation but the short cool growing season conditions are making it more difficult and non-profitable. To overcome this obstacle and make vegetable production profitable, knowledge about “what to grow” and “how to grow it” was studied. Several research and demonstration plots were conducted inside and outside high tunnels at the Powell Research and Extension Center garden to educate, train, and provide interested growers with the information they need to sustainably manage their land and improve their quality of life by raising healthier crops, while promoting sustainable practices which enhance the ecological, economic, and social aspects of the land and its people. Growers were provided information about new short growing season vegetables cultivars, composting techniques, as well as the advantages of growing

vegetable inside high tunnels as compared to outside (yield, quality, pest control, and the length of growing season). The objectives of the proposed project were 1) to identify new releases of short growing season vegetable cultivars; 2) to evaluate and compare production inside to outside high tunnels; 3) to demonstrate, educate, and train growers about the advantages and the use of high tunnels to extend the growing season as well as techniques to build up on-site organic compost, through workshops.

PROJECT APPROACH

The main objective of this study was to identify the most adapted vegetable varieties to northwestern Wyoming environment as well as educate, train, and compare crop performance inside and outside high tunnels.

2011

Several trials were conducted inside and outside high tunnels to evaluate the performance of four crops, including tomato, cucumber, and squash, four varieties each, all grown under two fertility regimes (organic and inorganic). Tomato varieties consisted of three determinate varieties (Sun Brite, Legend, and Bush Goliath Hybrid) and one indeterminate variety (Peron Sprayless). Cucumber varieties consisted of Diva Hybrid, Sweeter Yet Hybrid, Sweet Slice Hybrid, and Pearl Hybrid. Summer Bush squash varieties consisted of Golden Bush Scallop, Early White Bush, Peter Pan, and Sunray Hybrid. The area of each high tunnel was divided into two halves; one half was fertilized with manure and the other half with mineral fertilizer (urea) incorporated into the soil with a hand held Roto-tiller. All three crops were first planted in the greenhouse on the 28 of April and then transplanted inside the high tunnels on May 20 and outside the high tunnels on May 27. All varieties were arranged in a randomized complete block design. A drip irrigation system with spaghetti tubing was used to irrigate the plants. Tensiometers were installed at 6 and 12 in depth to monitor soil moisture and manage irrigation. Plots were kept weed free by hand weeding.

2012

Trials were conducted inside and outside high tunnels to evaluate the performance to evaluate the performance of several varieties of tomato, cucumber, and sweet pepper. Tomato varieties consisted of two determinate varieties (Sunbrite and Legend) and two indeterminate varieties (Peron Sprayless and Chocolate Sherry). Cucumber varieties consisted of Radar, Market More, Diamant, Sweeter Yet Hybrid, and Pearl Hybrid. Green pepper varieties consisted of Planet, Cute Stuff, Yum Yum Gold, and Golden Star. The experimental area was fertilized with mineral fertilizer (urea) and incorporated into the soil with a hand held Roto-tiller. All three crops were first planted in the greenhouse on the 15 of April and then transplanted inside the high tunnels on May 15 and outside the high tunnels on May 25. All varieties were arranged in a randomized complete block design. A drip irrigation system with spaghetti tubing was used to irrigate the plants. Tensiometers were installed at 6 and 12 in depth to monitor soil moisture and manage irrigation. Plots were kept weed free by hand weeding.

2013

On April 29, the gothic-type tunnel was completely destroyed by wind. Crops of different varieties were planted outside and inside the remaining structures. Artichoke, eggplant, pepper (sweet and hot),

cantaloupe, and watermelon were planted outside. The tunnel-type high tunnel was planted with artichoke, eggplant, cucumber, pepper (sweet and hot), and squash. The two-sided high tunnel was planted with 10 tomato varieties of determinate, semi-determinate and indeterminate varieties growth habit.

GOALS AND OUTCOMES

Vegetables crop production in high tunnels is growing rapidly, with new growers and new crops finding their comfort zone under those plastic roofs and walls. The movement to high tunnels started with people wanting a cheaper kind of greenhouse to produce high quality crops 3-4 weeks early in the spring and extend the growing season in the fall by 3-4 weeks. Many warm season vegetable crops can bring a higher price early in the growing season before large supplies are available. In order to encourage early vegetable production and capture the possible early market, growers can use plastic tunnels. Several research have shown that warm season vegetable crops tomatoes, cucumber, peppers, strawberries, and broccoli do very well (yield and quality) when grown in high tunnels. High tunnel operations have been viewed by many as a means to diversify and improve farm income. Growers are trying to take advantage of vegetable crop production which, in general, has higher return per unit area than agronomic crops. Warm season crops such as tomatoes don't mature until late August or early September, and have a very short "harvest window" before frost. However, research shows that tomatoes can mature as much as four weeks earlier in high tunnels, the yield and quality are often far superior. In addition, high tunnel have greatly aided in the control of diseases and in reducing common vegetable pest problems. High tunnels provide an excellent tool for organic producers since diseases and other pests can be controlled without chemicals.

The goals of the project were to:

Appraise on-site use of organic and inorganic compost: The condition of the soil is the key to garden success. Utilization of compost reduces dependency on manufactured chemical fertilizers. Therefore, creating a composting opportunity is an inexpensive option that saves money by keeping organic waste materials out of the landfills and keeping those nutrients and organic matter on the premises.

Outcomes

During the first year of the project organic residue was not readily available to make compost. As a result, it was decided to obtain compost from a local organic producer. Then due to turnover at the research station we became severely short staffed. In a period of 12 months the PI of the project, the Resident Associate, and our Farm Manager left the University and we were not able to accomplish this objective. As a consequence, commercial fertilizer was used during the second and third years in order to accomplish the main goals. The lab analysis of the compost used showed very little supply of nutrients. Still, plants grown in the composted plots were visually and quantitatively better when compared to the non-composted plots. Locally made compost takes between 2-3 years to be ready and local supply is very limited. As a consequence, commercial fertilizer was used during the second and third years. Although we had hoped to use to use organic compost to decrease environmental impact through use of alternative cultural practices this component was not accomplished for all three years. As previously stated, we only used compost the first year.

Evaluate new releases of short growing season vegetable cultivars: The Big Horn Basin is a cool growing season area. Therefore, our focus was concentrated on growing 55 to 65 day annual plants and identifying varieties that perform best inside and outside high tunnels. Although yield is very important to many producers, quality improvements are gaining in importance too. Therefore, our evaluation was to combine both yield and quality.

Evaluate and compare production inside high tunnels to that outside high tunnels: High tunnels are considered as protected growing systems that extend growing season, improve yield, enhance quality, and reduce the use of pesticides.

Outcomes

The decision on which crops to plant was made after a group (researchers, research associate, farm manager, extension educator, and master gardener) meeting. Then, varieties were chosen based on possible adaptation in the area. We realize that a couple of growing seasons may not be enough to determine varieties adaptation to our rather harsh environment. This is especially true when it comes to outside high tunnel plantings. Our progress and results were presented to producers during high tunnel field days and Workshops (actually called High Tunnel Tours) and in field day bulletins and extension publication. Unfortunately we did not develop ex-ante nor ex-post tests to quantify the impact of these activities.

2011

Within a crop, yield was significantly different between varieties, between location (inside/outside), and between fertilization practice (inorganic and organic). For all four crops, production inside high tunnel was by far higher than outside. Tomato production was higher when fertilized with urea but cucumber and squash produced more when grown with manure; while nitrogen availability may have been the major factor for tomatoes, water may have been the major factor affecting yield of cucumber and squash.

The major limitation during the first year was the availability of organic residue for composting at the experimental location. The solution found was to obtain the compost from a local organic lamb producer.

Tomato production: There was a significant difference between varieties, inside/outside, as well as inorganic/organic. With all four varieties, production inside high tunnel was by far higher than outside. Similarly, inorganic production was higher than organic except for Bush Goliath Hybrid. Of the four varieties researched, three varieties (Sunbrite, Peron Sprayless and Legend) ripened earlier in the high tunnel (last week of July) as compared to the outside (mid August). Bush Goliath Hybrid was a late producing variety (mid August) under high tunnel. Legend variety produced more fruits/plant but more smaller than larger fruit size as compared to the other varieties. The best and most aesthetically pleasing fruit came from Sunbrite and Peron Sprayless varieties grown inorganically under high tunnel. The last harvest of tomatoes in the field was September 20th. Tomatoes in the high tunnel survived until October 18th. The high tunnel extended the late season by at least four weeks.

Table 1. Performance evaluation of four tomato varieties grown under two fertility regimes (organic/inorganic) inside and outside high tunnel. 2011

	Inside	Outside
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Variety	Fertility	Fruit	Yield	Size	Fruit	Yield	Size
		(#/plant)	(lb/plant)	(lb/fruit)	(#/plant)	(lb/plant)	(lb/fruit)
Sunbrite	Inorganic	57	25	0.44	22	6	0.27
	Organic	28	10	0.36	19	5	0.26
Peron Sprayless	Inorganic	53	22	0.42	15	3	0.25
	Organic	49	14	0.29	6	2	0.33
Legend	Inorganic	97	23	0.24	12	3	0.25
	Organic	70	15	0.21	12	2	0.17
Bush Goliath Hy	Inorganic	55	17	0.31	5	2	0.40
	Organic	58	17	0.29	2	1	0.50

Cucumber production: There was a significant difference between varieties, inside/outside, as well as inorganic/organic. With all four varieties, production inside high tunnel was by far higher than outside. Similarly, inorganic production was higher than organic except for Pearl Hybrid. Of the four varieties researched, two varieties (Sweeter Yet Hy and Pearl Hy) yielded higher and produced more fruit/plant under high tunnel as compared to other varieties. Sweeter Yet Hy ripened earlier in the high tunnel (second week of July) as compared to the other varieties. Lowest yield and number of fruit/plant came from Sweet Slice Hy. The last harvest of cucumber in the field was September 20th. Cucumber in the high tunnel survived until October 18th. The high tunnel extended the late season by at least four weeks.

Table 2. Performance evaluation of four cucumber varieties grown under two fertility regimes (organic/inorganic) inside and outside high tunnel. 2011

Variety	Fertility	Inside			Outside		
		Fruit	Yield	Size	Fruit	Yield	Size

	(regime)	(#/plant)	(lb/plant)	(lb/fruit)	(#/plant)	(lb/plant)	(lb/fruit)
Sweeter Yet Hybrid	Inorganic	54	40	0.74	10	7	0.70
	Organic	54	39	0.72	16	11	0.69
Sweet Slice Hybrid	Inorganic	11	8	0.73	5	3	0.60
	Organic	15	9	0.60	5	3	0.60
Diva Hybrid	Inorganic	38	27	0.71	12	7	0.58
	Organic	38	24	0.63	10	5	0.50
Pearl Hybrid	Inorganic	71	34	0.48	14	7	0.50
	Organic	81	41	0.51	22	10	0.45

Summer Bush Squash: There was a significant difference between varieties, inside/outside, as well as inorganic/organic. With all four varieties, production (yield, number of fruit/plant as well as fruit size) inside high tunnel was higher than outside. Similarly, organic production was higher than inorganic except for Golden Bush. Of the four varieties researched, Sunray Hy ripened earlier in the high tunnel (3rd week of July) as compared to the other varieties (last week of July). The last harvest of squash in the field was September 20th. Summer Brush Squash in the high tunnel survived until October 18th. The high tunnel extended the late season by at least four weeks.

Table 3. Performance evaluation of four squash varieties grown under two fertility regimes (organic/inorganic) inside and outside high tunnel. 2011

Variety	Fertility	Inside			Outside		
		Fruit	Yield	Size	Fruit	Yield	Size
	(regime)	(#/plant)	(lb/plant)	(lb/fruit)	(#/plant)	(lb/plant)	(lb/fruit)
Golden Bush	Inorganic	8	4975	622	5	1544	309

	Organic	5	2936	587	7	1788	256
Early White	Inorganic	17	17120	1007	9	4511	501
	Organic	35	22320	638	14	9280	663
Peter Pan	Inorganic	15	13950	930	6	3173	529
	Organic	23	16706	726	11	11094	1009
Sunray Hybrid	Inorganic	32	13351	417	34	11739	345
	Organic	51	19690	386	28	8664	309

High tunnel production techniques and research results were demonstrated at a High Tunnel Field Day organized on Friday, July 15 at the UW Research and Extension Center - Powell. A. Garcia y Garcia, UW Irrigation Specialist, discussed irrigation and environmental conditions in high tunnels. Randy Violett, Research Associate, talked about research studies conducted. S. Frost, UW Extension Educator, discussed high tunnel construction. P. Lewis, UW Food & Nutrition Educator, talked about "Cooking with Herbs: the Finishing Touch." A bulletin by A. Mesbah and A. Garcia y Garcia was published in the Field Day Bulletin of the UW-AES (www.uwyo.edu/uwexpstn/publications).

2012 Outcomes

Tomato production: There was a clear difference between the varieties grown inside high tunnel as compared to those grown outside. With most of the varieties, production inside was three times higher than outside. In general, the four varieties researched yielded better than last year. The highest yielding variety was Legend (30 lb/plant) followed by Sun Brite (29 lb/plant). The largest size was achieved with Sun Brite (0.44 lb/fruit). All varieties ripened earlier in the high tunnel (last week of July) as compared to the outside (mid August). All varieties produced aesthetically pleasing fruits.



Figure2. Tomato production under high tunnel (University of Wyoming-Powell R&EC-2012).

Table 1. Performance evaluation of tomato varieties grown inside and outside high tunnel. 2012

Variety	Inside			Outside		
	Fruit	Yield	Size	Fruit	Yield	Size
	(#/plant)	(lb/plant)	(lb/fruit)	(#/plant)	(lb/plant)	(lb/fruit)
Sunbrite	66	29	0.44	25	8	0.32
Peron Sprayless	69	26	0.38	20	5	0.25
Legend	95	30	0.32	22	7	0.32
Chocolate Sherry	163	27	0.17	36	6	0.17

Sweet pepper: There was a big difference between varieties grown inside and outside high tunnels.

With all four varieties, production (yield/plant, number of fruit/plant) inside high tunnel was higher than outside. The highest yielding variety was Cute Stuff (15 lb/plant) followed by Golden Star Hy (14 lb/plant). In general, fruit sizes between inside and outside high tunnels were similar. All varieties produced aesthetically pleasing fruits.



Figure 3. Sweet pepper production under high tunnel (University of Wyoming-Powell R&EC-2012).

Table2. Performance evaluation of sweet pepper varieties grown inside and outside high tunnel. 2012

Variety	Inside			Outside		
	Fruit (#/plant)	Yield (lb/plant)	Size (lb/fruit)	Fruit (#/plant)	Yield (lb/plant)	Size (lb/fruit)
Planet Hybrid	30	9	0.30	15	5	0.33
Cute Stuff	62	15	0.24	35	8	0.23
Yum Yum Gold Hybrid	60	10	0.17	27	5	0.19
Golden Star Hybrid	40	14	0.35	23	7	0.30

Cucumber production: There was a clear difference between the varieties grown inside high tunnel as compared to those grown outside. With most of the varieties, production inside was more than 75% higher inside high tunnel than outside. In general, yields from all tested varieties were good to excellent. Diamant and Pearl Hy varieties yielded higher and produced more fruit/plant under high tunnel as compared to other varieties. All varieties ripened earlier in the high tunnel (last week of July) as compared to the outside (mid August). All varieties produced aesthetically pleasing fruits.



Figure 4. Cucumber production under high tunnel (University of Wyoming, Powell R&EC-2012).

Table 3. Performance evaluation of cucumber varieties grown inside and outside high tunnel. 2012

Variety	Inside			Outside		
	Fruit (#/plant)	Yield (lb/plant)	Size (lb/fruit)	Fruit (#/plant)	Yield (lb/plant)	Size (lb/fruit)
Radar	49	35	0.71	15	9	0.60
Market more	55	33	0.60	17	12	0.71
Diamant	65	45	0.69	25	17	0.68
Pearl	85	39	0.46	17	8	0.47
Sweeter Yet	50	35	0.70	11	7	0.64

Major Findings

Within a crop, yield was significantly different between varieties and between location (inside/outside). For all crops, production inside high tunnel was by far higher than outside. In average, production inside the high tunnels was 75 percent higher than outside. All varieties produced aesthetically pleasing fruits.

Technology Transfer

High tunnel production techniques and research results were demonstrated at a High Tunnel Workshop & Tour organized 20-21 of July at the UW Research and Extension Center - Powell. The workshop consisted on hands-on construction led by J. Edwards. The tour was led by A. Mesbah and included talks on irrigation, fertility, grape production, grants available for high tunnels, and vegetable nutrition. Two bulletin by Mesbah, Garcia y Garcia, and Frost were published in the Field Day Bulletin of the UW-AES (www.uwyo.edu/uwexpstn/publications). The talk "Expanding the Use of High Tunnels in the Big Horn Basin" was given by Garcia y Garcia at the 2012 Rocky Mountain Green Industry Annual Conference and Trade Show.

2013 Outcomes

The experimental area was fertilized with mineral fertilizer (Miracle Grow®) and injected into the irrigation system several times throughout the growing season. All crops were first planted in the greenhouse around the 10 of April and then transplanted inside the high tunnels on May 17 and outside the high tunnels on May 31. All varieties were arranged in a randomized complete block design. To determine the effect of the location, results were analyzed considering a split-split plot array; location (outside, high tunnel type) was the main treatment, varieties the sub-treatments, and type (for tomatoes and peppers only) was the sub-sub-treatment. Also, results were scaled up to tons/acre, considering a planting distance of 3 ft between rows and 2 ft between plants. A drip irrigation system with spaghetti tubing was used to irrigate the plants. Plots were kept weed free by hand weeding.



A



B

Figure 2 - a) outside and b) Inside high tunnels view. University of Wyoming Research & Extension Center, Powell, WY. 2013.

Tomato Production

Visually, tomato plants grown outside were not as healthy and vigorous as tomato plants grown inside (Figure 3). All varieties at both outside and inside the high tunnel started ripened the second week of August; the last harvest outside occurred on September 11 and the last harvest inside the high tunnel was on October 4. All varieties produced aesthetically pleasing fruits.



A



B

Figure 3 – Tomato production a) outside and b) Inside high tunnels. University of Wyoming Research & Extension Center, Powell, WY. 2013.

The statistical analysis performed on results obtained from both, outside and inside were limited to six varieties; four determinate and two indeterminate. Significant differences ($p < 0.05$) were found on yield, number of fruits/plant, and size of fruits between location, variety, growth type, and the interaction variety x growth type x location. Within determinate varieties, the highest yield inside the high tunnel was from Legend (39.10 tons/acre) followed by Sunbrite (37.40 tons/acre) while the highest yield outside was from Defiant (12.015 tons/acre) followed by Sunbrite (9.33 tons/acre) (Table 1).

Table 1 - Performance of tomato varieties grown inside and outside high tunnel. University of Wyoming R&E Center, Powell, WY - 2013.

Outside		Inside High Tunnel	
Variety	Average Yield (tons/acre)	Variety	Average Yield (tons/acre)
Determinate			
Defiant	12.05a §	Legend	39.10a
Sunbrite	9.33a	Sunbrite	37.40a
Legend	8.88a	Defiant	35.90a
Bush Goliath	1.25d	Bush Goliath	15.40b
LSD	5.69		10.75

Indeterminate			
Black Cherry	4.90a	Sun Sugar	10.12a
Sun Sugar	4.65a	Black Cherry	7.38b
LSD	3.02		2.82

§ Within location and growth type (determinate or indeterminate), means with the same letter are not significantly different according to Fisher's LSD (0.05).

In most tomato varieties yield inside was more than three times higher than outside. On average, the size of the fruit was doubled inside while the # fruits/plant increased by 2-6 folds, with the exception of the indeterminate variety Black Cherry which had more fruits/plant when grown outside. This, however, was compensated by a bigger size of the fruit inside, consequently producing 33 percent higher than outside (Table 2).

Similar to previous years, the determinate varieties Sunbrite and Legend produced the most. Consistently, Sunbrite performed very well during the 3-year study. The semi-determinate varieties performed better than the indeterminate varieties but not as good as the determinate.

Table 2 – Average production and average increase in production of tomato grown inside high tunnels. University of Wyoming R&E Center, Powell, WY - 2013.

Variety	Outside			Inside			Production Increase (%)		
	Fruit (#/Plant)	Size (lb/fruit)	Yield (tons/A)	Fruit (#/Plant)	Size (lb/fruit)	Yield (tons/A)	Fruit (#/Plant)	Size (lb/fruit)	Yield (tons/A)
Determinate									
Bush Goliath	6.8	0.05	1.2	18.3	0.23	15.4	63	79	92
Defiant	49.5	0.06	12.05	70.0	0.14	35.90	29	53	66
Legend	19.5	0.13	8.88	42.5	0.26	39.10	54	49	77
Siberian	24.5	0.02	1.90	167.5	0.03	15.40	85	31	88
Sunbrite	10.5	0.24	9.35	22.5	0.44	37.40	53	47	75

Indeterminate

Black Cherry	68.3	0.02	4.9	66.5	0.03	7.4	-3	37	34
Coure Di Beu	7.5	0.08	2.3	37.5	0.15	22.0	80	45	90
Sun Sugar	152.0	0.01	4.7	225.5	0.01	10.2	33	33	54

Semi-determinate

Gill's	12.8	0.09	3.8	23.5	0.23	20.4	46	64	81
Peron	8.0	0.09	2.6	237.5	0.13	20.1	97	32	87

Pepper Production

Differences on yield due to location were not significant (Table 3). Yet, production inside high tunnel was higher than outside. Inside, the highest yielding hot variety was Serrano del Sol (3.85 tons/acre) while the highest yielding sweet variety was Golden Treasure (4.10 tons/acre). In general, fruit sizes between inside and outside high tunnels were similar. Even though production outside was very similar between hot varieties, better production was observed with Purple Cayenne while Serrano del Sol outperformed the other varieties inside. As for the sweet varieties, Yum Yum Gold was the best producer outside. The production of sweet varieties inside was very similar; however, Golden Treasure was the best producer. Overall, inside the high tunnels the sweet varieties Golden Star and Yum Yum Gold performed as good as in 2012. All varieties produced aesthetically pleasing fruits.

Production in the high tunnels considerably increased yield of most varieties. While the hot varieties Peguis and Serrano del Sol had yield increase of 80%, yield increase in the sweet varieties was on average 60% (Table 4).

Table 3 - Performance evaluation of pepper varieties grown inside and outside high tunnel. University of Wyoming R&E Center, Powell, WY - 2013.

Outside		Inside	
Variety	Yield (tons/A)	Variety	Yield (tons/A)
Hot			

Purple Cayenne	1.65a §	Serrano del Sol	3.85a
Serrano del Sol	0.77b	Peguis	1.85ab
Peguis	0.40b	Purple Cayenne	0.85b
LSD	0.67		2.19
Sweet			
Yum Yum Gold	1.85a	Golden Treasure	4.10a
Golden Star	1.17a	Golden Star	3.50a
Golden Treasure	1.10a	Yum Yum Gold	3.13a
LSD	2.60		5.43

§ Within location and type (hot or sweet), means with the same letter are not significantly different according to Fisher's LSD (0.05).

Table 4 – Average production and average increase in production of pepper grown inside high tunnels. University of Wyoming R&E Center, Powell, WY - 2013.

Variety	Outside			Inside			Production Increase		
	Fruit (#/Plan t)	Size (lb/frui t)	Yield (tons/A)	Fruit (#/Plan t)	Size (lb/frui t)	Yield (tons/A)	Fruit (#/Plan t)	Size (lb/frui t)	Yield (tons/A)
Hot									
Peguis	3.5	13.6	0.40	20.5	15	1.85	83	11	78
Purple Cayenne	69.0	2.9	1.65	40.5	3	0.85	-70	2	-94
Serrano del Sol	18.7	4.8	0.77	54.5	8	3.85	66	43	80
Sweet									
Golden Star	3.3	63.7	1.17	3.0	122	3.50	-11	48	67
Golden Treasure	5.5	25.4	1.10	20.0	26	4.10	73	4	73
Yum Yum Gold	21.0	10.3	1.85	35.7	11	3.13	41	7	41

Egg Plant Production

There was a large difference between yield of artichoke grown inside high tunnel as compared to artichoke grown outside. Because no more than one variety planted, no statistical analysis was performed. However, yield inside was 3.70 tons/acre (± 1.20) compared to 1.30 tons/acre (± 0.50)

obtained outside; an increase of 65 percent on yield. The variety Imperial Star, planted only inside, produced an average of 3.0 tons/acre (± 1.0). The varieties produced aesthetically pleasing fruits in both locations (Table 5).

Table 5 – Average production and average increase in production of artichoke and eggplant grown inside high tunnels. University of Wyoming R&E Center, Powell, WY - 2013.

Crop	Variety	Outside			Inside			Production Increase		
		Fruit (#/Plant)	Size (lb/fruit)	Yield (tons/A)	Fruit (#/Plant)	Size (lb/fruit)	Yield (tons/A)	Fruit (#/Plant)	Size (lb/fruit)	Yield (tons/A)
Artichoke	Green Globe	1.5	128.2	1.5	4.8	113	4.4	68	-14	66
Egg Plant	Big Dragon	3.3	71.7	1.8	16.3	94	12.7	80	23	86

Other crops, such as Cantaloupe, Cucumber, Squash, and Watermelon were planted either outside or inside only so comparison was not possible. Also, the number of plants of each crop was limited and proper statistical analysis was not possible.

Major Finding

Within a crop, yield was significantly different between varieties, type, and between location (inside/outside). For all crops, production inside high tunnel was by far higher than outside. All varieties produced aesthetically pleasing fruits.

Major Constraint

Establishment outside, some disease problems, and irrigation and fertigation needed some attention.

Other Outcomes

“Expose vegetable growers to high tunnels and their advantages and management. This was accomplished with the organization of high tunnel tours and high tunnel workshops. Those activities attracted as many people as producers attending the field day of the R&E Center, the latter highlighting several major crops in the region. High tunnel production and environmental measurements were demonstrated during a Field Day on July 17. Also, a workshop on construction of high tunnels was led by J. Edwards on July 23-25. A High Tunnel Handbook (Panter, K.L., S.M. Frost, J.M. Edwards, R.P. Belden, A. Garcia y Garcia, and A. Mesbah) containing several articles featuring results from this project and others around the state was published by UW-Extension. A PDF copy of the bulleting can be found at: www.wyomingextension.org/agpubs/pubs/B1234.pdf.

“Increase the number of farmers market and the diversification of their produce.” The number of farmers markets in the area did not increase. Although we are aware of one specialty crop producer who has increased his operation from 2 hoop houses to 9 and is offering a greater variety of produce we do not feel we have enough information necessary to determine whether this statement was accomplished on a broader scale.

“Contribute and/or donate excess fresh produce to the community food banks.” Fresh produce was utilized to prepare food during workshops. Excess produce was also provided to senior citizens in Powell and Cody area.

BENEFICIARIES

Results from the project will directly benefit local producers in the region, master gardeners, students, and researchers. Over the 3-year project, the 2011 Field Day, the 2012 Workshop & Tour, the 2013 Field Day and a Workshop brought together more than 120 people, most local producers from the region and some from as far as Montana. We strongly believe our visitors were convinced on the potential benefits of high tunnel production in the region. During 2012 and 2013 we also had students from the Agroecology program of the Northwest Community College visiting the high tunnels as well as some students from the University of Wyoming during the R&E Center field day. Last, but certainly not least, our research has generated a considerable amount of biophysical information that is being analyzed to determine the potential for a peer review publication.

LESSONS LEARNED

- High tunnel production is well suited technology for Wyoming conditions
- Strong Wyoming winds can damage hoop houses
- Over three high tunnel shapes used, the gothic style showed to be prone to damages due to wind
- Considerable gains on growing season length were observed. For conditions in Powell, WY activities in the HT may start as early as mid-March and may end as late as mid-November, practically doubling the length of the average growing season for field crops
- Organic fertilization showed to be difficult because of limitations of local residue for composting



Due to weather conditions, some problems with crop establishment were experienced outside. Also isolated problems related to diseases and physiological disorders were also observed outside and inside (Figure 3). We also had some minor issues with irrigation frequency and fertigation.

Most of the problems showed in figure 3 seem to be related to blossom-end rot a physiological disorder associated with a low concentration of calcium in the fruit that affects tomatoes, peppers, and eggplants. Calcium is required in relatively large concentrations for normal cell growth; its deficiency may be caused by low soil calcium (low soil pH), poor watering (drought stress or excessive soil moisture fluctuations may reduce uptake and movement of calcium), and over application of ammonium fertilizer (rapid vegetative growth), among other factors (<http://ohioline.osu.edu/hyg->



fact/3000/3117.html and <http://extension.missouri.edu/p/m170>). As mentioned, the issues experienced with irrigation water management and fertigation may have contributed to this problem.

figure 3 – Isolated problems observed outside and inside the high tunnels. University of Wyoming Research & Extension Center, Powell, WY. 2013.

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