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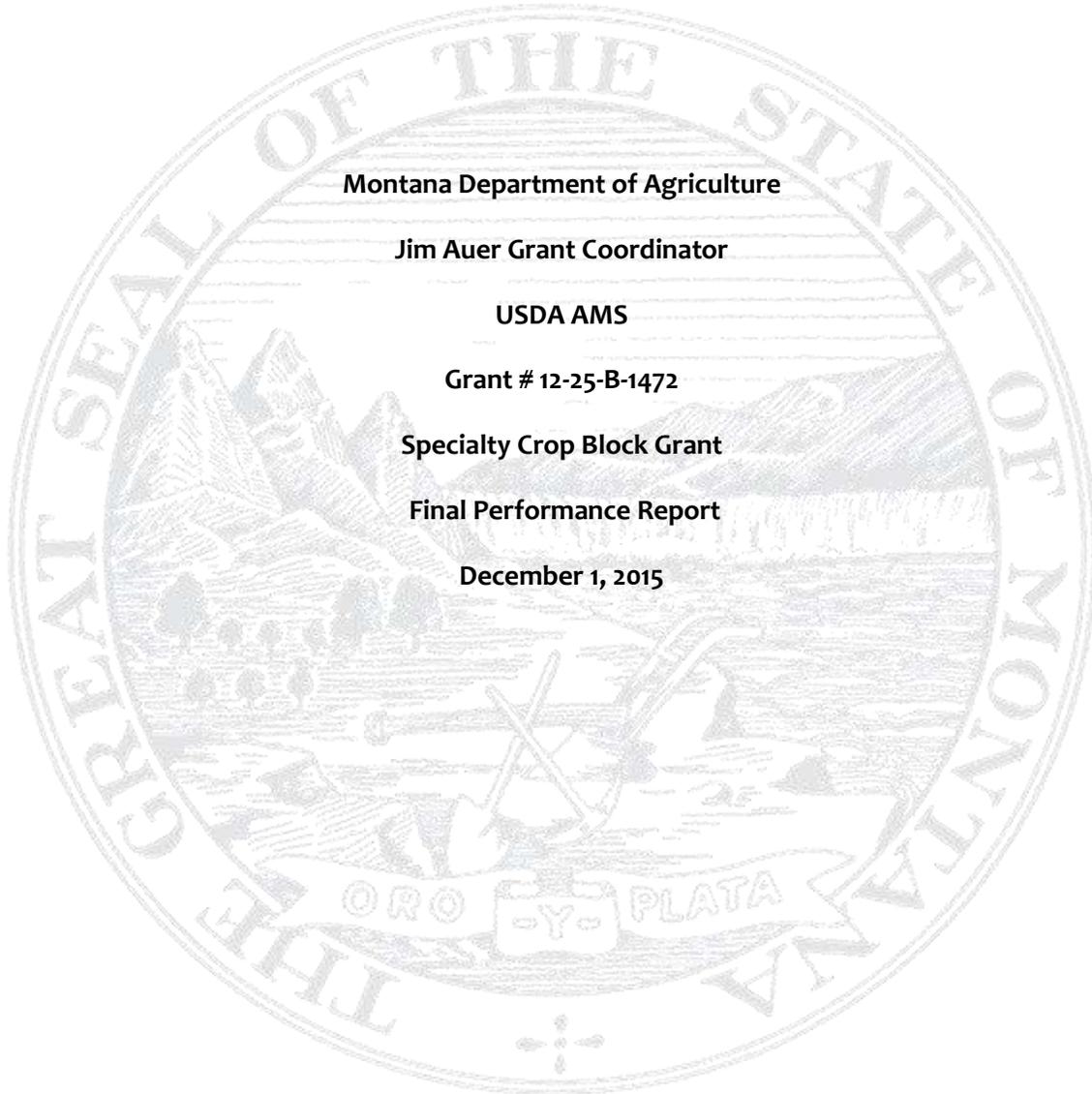


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Management of Ascochyta Blight in Lentils

Final report accepted March 2015

Project Summary

Ascochyta blight of lentil (caused by *Ascochyta lentis*) is considered one of the major threats to production as we grow more lentils in Montana. In a survey of North Dakota and Montana, Michael Wunsch (NDSU-Carrington) found *Ascochyta* on lentils in all major lentil production regions at low levels, and at moderate to high severity in several fields in Daniels and Valley Counties in Montana (See 'Identification and management of *Ascochyta* blight of lentil' at <http://www.ag.ndsu.edu/carringtonrec/documents/plantpathologyrd/noyeardocs/CHICKPEAAscochytagmt.pdf>). In addition, as more lentils are grown in the state and have been submitted for seed testing at Montana State, we have been detecting increasing amounts of *Ascochyta* in the seed, indicating that disease has also been increasing in frequency in the crop itself (Table 1). This is to be expected as more growers with little knowledge of anticipating and managing disease raise the crop. Many of the varieties commonly grown in Montana are susceptible to *Ascochyta* blight. For example, one of the most widely planted varieties, CDC Richlea, is very susceptible to *Ascochyta* blight.

This project is very timely because *Ascochyta* blight is very common in lentil fields, but often goes unrecognized and undetected. The disease spreads from farm to farm by seed, but within a farm spreads from field to field from infected residue.

This project has not been previously funded by SCBGP or SCBGP-FB.

Project Approach:

A field was identified near Richland, MT with a high level of infection with *Ascochyta* blight (*A. lentis*) in 2011. The grower planted Richlea lentils immediately adjacent to this field in 2012. Fungicide-treated buffer strips were tested for their ability to control the spread of *Ascochyta* blight from lentil residues in the adjacent field. Treatment plots consisted of fungicide-treated buffers 270 feet wide, 90 feet wide, and 0 feet wide (non-treated control). All plots were 290 feet long by 360 feet wide. The trial occupied a 360-foot-wide and 2,640-foot-long strip immediately adjacent to the field where lentils were grown in 2011.

The use of a fungicide-treated buffer strip was not a successful strategy for managing *Ascochyta* blight in this trial. Although a gradient in disease incidence was observed along transects perpendicular to the field where lentils were grown in 2011, the gradient was very shallow, and disease incidence was still very high at a 380-foot distance from the field where lentils were grown in 2011 (Table 1). Yield differences were not detected across treatments. Seed transmission was lowered by fungicide application. The results has been accepted for publication as 'Lonergan, E., J. Pasche, L. Skoglund, M. Burrows. 2014. Sensitivity of *Ascochyta* species infecting pea, lentil, and chickpea to boscalid, fluxapyroxad, and prothioconazole. Plant Disease (accepted).'

This project did not benefit non-specialty crops.

We were very fortunate to hire a graduate of the PSPP department, Erin Lonergan, to do this work and are progressing quite rapidly. I anticipate we will have assays for each major class of fungicide by spring 2014 and publish the work in a peer-reviewed journal such as Plant Disease. We have already identified fungal isolates that are less sensitive to boscalid. Spore germination assays indicate *M. pinoides* (from pea) is less sensitive to boscalid than *A. lentis* (from lentil) and *A. rabiei* (from chickpea). The *M. pinodes* and *A. lentis* isolates were collected from seed grown last year (2013) and have potentially been exposed to boscalid use which may account for some of the insensitivity. The next step is to complete mycelial growth assays for strobilurin, SDHI, and DMI fungicides. After these baselines are developed we will have a lab assay to test strains for resistance to the widely used fungicide classes. We will provide this as a service to growers who submit seed for *Ascochyta* testing and provide recommendations as appropriate.

Goals and Outcomes Achieved:

Objective 1. Participate in a study to determine the spread of *Ascochyta lentis* from infected lentil stubble.

The field study was performed as described in the proposal. Briefly, a field was identified near Richland, MT with a high level of infection with *Ascochyta* blight (*A. lentis*) in 2011. The grower planted *Richlea* lentils immediately adjacent to this field in 2012. Fungicide-treated buffer strips were tested for their ability to control the spread of *Ascochyta* blight from lentil residues in the adjacent field. Treatment plots consisted of fungicide-treated buffers 270 feet wide, 90 feet wide, and 0 feet wide (non-treated control). All plots were 290 feet long by 360 feet wide. The trial occupied a 360-foot-wide and 2,640-foot-long strip immediately adjacent to the field where lentils were grown in 2011. No target was established for this objective.

Objective 2. Distribute information to growers on disease management including fungicide efficacy.

Due to the lack of positive results from the trial described above, we have focused efforts on education of growers about the role of fungicides for disease control and threat of fungicide resistance (Burrows, SCRI funded 2013 ‘Evaluation of the *Ascochyta*/*Mycosphaerella* Pathogen Complex in Chickpeas, Peas and Lentils for Resistance to QoI and DMI Fungicides’). During the grant period (1 May, 2012 to 31 Dec, 2013), the educational efforts listed below have reached 896 growers and agricultural professionals directly. No target was established for this objective.

Date	Title	No. Attendees	Event Title	Location
6/5/12	Central agent update	10	WTARC	Conrad, MT
6/19/12	CARC field day - plant disease	130	CARC field day	Moccasin, MT
6/22/12	Ag agent update	2	Agent update, JP and Ron C.	Dillon, MT

7/12/12	Diseases and fungicide use	30	NARC field day	Havre, MT
7/18/12	Pulse diseases	90	Pulse Tour	Richland, MT
7/19/12	Wheat diseases and fungicide use	50	Swank field tour	Poplar, MT
12/12/12	Pulse diseases in 2013	200	Northern Pulse Growers Association	Billings, MT
1/23/13	Disease update	20	Broadwater Co training	Townsend, MT
2/13/13	Pulse crop diseases	270	Pulse day	Conrad, MT
3/22/13	Disease management for Pulse Crops	14	AGSC 450 Plant Disease Control	Bozeman, MT
6/7/13	Montana Farm Bureau Tour of Clinic	60	Montana Farm Bureau	Bozeman, MT
6/12/13	Plant Disease	15	Sheridan Co Extension field day	Medicine Lake, MT
6/12/13	Plant Disease	5	Sheridan Co Extension field day	Plentywood, MT

Objective 3. Assess the impact of extension activities associated with this project.

The **target of this project was a 50% increase in knowledge** after a presentation by growers in the audience. Perhaps the most important impact of this work is the management practice we tested did not work and is not recommended for use. Since the research results did not directly result in a recommendation, extension activities have focused on general education. A survey conducted at the Richland Pulse Tour was conducted of 46 participants.

- 91% were more confident about recognizing plant diseases after the presentation,
- 97% indicated their management of pulse crop diseases would change after the presentation due to the knowledge they gained.
- 85% of participants indicated the knowledge they gained would increase the profitability of their operation.

Based on these results, although based on limited sampling, it is our belief that the target of this objective was successfully met.

Beneficiaries

The beneficiaries of this project were 896 growers and agricultural professionals who participated in classes, presentations and workshops presented by the researchers on the outcomes of this research. As the result of the study conducted showed that the proposed treatment was not effective, there is not per se a quantifiable economic impact that can be identified.

Lessons Learned

The insight was gained that, at least in this trial, the use of a fungicide-treated buffer strip was not a successful strategy for managing Ascochyta blight. This was an unexpected outcome and, as an effect, researchers did not train stakeholders on the use of a fungicide-treated buffer strip as a strategy for managing Ascochyta blight.

As a positive of this experience, it is now practical to train farmers that the use of a fungicide-treated buffer strip is not a practical strategy for managing Ascochyta blight. As a negative, this study did not result in a practical recommendation for farmers on the management of Ascochyta blight.

Contact Person

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Contract #	# 1450686		

Additional Information

Extension publications include:

- M. Burrows. 2012. Diseases of cool season legumes (pulse crops: dry pea, lentil, and chickpea). MSU Extension Publications. EB0207.
- M. Burrows and M. Wunsch. 2012. Pathology for pulses: Research and extension efforts in Montana and North Dakota. The Pulse Newsletter. Northern Pulse Growers Association.
- M. Burrows. Identifying and Managing Ascochyta blight. Take Your Pulse newsletter. US Dry Pea and Lentil Council.

A peer-reviewed publication also resulted from work associated with this effort, with an undergraduate student (Neuman) as co-author:

- Burrows, M., L. Neuman, L. Skoglund. 2013. Evaluation of seed treatment fungicides for management of Ascochyta blight in lentil, 2012. Plant Disease Management Reports. (submitted)

Fostering Local Fruit Production through Cultivar Research and Education

Project Summary

Montana's local food systems are largely void of fruit, with the exception of parts of western Montana. Very little fruit tree research and education has been conducted in the state. Consequently, MSU Extension has very few resources to assist the public in establishing and successfully growing fruit trees in Montana. There is a huge demand for locally sourced food, and

many of Montana's counties are considered food deserts. This is a huge issue for food security in Montana, and nutritious fruit is missing from many people's diets.

This project did not build upon a previously funded SCBG project.

Project Approach

The original plan was to establish 5 fruit tree research sites located across Montana. We were able to establish 8 fruit tree research sites with this grant. The sites include: Helena, Winston, Whitehall, Bozeman, Columbia Falls, Power, Hinsdale and Colstrip. The last site, which was the Whitehall location, was planted in the spring of 2014. Through the course of this project, we have learned much about establishing orchards in the varied microclimates of Montana. Every fall from 2013 to 2015, we have collected data at each site. We are currently working on finalizing a fruit tree production guide that will be distributed this winter. We held three fruit tree research field days in August, 2015 at the Helena, Whitehall and Bozeman locations. The Helena location had about 50 people attend. The Whitehall location had about 30, and the Bozeman location had about 30 people attend. We discussed proper planting techniques, vegetation management, pruning, fertility and the preliminary results of the cultivar performance. After the field days, we had follow up visits with several people who are looking at establishing orchards in the next couple of years.

Only specialty crops benefited from this project.

Significant contributors to the project included, Brent Sarchet – PI – organization and oversight of the project, Toby Day – Co-PI – assisted with gathering research data, education, and assisted with oversight, Shelley Mills – research partner – assisted in planting the trees and gathering data in Hinsdale, and Pat McGlynn – research partner – assisted in planting the trees and gathering data in Columbia Falls.

Goals and Outcomes Achieved

Objective 1) Establishment of 5 fruit tree research sites

- 8 research sites were established

Objective 2) Selection of desirable fruit tree cultivars (6 apple, 5 pear and 3 plum)

Successful cultivars included:

- Apple: 1.Honeycrisp 2.Goodland 3.Northern Lights 4.Sweet 16 5.Carroll 6. Zestar 7.Northern Spy 8.Arkansas Black 9.Prairie Magic
- Pear: 1.Golden Spice 2.Ure 3.John's 4.Patten 5.Luscious 6.Parker
- Plum: 1.Mount Royal 2.Toka 3. Pipestone

Objective 3) Completion of planting the trees and installing the irrigation systems at 5 locations

- Established 8 orchard locations with the last location completed the spring of 2014.

Objective 4) Collect data and monitor the 5 sites

- Collected 3 years of data on 8 locations; the results will be summarized in a publication to be distributed in the winter of 2015/2016.

Objective 5) Offer 6 workshops in different counties –

- Offered 8 workshops related to fruit tree production;
- no new orchards have been established as a result of the work that we are aware of, but there are orchards that are being planned for planting in the spring of 2016.
- Workshops included:
 - April 4th - Helena, Montana, "Fruit Tree Grafting and Cultivar Selection" - 20 people
 - April 18th - Hinsdale, Montana, "Fruit Tree Grafting and Cultivar Selection" - 15 people
 - July 23rd - Corvallis, Montana, "Introduction to the Montana Heritage Orchard Program and Fruit Tree Cultivar Research Project - Preliminary Results" WARC Field Day - 50 plus people
 - August 13th - Helena, Montana, "Preliminary Results of Fruit Tree Cultivar Research" Fruit Tree Research Field Days - 55 people
 - August 20th - Whitehall, Montana, "Preliminary Results of Fruit Tree Cultivar Research" Fruit Tree Research Field Days - 25 people
 - August 27th - Bozeman, Montana, "Preliminary Results of Fruit Tree Cultivar Research" Fruit Tree Research Field Days - 25 people
 - September 18th - Helena, Montana, "Introduction to the Montana Heritage Orchard Program and Fruit Tree Cultivar Research Project - Preliminary Results" MNLA Fall Tour - 50 plus people
 - October 20th - Bozeman, Montana, "Introduction to the Montana Heritage Orchard Program and Fruit Tree Cultivar Research Project - Preliminary Results" MSU Extension Annual Conference - 22 people

Objective 6) 1,000 copies of a Montana Fruit Tree Growers' Guide distributed –

- The publication will be printed and distributed in the winter of 2015/2016.

All objectives of this grant, except for distribution of the guide, have been accomplished. The Montana Fruit Tree Growers' Guide will be completed and distributed in the winter of 2015/2016.

As a baseline to this work, no fruit tree research sites existed and no one was conducting fruit tree research in the state. Not only are we now conducting research at 8 sites and have three years of data, we are also distributing that information to the public through workshops and a publication that will be finalized in the winter of 2015.

A major successful outcome of this project has been the establishment of 8 fruit tree cultivar research sites.

Beneficiaries

Beneficiaries included people who are interested in establishing orchards and current orchard owners are benefiting from this project. As a result of our work, we suspect that there will be at least 3 orchards established in the next couple of years. Orchards can have a significant economic impact especially in small communities in terms of jobs and revenue for the landowner, not to mention the health benefits to the local residents having access to the local fruit.

Over 262 people reached just through the workshops and presentations. If you include contact through media, it would be well over 10,000 people connected.

Lessons Learned

Conducting on-farm research has many challenges. The landowner is ultimately responsible for the orchard. Some landowners are more diligent about the orchard's care than others, and the results reflect some of that management variation. We had to replace many more trees the first couple of years than we had projected. Future work should plan for 10 to 15 percent replacement after year 1 and 5 to 10 percent after year 2.

The goal to have the publication completed by the end of the grant period was not achieved. The timeframe to put the publication together took more time than was originally planned, thus the reason the final publication will not be complete until the winter of 2015.

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Additional Information

None

Dry Pea Cultivar Selections for Starch Characteristics

Project Summary

Dry pea production acres have increased from 33,000 acres in 2003 to over half a million acres in 2014 (Montana Agricultural Statistics). Most of dry peas produced in Montana are exported to foreign countries. About 80% of dry peas imported to China were used for vermicelli production. Starch contents and characteristics affect the vermicelli quality and market. Therefore, it is important and timely to evaluate the starch characteristics of Montana peas and select suitable varieties.

In China, yellow pea starch as a substitute for mung bean to produce vermicelli noodles. Starch contents and characteristics affect the vermicelli quality and market. Great variations have been found in starch contents and characteristics in dry pea wild types and mutants. The objective of this project was to screen commercial varieties and populations of dry peas and select or breed dry pea cultivars with suitable starch characteristics for Chinese vermicelli production. According to the USDA-FAS GAIN Report, the average quarterly export of U.S. dry pea to China was 11,959 MT compared to 138,337 MT of Canadian dry pea in 2011.

Project Approach

1) Obtain dry pea populations and mutants

2) Plant the populations and mutants at the CARC near Moccasin, MT

In 2013, the PI obtained 10 pea advanced breeding lines, 31 commercial varieties, and 34 selected lines from breeding populations. These materials were planted at the Central Agricultural Research Center, near Moccasin, MT in April 2013 for agronomic evaluation and seed increase. The materials were harvested in July 2013 and samples were collected from each plot. The pea samples were ground to pass 1 mm screen for chemical analysis.

In 2014, the PI collected 22 pea advanced breeding lines, 35 commercial varieties, and 21 selected lines from breeding populations. Most of the entries were duplicates from 2013. These materials were planted at the Central Agricultural Research Center (Carc). The materials were harvested in July 2014 and samples were collected from each plot. The pea samples were ground to pass 1 mm screen for chemical analysis.

3) Sample dry peas and extract starch

4) Laboratory analysis of starch characteristics

During the period from November 1, 2013 to September 30, 2014, resistant and digestible starch contents were analyzed on 76 samples collected in 2013. The resistant starch contents ranged from 1.2% to 9.2%, and the digestible starch contents ranged from 25.4% to 46.9%. There were variations among the entries, indicating genetic variations among the breeding materials and commercial varieties. Therefore, there is potential to select cultivars with desirable resistant and digestible starch contents.

Amylose contents were also analyzed on 117 samples collected in 2013. The amylose contents ranged from 9.0% to 19.5%. Variations were also found among the breeding materials in amylose contents.

During the period from January 2015 to August 2015, the pasting properties of starch from thirteen different dry pea cultivars, one mung bean cultivar, and two commercially available starches of pea and mung bean were measured using a Rapid Visco Analyzer. Results showed great variations among pea cultivars. The high amylose pea B10-10 had significant different characteristics from other dry peas. The pasting characteristics of dry peas were also found different from mung beans. We also measured textural properties of dry pea and mung bean starch gel. We found mung beans had lower hardness than most of the dry pea cultivars, except the high amylose variety, B10-10, which had lower hardness, cohesiveness, and springiness than mung bean and other dry pea varieties. In-vitro digestibility test indicated that there were significant varietal differences in slowly digestible starch and resistant starch.

5) Interview the vermicelli processors to match the starch characteristics with end user's specifications

The PI visited the pea starch processing facility in Qingdao, China from February 19 to February 25, 2014, and interviewed pea buyers and processors in China about preferred pea starch characteristics for Chinese vermicelli production. In Qingdao, China, the Double Towers company recently invested 0.5 billion Chinese yuans to build a pea starch and protein processing facility, which processes 300 to 500 MT yellow peas daily and produces 200 Metric Ton (MT) starch. Most of the yellow peas were purchased from Canada. Besides starch, the facility also extracts proteins and microfibers from peas. They prefer dry peas with high starch and protein yields. The starch must have high pasting/viscosity, high water absorbing capacity, flexible, and good taste.

6) Cultivar development and production of the desired dry pea cultivar(s)

The selected breeding materials were planted in April 2015 and harvested in 2015 to increase seed for further evaluation.

In summary, we found variations of resistant starch contents, amylose contents, and starch pasting properties and textural properties among the pea cultivars. The pea starch characteristics are different from mung bean. We found great variations in resistant starch and slowly digestible starch contents among the pea cultivars, which allow us to select cultivars for developing low glycemic index healthy

The overall scope of this project was entirely focused on dry peas.

Significant contributors to the project were Chengci Chen – project director, Aifen Tao – research assistant, and Yesuf Mohammed – research associate.

Goals and Outcomes Achieved

The ultimate GOAL of this project is to increase U.S. dry pea export to Chinese market through selecting cultivars with ideal starch characteristics suitable for Chinese vermicelli production. **The specific objectives are:**

1) Screen dry pea populations and mutants for digestibility, physical and structural properties of starch.

Achieved: We found variations of resistant starch contents, amylose contents, and starch pasting properties and textural properties among the pea cultivars. The pea starch characteristics are different from mung bean. We found great variations in resistant starch and slowly digestible starch contents among the pea cultivars, which allow us to select cultivars for developing low glycemic index healthy food products from pea starch.

Variety development and testing is a long-term measure, and this PI has been working with pea breeders in developing new varieties. We have made good progress in selecting cultivars that can adapt to Montana environment and meet buyer's preference.

2) Interview Chinese end users to identify the dry pea starch specifications for vermicelli production

Achieved: The PI visited Qingdao, China from February 19 to February 25, 2014, and interviewed pea buyers and processors about preferred pea starch characteristics for vermicelli production. They prefer dry peas with high starch and protein yields. The starch must have high pasting/viscosity, high water absorbing capacity, flexible, and good taste.

Compared to the baseline, the body of knowledge existing prior to this research, our pea variety evaluation research, including statewide variety trials and quality testing, has contributed to pea industry in Montana. Farmers at different geographic regions chose different varieties based on the adaptation of the varieties in their regions and buyer's preference for the product quality. The variety selection by farmers is in line with our research results on commercial varieties. However, the new

variety development task cannot be accomplished during this project time frame. We have selected elite breeding lines, which have been screened at Moccasin, MT, but it will be a few more years down the road before a new variety with superior yield and quality can be released to farmers in Montana.

In quantifiable terms, 22 pea advanced breeding lines, 35 commercial varieties, and 21 selected lines from breeding populations were selected for testing. 76 samples collected in 2013 with resistant starch contents ranging from 1.2% to 9.2%, and the digestible starch contents ranged from 25.4% to 46.9%. Amylose contents were also analyzed on 117 samples collected in 2013 ranging from 9.0% to 19.5%.

Additionally, the following presentations were made regarding the project:

- 1) Central Agricultural Research Center 2014 Field Day on June 23, 2014, about 100 people attended.
- 2) 2014 Montana Pulse Day on December 5, 2014, about 250 farmers and industrial representatives attended.
- 3) Richland county on-farm crop tour on July 1, 2015, about 60 farmers and industrial representatives attended.
- 4) Northern Agricultural Research Center 2015 Field Day on July 2, 2015, about 300 people attended.
- 5) Eastern Agricultural Research Center 2015 Field Day on July 14, 2015, about 110 people attended.
- 6) Central Agricultural Research Center 2015 Field Day on July 16, 2015, about 100 people attended.
- 7) Western Triangle Agricultural Research Center 2015 Field Day on July 17, 2015, about 70 people attended.

It is worth to mention that, since 2013, the dry pea market has shifted from starch-based to protein-based market. The Chinese processors have extracted proteins from pea grains as primary products and starch became the secondary product, because protein has higher market value than starch.

Beneficiaries

Beneficiaries were Montana pea growers, U.S. dry pea processors, and foreign pea buyers. The following data were gathered from farmers at the 2015 annual field day:

- **Farmer A** in **Valley County** grew 550 acres **CDC Golden** in 2013, 1150 acres **CDC Meadow** in 2014, and 1050 acres **CDC Meadow** in 2015.
- **Farmer B** in **Valley County** grew 1400 acres **CDC Meadow** in 2013, 1400 acres **CDC Meadow** in 2014, and 1400 acres of **CDC Meadow** in 2015.
- **Farmer C** in **Daniels County** grew 1200 acres **CDC Meadow** in 2013, 1200 acres **CDC Meadow** in 2014, and 1200 acres **CDC Meadow** in 2015.
- **Farmer D** in **Roosevelt County** grew 1300 acres **CDC Meadow** in 2013, 1300 acres **CDC Meadow** in 2014, and 1300 acres **CDC Meadow** in 2015.
- **Farmer E** in **Judith Basin County** grew 300 acres **Montech 4152** in 2013, 300 acres **Montech 4193** in 2014, and 300 acres **Montech 4152** in 2015.
- **Farmer F** in **Pondera County** grew 150 acres of **Aragon** in 2014, and 1100 acres of **Aragon** in 2015.

- **Farmer G in Toole County** grew 1000 acres of **Montech 4152** in 2013, 975 acres **Montech 4153** in 2014, and 1200 acres of **Montech 4154** in 2015.
- **Farmer H in Sheridan County** grew 500 acres **Delta** in 2013, 350 acres of **CDC Treasure** in 2014, and 450 acres of **CDC Treasure** in 2015.

Most of farmers answered that they have chosen those varieties to grow based on Montana State University variety evaluation report and the buyer's preference. These survey results indicated that farmers do follow the variety evaluation report generated from our statewide variety evaluation. Farmers at different geographic regions chose different varieties based on the adaptation of the varieties in their region and buyer's preference for the product quality.

Every year, results were presented to growers and industrial representatives at different field days, crop tours, and Montana Pulse Day. In 2014 and 2015, the following talks were given with more than 1290 attendees. The events included:

1. Central Agricultural Research Center 2014 Field Day on June 23, 2014, about 100 people attended.
2. 2014 Montana Pulse Day on December 5, 2014, about 250 farmers and industrial representatives attended.
3. Richland county on-farm crop tour on July 1, 2015, about 60 farmers and industrial representatives attended.
4. Northern Agricultural Research Center 2015 Field Day on July 2, 2015, about 300 people attended.
5. Eastern Agricultural Research Center 2015 Field Day on July 14, 2015, about 110 people attended.
6. Central Agricultural Research Center 2015 Field Day on July 16, 2015, about 100 people attended.
7. Western Triangle Agricultural Research Center 2015 Field Day on July 17, 2015, about 70 people attended.

Lessons Learned

Plant breeding and variety development is a long-term effort. Therefore, it is unrealistic to develop a new variety that is widely accepted by growers in three years of project duration.

An unexpected outcome during the project period was the shift in the pea market from a starch-based to a protein-based market. Therefore, the protein measurement component has been added to the project. This protein research has drawn attentions from the pea industry. The results will be presented in 2015 Montana Pulse Day conference in December 2015.

Although we couldn't develop a new variety during the project duration, we have reported the results of commercial varieties to growers, which have guided growers for selecting varieties for their farms.

A lesson learned was that, due to the market changes during the project period, we added a protein measurement component into the project. This protein research is important and timely, and will create additional impact to the pulse crop industry.

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Additional Information

Two manuscripts were prepared for journal publication, and results from this study will be presented at 2015 Montana Pulse Day conference, where more than 200 growers, buyers, and processors are expected to attend.

Polymerase Chain Reaction Protocols/Procedures for Potatoes

Project Summary

There were two aspects to this project, first was to equip the potato testing lab at Montana State University with a Real-Time Polymerase Chain Reaction (PCR) instrument to expand their ability to test for potato disease and second, to perform testing to establish whether seed potatoes sold to home gardeners are serving as an entry point for potato disease into the state.

Montana employs the most intensive testing program for seed potatoes in the nation but, the purchase of a real time PCR instrument increased the capacity to perform rapid pathogen identification for a wider range of organisms. This enhanced the diagnostic accuracy of the program and significantly reduced the cost to producers for testing. Montana seed potato growers produce at least 10% of the seed potatoes in the United States on a yearly basis, and many other states rely on Montana Seed for growing for re-certification in their state. Better diagnostics have allowed Montana producers to respond to pest management issues more rapidly and effectively, benefiting potato production for the entire nation.

The need to ensure that home growers are using certified seed potatoes is rooted in the fact that Montana has a closed system for the production of seed potatoes. This helps protect our industry from the importation of diseases from outside Montana. One exception is that seed potatoes from outside MT can be sold as garden seed with the only requirement being that they are certified by another state agency, and that they are grown in an area without late blight. In random testing of seed potatoes sold through garden centers, we have detected as much as 60% Potato Virus Y (PVY). Considering we have a closed system, it is plausible that the avenue for import of these strains has been from garden seed.

This project is timely because real-time PCR has become the standard for diagnostics of plant pathogens. It is also important to know if garden seed could be harboring pathogens such as late blight and powdery scab. In Montana, we have had 3 outbreaks of late blight, approximately 10

years apart, and have not been able to document where the inoculum came from. Since powdery scab is not currently found in seed potato fields, it is important to determine if there is future risk from the import of garden seed, before an outbreak occurs.

This project built on two previous SCBG projects:

Project 1 – Adopting real-time PCR protocols for disease testing, optimizing potato micro-tuber production and updating the seed potato certification database to facilitate end-user compliance with Good Agricultural Practices.

Project 2 – Increasing planting of Montana Certified seed potatoes in home gardens in Montana.

Project Approach

In the first year of the project, we proof-tested real-time PCR protocols for 8 pathogens, and conventional PCR protocols for 5 pathogens. For bacterial ring rot which is caused by *Clavibacter michiganensis*, we had tested 3 different primer sequences and protocols. A significant impact of this project is that due to an outbreak of BRR in Idaho and the Columbia Basin in 2013, we were required (on very short notice) to test seed that was being sold to customers in ID, WA and OR. Because we had already adopted the protocols in our lab, we were at an elevated state of readiness to do this testing efficiently and in a timely manner.

In the spring of 2013, a survey of Garden Seed Potatoes was performed on 56 samples representing 36 varieties of potatoes originating from 13 different vendors from California to Maine. Of these samples, 50% had detectable PVY with values ranging from 1.45% to 94.75%. 39% of the positive samples were identified as the strain PVY:NTN which causes tuber necrosis. While we have this strain in Montana, it is at a much lower incidence, and any new introductions in seed potato producing areas is detrimental to farmers likelihood of producing seed within certification tolerances. Of the samples with virus, over half were over 10%. Considering that PVY multiplies in the field at an average rate of 10X during the growing season, it is reasonable to assume that gardens planted with these seed potatoes will have 100% PVY before the end of the growing season. All samples were negative for late blight and powdery scab. PCR assays were run for bacterial ring rot (*Clavibacter michiganensis*) due to an increase in this disease in our region. The results of the Garden Seed Survey were reported to the MPIA Research Committee and to all seed potato growers at the MPIA Growers meeting in November.

Presentations at MPIA reached approximately 100 potato growers in total.

In March 2014, we obtained DNA extracted from Columbia Root Knot Nematode (*Meloidogyne chitwoodi*) from Dr. Axel Elling at Washington State University. This DNA was used as test material for evaluating a real-time protocol for detection of the nematode. The real-time PCR protocol of Zijlstran and Van Hoof was successful and the presence of *Meloidogyne* DNA was confirmed. If a suspect nematode infected tuber is submitted to the lab, we will use this DNA as a positive control.

During the summer of 2015, it was brought to the certification programs attention that *Dickeya dianthicola*, a pathogen that causes blackleg type symptoms on potatoes in Europe, was discovered in the US. All certification labs were encouraged to adopt PCR assays for this pathogen. We obtained a protocol from University of Wisconsin along with positive controls for the pathogen. We have proof-tested the assay and are getting the appropriate results with the positive controls. It is highly important that we have this assay working because there will be an elevated interest in identifying the causal agent for any potatoes with blackleg symptoms.

Significant contributors to the project included the Montana Potato Improvement Association, Potato Lab staff, Larry Krum from the Montana Department of Agriculture, and MDA phytosanitary inspectors.

The addition of the PCR instrument to the lab has been a major success. Last year we performed real-time PCR tests on nearly 8000 dormant potato tubers and we performed over 700 tests for bacterial ring rot. The lab charges the growers at cost resulting in testing fees that are at least 50% less than any other lab, either commercial or private. All of the protocols used have been proof-tested in the lab and are readily available in the volumes of manuals that have been developed. By having this instrumentation in place and developing a working expertise in realtime PCR, the potato lab were able to quickly adopt a protocol to detect a new pathogen of importance in the United States (*Dickeya spp.*).

Goals and Outcomes achieved

Outcome Performance Measure	
1) Efficiency and price of performing diagnostic tests that we previously contract out or purchase kits.	Thanks to the addition of the PCR instrument, the lab has been able to charge the growers at cost, resulting in testing fees that are at least 50% less than any other lab, either commercial or private.
2) Number of diseases that we are able to identify on a routine basis using real-time PCR	We have developed a PCR procedures manual that includes protocols for over 20 different pathogens and for differentiating strains of PVY. This manual is used on a daily basis in the lab.
3) Disease status of imported seed potatoes	In the spring of 2013, a survey of Garden Seed Potatoes was performed on 56 samples representing 36 varieties of potatoes originating from 13 different vendors from California to Maine. 50% had detectable PVY, 39% of the positive samples were identified as the strain PVY:NTN. Samples tested in 2014 showed 50% of the seed lots containing PVY with the majority at very high levels and the strain PVY-NTN in over 40%. In 2015 samples 46% of the samples tested positive for PVY and two samples showed ring rot.

No long term outcomes were included in this project.

Quantifiable outcomes

- In 2013, we proof-tested real-time PCR protocols for 8 pathogens, and conventional PCR protocols for 5 pathogens.
- For bacterial ring rot, which is caused by *Clavibacter michiganensis*, we had tested 3 different primer sequences and protocols.
- In the spring of 2013, a survey of Garden Seed Potatoes was performed on 56 samples representing 36 varieties of potatoes originating from 13 different vendors from California to Maine.
 - Of these samples, 50% had detectable PVY with values ranging from 1.45% to 94.75%.
 - 39% of the positive samples were identified as the strain PVY:NTN which causes tuber necrosis. Of the samples with virus, over half were over 10%.
- During the winter and spring of 2014 we obtained more samples of garden seed potatoes from throughout the United States, mostly through mail order sources.
 - The results were very similar to 2013 with over 50% of the seed lots containing PVY with the majority at very high levels.
 - Of additional importance, we identified the strain PVY-NTN in over 40% of the seedlots from Colorado.
- During the spring of 2015 we obtained 24 samples of garden seed from throughout the United States and tested them for PVY, PVX, bacterial ring rot, powdery scab and late blight.
 - 46% of the samples tested positive for PVY and of these samples, the average amount of PVY was 41%.
 - We detected Bacterial Ring Rot in two samples.
- Through adoption of numerous PCR protocols of important potato pathogens we have reduced diagnostic time from 2 weeks, if we had to send samples to an outside lab, down to 1-2 days by performing the assays in our own lab. This is useful for improving our response time to diagnostic samples submitted by growers and also has improved our routine testing of our potato mother stock.

Beneficiaries

All growers benefited from the Potato Lab's readiness to perform 100's of realtime PCR assays for bacterial ringrot. They were required to perform the test to fulfill contractual agreements starting in 2013. If we wouldn't have been able to perform the testing, samples would have been sent out of state at a cost of at least 2X what the Potato Lab charged. Demonstrating the poor quality and high disease incidence of garden seed coming in from Montana enhances our ability to market Montana Seed Potatoes within our state. In the future, it could enhance our ability to market our seed potatoes for the garden seed market outside Montana.

At least 48 family seed potato farms which produce >\$40 million in direct seed sales benefited from this project. Readiness to respond to testing requirements of the industry at low cost enables them to be profitable. Home gardeners throughout the state have been informed of the disease problems from out-of-state seed in the article on Montana Seed Potatoes published in Big Sky Small Acres.

Lessons Learned

The fact that we received two samples that were positive for bacterial ring rot led to the development of a new policy on handling out-of-state potatoes. All samples from outside Montana

will be opened in the Schutter Diagnostic lab and samples for testing will be processed there. We do not plan on doing any more testing of garden seed from outside Montana!

We didn't expect the exceptionally high demand for the realtime PCR service by our lab. We knew it was the state-of-the art for diagnostics but didn't realize the extent that we would perform such a high volume of tests in the short term.

Contact Person

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Additional Information

The publication, "Planting Certified Seed Potatoes" can be found at <http://www.msuxextension.org/BSSA/Articles/2015/SpringSummer/PlantingCertifiedPotatoes.pdf> Spring/Summer edition of Big Sky Small Acres. Additionally, the www.mtseedpotato.org website for selling Montana Seed Potatoes to retail vendors was funded through 2013 SCBG.

Promoting the Production and Consumption of Organic Lentils in Montana through Culinary Collaboration and Innovation

Project Summary

This project focused on increasing the production and consumption of organic lentils in Montana.

Though Montana is a top producer of both conventional and organic lentils, the quantity of organic lentils produced is relatively small (2% of all production)¹. Organic lentils are imported to satisfy U.S. demand, creating an opportunity for Montana growers². In addition to being an economic opportunity, lentil production has the potential to improve soil and disrupt weed and disease cycles when rotated with the production of grains³.

In Montana, lentils are underappreciated and under-consumed. Consumption of lentils is healthful and can address a variety of diet related issues common in Montana including diabetes and obesity⁴. For example, Lentils have higher protein content than other legumes, and are an excellent source of fiber, iron, folate, and other micronutrients. Lentils are gluten and soy free, have a low glycemic index, and are very satisfying. For both professional and home chefs, lentils are an economical and versatile ingredient for soups, salads, entrees, and desserts⁵. Project partners addressed the goal of increased production and consumption of organic lentils through the following objectives:

1. Create opportunities for collaborative relationships among organic lentil producers and chefs.
2. Provide training for Montana's dietetic professionals on the benefits of organic lentils.
3. Create new visually appealing marketing materials for Montana's organic lentils.

Through increasing the production and consumption of organic lentils in Montana, this project benefitted Montana's organic lentil industry, producers, chefs, dietetic professionals, and consumers.

This project was timely because organic lentils have the potential to become an important part of a Montana food system strategy for increased self-reliance and food security, and improved public health. Increased production and consumption would result in ecological benefits (soil health), economic benefits for producers and restaurateurs, and health benefits for consumers. In addition, the state will enjoy the economic impacts of growing markets.

Project Approach

In the first year (2013) we developed a slide presentation, drafted a lentils guidebook and planned 3 conventions that occurred in **Year 2 (2014)**:

1. **February 24, Helena.** One three-hour workshop was held in Helena for producers, chefs and distributors who were already working with lentils or had expressed interest in doing so. A one hour presentation and a working draft of the guide were offered. Participants were broken up into groups based on topics of production, processing and distribution, nutrition, and culinary. Each group was tasked with focusing on the guide's topic area and offering modification, with one of the four team members mediating. Overall, the workshop proved successful in developing relationships between producers, distributors and chefs, as well as for providing constructive feedback of the guide. Approximately 20 attended.
2. **May 30, Billings.** The revised lentil guide was offered alongside a keynote presentation at a gathering of dietitians at the annual Food and Nutrition Conference and Exposition (FNCE) of the Montana Academy of Nutrition and Dietetics (MTAND) in Billings. The presentation and introduction to the lentil guide was followed by a sampling of several lentil recipes. Approximately 50 attended. Additionally, the current class of the Montana Dietetic Internship (18 future dietetic professionals) were presented with the lentil guide and benefits of lentil consumption; during the internship orientation, the lentil guide was also presented to the Montana State Prison with encouragement to incorporate lentils into the menu cycle.
3. **June 17-18, Great Falls.** This training occurred at the annual meeting of the Montana School Nutrition Association (SNA). We conducted a 3-hour pre-conference workshop/training and an additional 1-hour break-out session with nearly final electronic and print materials, and provided instruction related to preparation of lentils, along with sampling of recipes. Approximately 30 attended each of two events at this conference. The pre-conference training offered more focus on the cooking properties of lentils and the logistics of incorporating lentils into a large scale production. Efforts were made to cover the system approach of lentils from production to consumption with emphasis placed on areas of audience interest. This session was composed of foodservice workers from 19 different towns across Montana. Participants were asked to break into groups and brainstorm ways to incorporate lentils into current menu items. The groups reconvened and shared ideas as a whole. Among them were lentil burgers, lentil hummus and adding lentils to tacos and burritos. Several questions arose about incorporating lentil flour into baked goods, and as a result, the guide was modified to address these specific questions.

Surveys: At both events in Billings and Great Falls, a survey was conducted among participants. The responses were resoundingly positive. Out of a total of 75 completed entries, 57 percent determined that the information provided during the presentation was useful. 88 percent marked that they were either 'Very Likely' or 'Extremely' likely to implement lentils into their practice or professional setting.

Further, 95 percent indicated that they would ‘Probably’ or ‘Definitely’ try one of the recipes provided in the presentation or printed guide. Based on the completed surveys and the feedback from attendees at the presentations, it is our impression that we have succeeded in meeting our initial objectives of this project.

In Year 3 we finalized our publication: “Lentils: Gems in the Treasure State” and made it available online at no-charge at this web site:

<http://www.montana.edu/hhd/documents/facultyandstaff/publications/lentilbooklet.pdf>

The slide presentation was presented at one additional convention: the Montana Organic Association’s annual conference, Dec 4-6 2014, in Great Falls. 20 people attended

Additionally, we have partnered with the MSU University Foodservice to host the “Lentil Rush: A Celebration of Montana’s Gems” at Montana State University in Bozeman. Additional project partners included the Sustainable Food & Bioenergy Systems Degree program, Towne’s Harvest Garden, the Alternative Energy Resources Organization, and the Gallatin Valley Farm to School Program. The event included a series of lectures including an agronomist (Perry Miller), a nutrition scientist and project partner (Michael Fox), a lentil processor and project Partner (David Oien), and author of the recently published book, “Lentil Underground” (Liz Carlisle). Approximately 150 students, faculty, staff, and community members attended.

In year 3 we conducted a follow-up survey with year 2 workshop attendees (dietitians and school foodservice managers). Two-thirds of the 15 respondents indicated that they have been able to implement use of lentils into their practice either somewhat or to a great extent. Two-thirds of respondents sometimes or frequently refer to the lentil guide we distributed. About 80% of respondents found the information in the lentil guide valuable or very valuable. The workshop changed participants’ enthusiasm about lentils for 87% of respondents. Additional information desired includes additional recipes and more information about obtaining lentils and lentil flour in foodservice quantities. Though our survey response rate was only 28%, it appears that participants did find the workshop and lentil guide information valuable and have to some extent be able to implement use of additional lentils in school foodservice.

This project focused solely on promoting the production and consumption of lentils.

This project had three project partners: Alison Harmon (at MSU with her team of 3 graduate students), David Oien of Timeless Seeds, and Anna Jones-Crabtree of Vilicus Farms. Anna Jones-Crabtree was instrumental in reviewing the project products including the slide presentation and the lentil guidebook. She provided contacts for producers so that they could be included in conventions. David Oien likewise was a critical partner in identifying both producers and chefs and additionally participated in all presentations made at conventions to provide the lentil producer and processor perspective, and to serve as an exhibitor. Alison Harmon and her team of graduate students developed the draft slide presentation and lentil guidebook and finalized these with input from the other project partners.

Goals and Outcomes Achieved

We planned to conduct two conventions and one training for dietetic professionals. In total, we conducted 5 conventions (including one training for dietitians, and one training for school foodservice managers). We developed one slide presentation related to lentils in the food system, and one comprehensive booklet titled: “Lentils: Gems in the Treasure State”

Goal: 30 participants at each convention; 100 dietitians

Actual: 20 participants at first convention, 50 dietitians, 60 school foodservice managers, 20 participants at MT Organic Association, 280 attended the Lentil Rush Event.

Goal: 75% of attendees would taste lentils

Actual: 100% of attendees tasted lentils at each event

Goal: Surveys indicated increase in lentil interest

Actual: Respondents indicated usefulness of training and materials and increased interest in lentils

Goal: Follow-up survey increase in lentil interest

Actual: Follow-up surveys indicated that participants had tried and offered lentils

Goal: 20 profiles of chefs and farms in booklet

Actual: The booklet provides profiles of 2 chefs and 2 farmers, as other kinds of informative content were prioritized.

Goal: 500 copies of booklet disseminated

Actual: 200 hard copies of the draft were disseminated at conventions, 100 pages providing the booklet electronic link were disseminated once finalized. The link has been disseminated on-line and on listservs to more than 2000 individuals.

Goal: Lentils booklet available on 5 web sites

Actual: The booklet is referenced on multiple web sites, and is available for download on 3 web sites.

Beneficiaries

Lentil producers, processors and distributors benefitted from the improved awareness about the health benefits and culinary uses of lentils among school food service directors, dietitians, and consumers (those three groups were also beneficiaries). A conservative estimate would be 7 lentil producers, 3 processors and distributors, 60 school foodservice directors, 50 dietitians, and countless consumers (minimum of 300). We anticipate seeing improved sales of lentils to restaurants, institutional foodservices, and to other retail outlets as a result of this project.

Lessons Learned

The biggest challenge of the project was the difficulty of convening multiple kinds of food system stakeholders at one event—we did this at our first convention, which was a mixture of producers, chefs, processors, distributors, food service etc. We also did this at the last event (the Lentil Rush).

The other educational sessions were more focused on dietitians exclusively, foodservice exclusively, and Montana organic producers.

An unexpected outcome was the significant amount of interest in the nutrition and culinary uses of lentils among food and nutrition professionals. They are literally hungry for more information, which should encourage additional SCBG projects in the future.

The only outcome measure that wasn't addressed in a significant way is the networking among producers and chefs. We did succeed in improving overall awareness about the virtues of lentils to all of our audiences.

The Lentil Rush celebration was both educational, encouraged mixing of all food system stakeholders and was a surprising amount of fun. We completely filled the venue with participants, and had to turn away additional guests. This kind of collaboration could be a model for future events that celebrate agriculture, specialty crops, health, and excellent food.

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Additional Information

Lentil Book: <http://www.montana.edu/hhd/documents/facultyandstaff/publications/lentilbooklet.pdf>;

Lentil Rush Celebration: <http://calendar.msu.montana.edu/events/14774>

Lentil Underground: <http://lentilunderground.com/>

Timeless Seeds/Lentil Underground: <https://www.timelessfood.com/lentil-underground/>

References:

¹USDA National Agricultural Statistics Service: Montana's Rank.

http://www.nass.usda.gov/Statistics_by_State/Montana/Publications/Annual_Statistical_Bulletin/2011/rank.pdf & Montana Department of Agriculture Organic Certification Program. <http://agr.mt.gov/organic/info/02Montana.pdf>

² USA Dry Pea & Lentil Council. <http://www.pea-lentil.com/core/files/pealentic/uploads/files/Chapter3.pdf>

³ Montana State University MontGuide: Growing Lentils in Montana.

<http://www.co.yellowstone.mt.gov/extension/ag/pubs/mt9615.pdf>

⁴ USA Dry Pea & Lentil Council. <http://www.pea-lentil.com/>

⁵ USA Dry Pea & Lentil Council. <http://www.pea-lentil.com/>

Educating the Food Industry on the Benefits of Pulses as Food Ingredients

This final report was submitted in Montana's SCBG 12-25-B-1472 Annual Report, submitted 12/31/13.

Contact

USA Dry Pea & Lentil

Mackenzie Femreite

Project Summary

The USA Dry Pea and Lentil Council (USADPLC) believes that international and domestic trade will be enhanced with continued promotion of pulses as ingredients in value-added foods. Over the last few years, the Council has partnered with various universities and technical food research firms to explore the functionality of pulses from the whole, dry form to processed flour form. The Council is seeing an increased awareness and demand for pulse flours from the food industry; however, there is still a lack of complete understanding of the functionality of pulse flours in value-added food items. Having supported the technical research and product development efforts listed below and established the technical pulse processing methods ideal for commercial food use, the Council now seeks to further EDUCATE professionals in the food/foodservice industry.

Recent Technical Research and Product Development Efforts		Data and Information Derived
1. Identified US Pulse Quality Characteristics		Color size, shape, consistency, etc.
2. Evaluated Physical and Chemical Properties		Micro-nutrient and Macro-nutrient profiles
3. Established Cooking Properties and Cooking Parameters		Cooking times, soaking times, water absorption
4. Established Pulse Flour Milling Processing Techniques		Optimal mill type, sieve size, milling time, shear rate, speed
5. Tested Flour Functionality and Established Flour Specifications		Shelf life testing, applicability in different food systems raw vs. pre-cooked flour
6. Developed over 35 Pulse-based Product Prototypes		Food-service scale formulations, formulations for biscuits, cookies, muffins, breads, tortillas, nutrition/power/energy bars, dry starch mixes, flatbreads, pizza crusts, vegetarian spreads, sauces, etc.
7. Researched Impact of Pulses on Health and Wellness		Consumer-friendly recipes and brochures
8. Development of a Technical Manual for Pulses		Comprehensive reference material for food industry professionals

Food Industry professionals are interested in receiving more technical and nutritional information about novel uses of pulses. The Council has introduced new formulations for pulse-based product prototypes to food industry professionals at trade shows across the country, and the feedback received on their taste and texture has been highly positive.

However, distributing the technical information in its current form as reference material would prove ineffective at prompting the immediate adoption of pulses as ingredients. The use of pulses as value-added ingredients is still a relatively new concept, so there is still a need to educate the industry on how the technical properties of pulses function as ingredients.

As part of the strategy to drive usage of products, the USA Dry Pea & Lentil Council hosted an educational Trends Tour and Culinary Course prompting the immediate adoption of pulses as ingredients. The Trends Tour and Culinary Course focused on promoting new product development of pulse-based foodservice products and the execution of improved market development for the region's pulses. Key USADPLC cross-functional team members and foodservice professionals (food processors and manufacturers) participated in a 1 ½ -day Chicago-based trends tour and culinary course highlighting a number of retail culinary outlets. As planned by Culinary Sales Support, Inc. (CSSI), with regard to team objectives, the tour focused on a combination of both out-in-the-field trend tour and culinary course work.

Trend Tour - Tour participants visited a variety of venues in the Chicago area, including: key chains, notable local restaurants, and contract feeding locations with a large variety of pea, lentil and chickpea offerings to gain greater perspective for alternative culinary developments, serving styles, varieties and menu trends in the pea, lentil and chickpea arenas. Trends observed on the tour were then put to practice by attendees via a hands-on culinary demo stations.

Culinary Course - Utilizing USADPLC Members, foodservice professionals and CSSI Chefs and CSSI Registered Dietitians, culinary courses educated participants on the outlined objectives. Elements of the culinary course included: lecture, round-table discussion and culinary demonstrations.

The goal and objectives of this project are as follows:

Goal: To increase the usage of dry peas, lentils, and chickpeas as ingredients in a variety of value-added food products.

Objective: To **EDUCATE/TRAIN** professionals of the food industry of the *benefits* of pulses:

1. **Nutritional Attributes** – Dry peas, lentils, chickpeas, and their flours are high in protein and fiber, low in sodium, fat, are cholesterol-free and are rich in vitamins and minerals.
2. **Health Benefits** – Consumption of pulses is associated with lower risk of heart disease, diabetes and some cancers. One serving provides about 25% of the daily requirement for fiber.
3. **Functional Properties** – Dry peas, lentils and chickpeas, as ingredients, have unique properties that function and improve not only the nutritional quality of conventional foods but also texture, absorption, gelling of food systems.
4. **Innovation in Product Development** – Increased consumption of dry peas, lentils and chickpeas will only be stimulated by educating the food industry on novel

applications for pulses, and increasing their availability on RTE consumer products.

5. **Gluten-Free Ingredient** - Dry peas, lentils and chickpeas are naturally gluten-free. Gluten-free food options have gained status as the number of people aware of the association of gluten with Celiac disease increases.

A similar project was submitted by the Washington Dry Pea & Lentil Commission (member of the USA Dry Pea & Lentil Council) to the USDA/AMS Federal State Marketing Improvement Program, which was awarded funding in 2008. The Montana SCBGP pursued a similar project in FY 2012. As indicated in both FY 2008 and FY 2012 final reports, the activity was well attended, well received and very successful.

Funding this project for FY 2013 did not duplicate efforts, but rather built upon previous efforts of educating an additional full class of food industry participants who are keenly interested in learning more about the versatility and functionality of pulses as ingredients. Research and development of food products can take several years to complete. As such, continual efforts of education are critical to the successful development of new value-added food products. This course also spotlighted novel applications of functional ingredients, including fiber and starch extracts.

PROJECT APPROACH

Strategy

Trends Tour - Tour locations highlighted unique combinations and breakthrough/standout versions of impactful menu items throughout the Chicago area. To conclude the course, the group participated in a debrief session to review what was observed and tasted throughout the full-day tour, with observed trends being put to practice via hands-on culinary demos in the kitchen.

Culinary Course – Targeted participants included food processors, manufacturers and registered dietitians that benefit from the expertise of USADPLC members, CSSI chefs and market trend professionals. The culinary course set the stage for the trends tour and culinary demonstrations that utilized course content. Follow-up materials provided attendees with increased understanding of dry peas, lentils and chickpeas recipe concepts that could be easily implemented through knowledge acquired from the culinary courses and hands-on experiences.

Planning

❖ Venue and Date

The first step was to secure a location for the culinary course. The USADPLC began working with CSSI in summer of 2012, and after reviewing the accommodations of CSSI, previous culinary work and the culinary scene that Chicago has to offer, the USADPLC decided to host a trends tour and culinary course at CSSI. The CSSI offices were secured for July 12, 2013. This location was chosen for a variety of reasons:

1. It is an attractive location for food industry members.
2. It is an attractive location for technical and culinary speakers.
3. The facility is equipped with the staff, classroom and kitchen facilities necessary to fulfill the full requirements of the course.
4. CSSI has contacts with several food manufacturers, restaurant operators, well-named speakers and chefs.
5. CSSI provided outreach to targeted contacts, created the curriculum for the course, researched locations for the trends tour, chose the guest speakers and compiled the information used for the course manual, trends tour booklet and recipes. This course manual was distributed to all participants of the course.

Photo: Culinary Sales Support, Inc. offices and kitchen in Chicago



❖ **Program**

The next step was to plan the program and develop the curriculum. The final schedule for the course can be found in Appendix A. The focus of the course was to provide education to targeted members of the food industry regarding health and nutrition, value-added products, foodservice trends, gluten free issues as well as how DPLCs are being presented on menus at restaurants and other foodservice locations. Therefore, the culinary course schedule included; registered dietitians, market researchers, crop specialists, and R&D chefs. The trends tour locations included: a contract feeding location, restaurant chains and single independent restaurants.

❖ **Curriculum development**

In order to develop the curriculum for the course, Ali McDaniel consulted with culinary and technical experts at CSSI and Northern Crops Institute as well as pulse industry members and other staff at the USADPLC. The course curriculum was also structured so as to incorporate feedback from a previous course in 2012 held at the Culinary Institute of America (CIA). The focus of the curriculum was educating attendees on nutritional and functional benefits of pulses, as well as innovative ways to use dry peas, lentils, chickpeas and their fractions in food applications. In order to accomplish this goal, the menu items featured at the course

showcased items that would translate well into value-added applications such as baked items, entrées for frozen meals and snack food products. The course was split into two types of learning: lecture style classes and culinary demonstrations. CSSI provided a course binder containing comprehensive information presented by the guest speakers as well as a trends tour booklet with comprehensive information and discussion questions for the locations that were visited. These binders and trends tour booklets were printed and given to each participant as a take-away resource.

For the trends tour locations, CSSI researched locations that were featuring dry peas, lentils and chickpeas (DPLC's) in an innovative way and menuing DPLC's in multiple applications. We were able to interact with key decision makers, head chefs and staff regarding the importance of DPLCs in the featured cuisines, the versatility of DPLC's on the menu and innovative menu items that were in development. For the culinary demos, each station featured a different recipe and product. Pea protein was used to make a breakfast smoothie, raw lentils were cooked and shown as a meat extender in tacos, chickpea flour was used to batter chicken to make a healthier fried chicken, pea flour was used to bake gluten free cookies, and pea starch was used to thicken soup. Participants were able to interact with CSSI Chefs, CSSI Registered Dietitians and technical experts from Northern Crops Institute throughout the hands-on portion. This allowed for non-structured interaction between participants and instructors on how best to incorporate dry peas, lentils and chickpeas into their product line.

❖ **Speakers**

A list of the final speakers and topics is shown below. Each speaker's biography can be found in Appendix B.

- **Introduction to the USADPLC** Ali McDaniel, Food Marketing Manager, USA Dry Pea & Lentil Council
- **Nutritional Value of Peas, Lentils, and Chickpeas** Marie Molde, Registered Dietitian and Katy Martin, Registered Dietitian, R&D Chef
- **Value-Added Products 101** Thunyaporn Jeradechachai (Naggie), Crop Quality Specialist, Northern Crops Institute
- **Foodservice Industry Trends** Laura MacPhail, Principal, The Hale Group
- **Celiac and Gluten Free Informational Session** Lara Field, MS, RD, CSP, LDN, University of Chicago Celiac Disease Center

❖ **Promotion and Execution**

- Website Development
 - The URL www.pealenticulinarycourse.com went live in May to help promote the course. The site included details on the date, time, and location of the event as well as speakers, topics and information on how to register for the course. Participants were able to register directly on the site which was linked to an excel

spreadsheet to keep track of the registrants. Once an application was submitted it was reviewed by USADPLC staff for acceptance. All applicants were notified within 5 business days on the status of their application (accept or deny). This allowed the USADPLC time to assess the quality of the applicant. Once the participants were notified of their acceptance, they were instructed to confirm their attendance with Ali McDaniel and proceed with making their own travel arrangements.

- **Trade Shows** were also used to help promote the course. USADPLC attended key industry trade shows throughout the year where they promoted pulse crops as ingredients. At these shows product samples were made available for tasting, informational brochures handed out, and the culinary course information provided. Below are a few of the key shows at which the course was promoted.
 - **Research Chefs Association** - USADPLC staff and CSSI Chefs attended the Research Chefs Association annual conference in Charlotte, NC March 6-9, 2013 where 1,200 research chefs and R&D professionals were in attendance. The USADPLC partnered with Northern Pulse Growers Association to sponsor the Regionals Breakfast where approximately 500 attendees gathered Friday morning. Attendees were treated to red lentil ginger porridge, a chocolate protein breakfast smoothie, breakfast strata with eggs, chickpeas and butternut squash and breakfast enchiladas featuring chickpea flour tortillas (Potapas™) and pardina lentils. The USADPLC also exhibited a booth where a snack pot featuring chickpeas, pardina lentils and beluga lentils and a red lentil coconut curry soup were served for sampling. Several attendees stopped by the booth to express their enjoyment of the items served at the breakfast. They were genuinely surprised and excited about the versatility of pulses. There was a lot of interest in the course and several attendees specifically asked to be included in the mailing list for the culinary course.
 - **National Restaurant Association Show** USADPLC staff and CSSI Chefs attended the NRA Show in Chicago, IL May 18-21 where over 2,000+ exhibitors and 62,000 foodservice professionals go every year to learn the latest and greatest in the restaurant world (new products, services, equipment, etc.). Attendees include representatives from 98% of the Top 50 chains, 94% of the Top 100 chains and 82% of the Top 200 chains. Samples at the USADPLC booth included a chickpea gazpacho and a gluten free pasta salad featuring red lentil pasta.
- **Save-the-Date E-blasts** were created and sent out to a targeted list of participants.
- **Save-the-Date Cards and Invitations** were designed (Appendix C) and distributed at industry trade shows.
- **Surveys** were created and distributed at trade show events to gauge interest and to collect additional contacts.

Invitees were directed to the course website for more details and the registration page. Applicants filled out a form (Appendix E), which helped to shape some of the course content. A total of 30 applications were received and all were accepted after the review process (Table 1). Of these applicants 6 were unable to attend due to last minute circumstances; these are marked with an asterisks below. For all subsequent courses the USADPLC plans to implement a policy where participants leaving early or cancelling last minute will have to reimburse the USADPLC for their spot in the course (which is currently free to participants), except in extreme cases. This will help to ensure that all participants stay throughout the duration of the course as well ensure they do take a spot from others wanting to attend.

Table 1: List of Trends Tour and Culinary Course attendees

First	Last	Company	URL	Title
Adam	Shaffer	Fuchs North America	Fuchsna.com	Food Scientist/Technologist
Steven	Thommen	Fuchs North America	Fuchsna.com	Food Scientist/Technologist
Jill	Biagi	Fuchs North America	Fuchsna.com	Sales Manager
Adam	Synogroun d	Fuchs North America	Fuchsna.com	Sales Manager
Michael	Haracz	Woodland Foods	Woodlandfoods.com	Research Chef
Charla	Draper	Hillshire Brands	Hillshirebrands.com	R &D/Scientific/Technical
Tim	Hsu	Campbell’s Soup	Campbellsfoodservice.co m	Research Chef
Marta	Busken	Illinois Valley Community Hospital	Ivch.org	Nutrition Specialist
Alex	Dalquist	Ruiz Foods, Inc.	Elmonterey.com	R &D/Scientific/Technical
David	Busken	Oak State	Oakstate.com	Director of Research/Technical Director
Jennifer Slagle	Talbert	Abelei Flavors	Abelei.com	Food Scientist/Technologist/Fo od Engineer
Lidia	Olenczuk	Pacific Atlantic		Nutrition Specialist
Daniel	Best	Best Vantage Inc.	Bestvantageinc.com	President
Kristen	Johnson	Meijer	Meijerhealthyliving.com	Nutrition Specialist
Brian	Junkins	Jaali Bean	Jaalibean.com	Co-Founder, President
Max	Maxwell	Glanbia Nutritionals	Glanbianutritionals.com	Other

First	Last	Company	URL	Title
Josh	Patel	Creative Food Consulting, LLC	Creativefoodconsulting.com	Innovation Director
Taras	Remeniuk	Herbco International Inc.	Herbcointl.com	R&D, Test Kitchen Chef
Marie	Jirsa	Hillshire Brands	Hillshirebrands.com	R&D, Test Kitchen Chef
Monila	Junkins	Jaali Bean	Jaalibean.com	Chief Food Officer & Co-Founder
Kevin	Bull	Wixon, Inc.	Wixon.com	Senior Buyer
Kantha	Shelke	Corvus Blue LLC	Newhope360.com	Journalist / R&D
Shawn	Pinsky	MXO Global Inc.	Tolerantfoods.com	VP of Operations
Peter	Valkenber	Morrison Healthcare Food Service	Compass-usa.com	Corporate Executive Chef
Michael	Panfil	Business Excellence/Compass	Alltogethergreat.com	Corporate Executive Chef
Upasana	Abbott	NOW Foods	Nowfoods.com	R&D New Product Manager
Maribel	Alchin	Meijer	Meijerhealthyliving.com	Healthy Living Advisor
Ken	Woroniecki	Woodland Foods	Woodlandfoods.com	Corporate Executive Chef
Kaye	Effertz	Northern Pulse Growers Association	Northernpulse.com	Food Marketing Manager
Naggie	Jeradechac	Northern Crops Institute	northern-crops.com	Crop Quality Specialists

- ❖ **Significant Contributions** - The USA Dry Pea & Lentil Council’s mission is to promote dry peas, lentils and chickpeas through industry education, market development, research coordination and government affairs. The USADPLC is committed to the development of the pulse industry in the Northern Plains region and demonstrated its commitment to this project by providing matching and in-kind contributions totaling \$6,000. The dedication and expertise of the Council, its industry members, expert speakers and venue partners who were actively involved in the planning created an opportunity for the project to meet all goals and expectations.

Goals and Outcomes Achieved

Overall, the course was very successful in meeting the goals and objectives set forth by the USA Dry Pea & Lentil Council. All of the participants left the course feeling very enthusiastic about the possibility of using more pulse based ingredients in their product lines. Participants were all very complementary of the course and the information gained throughout the course. The main goal of this course was to EDUCATE the food industry on pulses as ingredients and 100% of participants that

completed the survey had an increased knowledge of pulse ingredients after the course. The Council has completed 18 ingredient sample and information requests. The post survey was sent to participants early September and revealed that 77% of the participants are in the process of developing at least one new pulse product as a result of the course. The other 25% still had an interest in incorporating pulses within the next year. These findings are very encouraging and help the USADPLC to know that the course was indeed successful at achieving its goals. Several other benchmarks were included to help determine the success of the course and these are outlined below.

- ❖ **Completed surveys, course registration and company representation** - Participants of the course were from some of the top food companies in the US including companies such as Campbell's Soup, Morrison, Compass Group, and Hillshire Brands (see Table 1 for complete listing). The fact that these companies decided to spend money and time to send their employees to this event tells us that they too see the value in pulses as ingredients. Having even one product come out of this course within such high profile companies would have a significant effect on increasing domestic pulse usage and there is a strong possibility we will see even more products than that.

In order to help us determine the success of the course and the format, surveys were administered to participants at the end of the day. Examples of these surveys can be found in Appendix E.

Sample comments regarding the best part of the event:

- Excellent facilities!
- Excellent well thought out and organized culinary tour/trends. Overall information about elements and opportunities to educate key consumers about pulses and their benefits.
- Looking forward to continuing relationship with pulse team and information on products.
- Overall really liked the program and appreciate the opportunity of attending.
- It was perfect. Very impressed. Happy I attended. Will attend again.
- The food demonstrations, culinary trends and seeing all of the new foods out there. I loved the speakers and all the expertise they brought.
- Visiting restaurants that featured pulses and the cooking demos.
- Seeing for myself the extent of trendy restaurants serving peas and lentils. Good info on celiac. Good cooking ideas!
- The multi-disciplinary approach to the presentation of the data/trends.
- Practical uses for pulses in culinary product development.
- The culinary tour was very good! Also I really enjoyed the group discussion.
- Learning so much about diversity of pulses.
- Great presentation - Talks - Demos and most of all FOOD!
- Restaurant tour - provided real-world examples and showcased flavor profiles.
- The interaction between others interested in pulses and the technical presentations.
- Conference was very well done!
- I look forward to cooking with these product ideas the next stage of commercialization.

Sample comments on ways to change the day:

- Nothing really! Everything was terrific.

- Would have found hands on session beneficial. However adjustment to visit the demo station was a better fit for available timeline.
- Maybe a little more round table discussions (time permitting).
- Extend it to 4 days. Give out recipes.
- It may have been helpful to hear from some suppliers to understand their needs and concerns.
- A lot of food - but of course I wouldn't have had to eat all of it!
- Eat less.
- Maybe little more time in food demonstrations, needed recipes for demos.
- More discussion on the products commercially available and pricing/costs as food ingredients compared to replacement items.
- Held questions until end of presentations.

From the comments you can see that overall the feedback was very positive; however, there are also some very constructive points to be considered for subsequent courses.

❖ **Course Interaction** - Attendees were given the opportunity to network beyond the culinary course and trends tour.

- A welcome reception was held at bellyQ restaurant where appetizers featuring peas, lentils and chickpeas were served. Items included; Hot & Sour Lentil Soup Shooters, Chickpea and Lentil Mini Club, Sweet Rice and Lentil “Risotto,” Split Pea Cakes, Pea and Yuzu Hummus with Middle Eastern Flatbread, Three Bean Salad with Edamame, Chickpeas and Lentils.
- A final dinner was held at Little Goat Diner featuring items such as chickpea fritters and kalbi beef ribs served with lentils. Little Goat Diner is owned by winner of season four of Bravo’s “Top Chef”, Stephanie Izard. Having a celebrity chef cooking a private dinner using pulses adds another level of interaction and interest.

Beneficiaries

US Growers: According to the USDA/NASS 2011 production numbers, U.S. growers harvested 920,500 acres of dry peas, lentils and chickpeas accounting for ~550,000 metric tons of product. Montana represents approximately half of overall pulse production (~460,000 harvested areas), making Montana the number one pulse producing state in the nation. Production of dry peas, lentils and chickpeas has doubled in the past five years, and there is tremendous opportunity for additional growth. Moving more pulses into the domestic market would decrease grower and processor transportation costs significantly, thus increasing profitability to the growers and processors of Montana. The Council also has the opportunity to expand the international market by promoting the U.S. pulses as ingredients to India and China. Although the course focused on domestic trade, several of the companies in attendance represent global brands.

Montana Agriculture: The continuous expansion of pulse acres has helped Montana’s agriculture excel. Pulses serve as excellent rotational crops that fix nitrogen in the soil. In addition, pulses break grain disease cycles, which help to increase the yield of wheat and other major cereals.

The primary beneficiaries of this project will be nearly 1,300 U.S. pulse farmers involved growing dry pea, lentil and chickpea crops. These crops represent \$382 million in direct and indirect farm income, including the significant benefits of increased yield and limited use of fertilizer in the rotations.

To date, the pulse crop industry has been successful in marketing the annual production through international food aid and international commercial markets. There is now an added need to develop value-added food/foodservice markets. Expansion of these markets would create new opportunities for the pulse crop industry and producers to diversify the marketing of pulse crops with a significantly higher value back to the producer.

Food service: Moreover the development of the foodservice market will create new opportunities for the expansion of the value-added companies in this region.

Value-added companies: New value-added companies will create increased opportunities for the producers in the area and enhance the value of their pulse crops.

Lessons Learned

The USADPLC staff worked very hard with CSSI to provide a custom program to trigger inspiration. This was the first 1-½ day course that the Council executed that had both in the classroom and out-in-the-field experience that covered a broad array of applications and culinary outlets. Through tasting delicious foods, learning how other restaurants are adopting pulses into their menus and receiving the technical education needed to work with pulses, this course served as a catalyst for participants to go back to their companies and enhance their dishes and menu options for their consumers and clients. The feedback and follow up with participants have all been extremely well received and the participants have requested to attend future trainings.

Availability, ingredient costs, cost reduction, nutrition comparisons were desired topics that were not covered by this course. Additionally, the course may need to be longer because time and schedule were frequent comments in the responses. These are instructive points and will be considered for subsequent courses.

The USADPLC will continue to follow up with the participants to track the development of product development work during the course of the next year. We hope to be able to continue listing success stories that have developed in part due to this course. Using the feedback from this year's course, the USADPLC hopes to continue assisting the product development efforts for value-added foods containing dry peas, lentils and chickpeas on the domestic market. Healthy food trends will continue to demand more of food companies, and the USADPLC feels that pulse ingredients are going to assist them in meeting these growing consumer demands.

Additional Information



Appendices A-E.pdf

Implement a Regional Market Campaign and Distribution Strategies that will Lower Costs and Increase the Consumption and Purchasing of Local and Region

Project Summary

This project also focused on keeping our regional food dollars circulating in our communities, increasing consumer knowledge of Montana specialty crops, and leveraging independent grocers' desire to carry more locally raised fruits and vegetables.

The concept for the project was developed over a two year period prior to implementation with the support of the Specialty Crop Block Grant. Influential to project development was a *Western Montana Local Farm & Food Economy* study conducted by Ken Meter of Crossroads Resource Center in 2011. The study found that residents in western Montana spent \$749 million a year purchasing food and approximately \$680 million of that was spent on food produced outside the region. The study also found that 73% of the regions farmers reported net losses in 2007 and earned \$76 million less in 2008 than they earned in 1969. One of the recommendations of the study was simple and doable: If western Montana consumers purchased only 15% of the food they needed directly from farmers in the region, this would create \$66 million of new wealth in the region.

A Five Valley Network Summit was held in March 2011, which invited partners from all sectors of western Montana's regional food system development. Participants identified a focused project that would increase awareness and education for western Montana consumers about the benefits of purchasing local fruits and vegetables. The group developed a regional marketing campaign to make shopping and supporting Montana specialty crops as simple as possible for consumers.

The Specialty Crop project targeted the need to build awareness of the benefits to purchasing local specialty crops and to assist growers in improving aggregation and distribution of specialty crops state-wide. In 2012, Lake County Community Development Corp's (LCCDC) farm to institution program had just started to gain some traction with the assistance of FoodCorps members. Second standard fruits and vegetables were leveraged as a way to offer lower cost produce for schools to

have processed. This portion of the project got back to basics in building capacity by reducing the overall cost of distribution with improved packaging that was uniform for warehouse and transport.

Timeliness

Two surveys conducted prior to the project noted that many independent grocers did in fact carry local items, but the stores did so marginally well. This indicated a desire from both sellers and buyers to support locally and regionally grown fruits and vegetables. Based on economic data from the Food & Farm Economy study, a targeted marketing campaign with local economic information was needed to change perceptions and resonate with the community. The data piece, “If western Montana consumers spent only 15% of their grocery budget on local food, it would generate \$66 million of new farm income in the region” was broken down into \$4.60 per week, per person. This was an impactful message that could be shared with consumers.

Project Approach

Goal 1- Increase the consumption and nutritional knowledge of locally and regionally produced specialty crops

Objective 1: To develop an effective market campaign that highlighted the nutritional, economic, and social benefits of purchasing locally and regionally produced fruits and vegetables,

Achieved: A Marketing Working Group was gathered and the campaign message was further developed. The marketing working group organized around an educational campaign targeting mainstream grocery consumers who shop at independently owned grocery stores.

Objective 1B: Link local schools and institutions into the distribution routes and hubs

Achieved: The current network of partner distributors, like Charlie's Produce and the Fish Company, is reaching grocery stores in various regions of Montana. Stores like the Real Food Store in Helena, 2Jays Market in Great Falls, and the Good Earth Market in Billings have all served as "food hubs" storing food for pickup from smaller schools. Because of Montana's remoteness, getting local food to some districts is very challenging and so this method of working with various locally owned grocery storage facilities with similar ideals has worked to some extent.

Objective 1B: MMFEC and Montana Schools are included in the distribution system drop off hubs

Achieved: Kalispell, Ronan, and Polson School Districts are all regular weekly distribution stops for the Western Montana Growers Cooperative (WMGC). Mission Mountain Food Enterprise Center (MMFEC) processes fresh fruits and vegetables throughout the week and WMGC makes pick-ups and deliveries to the schools every Wednesday. Most other schools served are on the way to these three main stops and orders can efficiently be added on in western Montana. Schools between Missoula and Kalispell are well served.

Objective 2: Design and publish market materials that meet the needs of regional retail grocers and effectively convey the regional market message.

Achieved: Campaign materials were designed and published that met the needs of regional retail grocers and effectively conveyed the regional market message. The campaign materials developed included an educational infographic that highlighted the economic, environmental, and health benefits of purchasing regional fruits and vegetables. The infographic also included a logo for consumers to look for when shopping. A point of display (POD) was developed with the logo to be placed in front of appropriate items. After piloting the program in Harvest Foods in Ronan, it was decided that a channel strip needed to be developed, as many tags did not stay well in front of the products. A tool-kit was also developed to give background on the project and basic information so that communities could bring the campaign to their local grocers.

Goal 2: Reduce costs and build efficiency in the aggregation and distribution of locally produced and processed specialty crops

Objective 1: Assist Western Montana Growers Cooperative and Flathead Cherry Growers Cooperative in improving aggregation and distribution of specialty crops through the Montana Food Corp program

Achieved: LCCDC assisted the Western Montana Growers Cooperative (WMGC) and Flathead Lake Cherry Growers Cooperative (FLCG) in improving aggregation and distribution of specialty crops through the FoodCorps program and other distributors such as Charlie's Produce. Produce processed and sales through the Western Montana Growers Cooperative (who also purchases cherries from the Flathead Lake Cherry Cooperative) increased each year of the project. In 2012 FLCG introduced its redesigned Montana Premium Box. The box was designed so it could be used in a retailer's Montana Cherry Display. Tim Hendricks, of Charlie's Produce, reported the following comment from store managers and customers. *"The Montana Black Boxes are a great way to separate the Premium fruit from anything else on the market."*

Objective 2: Reduce cost of distribution through improved packaging that is uniform for warehouse and transport and will promote WMGC cooperative members

LCCDC assisted to reduce cost of distribution through improved packaging that is uniform for warehouse and transport. This was done by researching and purchasing effective packing for mixed specialty crops that improved distribution efficiency.

This project did not benefit non-specialty crops, the marketing campaign was "Choose Local, Montana Fruits and Vegetables". Stores were directed to use the materials only for Montana specialty crops.

Goals and Outcomes Achieved

In October 2012 a Marketing Working Group was gathered and the campaign message was further developed. The marketing working group organized around an educational campaign targeting mainstream grocery consumers who shop at independently owned grocery stores. Campaign materials were designed and published that met the needs of regional retail grocers and effectively conveyed the regional market message. The campaign materials developed included an educational

infographic that highlighted the economic, environmental, and health benefits of purchasing regional fruits and vegetables.

LCCDC assisted the Western Montana Growers Cooperative (WMGC) and Flathead Lake Cherry Growers Cooperative (FLCG) in improving aggregation and distribution of specialty crops through the FoodCorps program and other distributors such as Charlie’s Produce. LCCDC assisted to reduce cost of distribution through improved packaging that is uniform for warehouse and transport. This was done by researching and purchasing effective packing for mixed specialty crops that improved distribution efficiency.

All outcome measures were achieved during the grant period.

Goals:

- 1) 20% increase in sales- \$720,000.00 25% increased sales of the Flathead Cherry.
 - Overall, sales were increased by over \$5,000,000
- 2) Decrease the number of residents not consuming adequate amounts of fruits and vegetables.
 - Data collected from the Behavior Risk Factor Surveillance System indicate that consumption of fruits and vegetables increased during the grant period as outlined in the tables below:

MT BRFSS for the Northwest Region, 2011 & 2013

2011		2013	
Fruit Intake	Percent	Fruit Intake	Percent
1+ Fruit/day	61.1	1+ Fruit/day	64.2
<1 Fruit/day	38.9	<1 Fruit/day	35.8

2011		2013	
Vegetable Intake	Percent	Vegetable Intake	Percent
1+ Vegetable/day	80.6	1+ Vegetable/day	82.6
<1 Vegetable/day	19.4	<1 Vegetable/day	17.1

- 3) 10% decrease in cost of distribution because of increased efficiencies.
 - Per Jim Sugarek of the Western Montana Growers Coop, *“In addition to organizational efficiencies, the packaging has improved sales and marketing. Efficiencies of stacking and labeling carry through to the cooperative’s wholesale customers. Custom printed produce ties promote the WMGC, Organic, and Homegrown produce and the individual farms all the way to the end user. Improved packing is improving the cooperative efficiencies, enhancing their reputation and promoting local foods, the coop and the farmers.”*
- 4) 25% increased sales of the Flathead Cherry through aggregation and distribution through Charlie’s Produce (\$125,000.00)
 - In 2012, sales exceeded \$284,526. Sales were \$275,814 in 2013 and \$153,594 in 2014 due to a smaller than average cherry harvest.

Some of the successful outcomes were outlined through conversation at participating grocery stores

The General Manager and the Assistant Manager from the Polson Super 1 noted that the store had “definitely” seen an increase in sales for Montana Specialty Crops, but that the advertising and signage had to be there for customers to take notice. “Folks are even willing to pay a little extra and

lean toward the local with the signs there labeling the product as local”. When asked why they thought there had been an increase in local produce sales, it was mentioned that there is a perception, whether it is entirely true or not, that local products are healthier.

The store manager from Withey’s in Kalispell, when asked if the store had seen a significant increase in local produce sales, said, “Definitely an increase... local folks and especially tourists are asking for local. They would rather buy local than organic. The signs have been a huge help. People from Eastern Montana have asked about the signs and I sent them to your website. People are willing to spend more on local products. It used to just be people in their 20s and 30s coming in and asking for these products, and now it is everyone, Grandmas, etc.”

The owner of Marketplace in Hamilton was interviewed along with his produce manager.

“When the campaign started two years ago, we didn’t even sell local produce. Now we do, as we’ve made it a priority. We gave the responsibility of ordering local to a different person. He has really taken off with it. He goes to all the farms that we source from in the Bitterroot to see their sustainable practices and he’s really built a relationship with the farmers. The farmers in the area have spread the word that Lee at Marketplace is someone that will buy local produce”.

When asked what he thought had contributed to this increase in sales, he said,

“The Choose Local Fruits and Veggies signage has really helped. We have posters everywhere and all of our local produce is labeled. Also there have a lot of other folks in the community that are trying to educate consumers about supporting local businesses. There is a radio ad that talks about how far a dollar goes in the local community when you spend it at a locally owned store rather than a chain. I think that has been helping folks connect the dots.”

Beneficiaries

While data was collected only through the Western Montana Growers Cooperative, there are many independent growers and distributors throughout Montana that have benefited from the Choose Local Campaign. Raising consumer awareness has helped farmers, consumers, and businesses all along the grocery supply chain.

Western Montana Growers Cooperative has 35 specialty crop producer/members who benefited from this project. These producers sold more of their specialty crop production through the cooperative as indicated by the increased sales of the cooperative. The Flathead Cherry Growers Association has 100 members and the overall benefit to the cooperative was substantial, with the increased sales of the product since 2011.

Lessons Learned

Turnover with store staff was a challenge for implementing a multi-year project such as this. It would have been wise to have the store sign a commitment form, and list who would be responsible for the

in store campaign if the original champion left. Working with the store to develop a local purchasing guide specific to their area, to assist the produce manager would have been a tremendous help.

One surprising outcome was the data collected for Mission Mountain Natural Foods, a health food store in Polson. The store experienced a decrease in local produce sales, while Polson Super 1, a traditional grocery store, experienced growth.

Not all stores experienced growth in local specialty crop sales. It seems that this had to do rather with store staffing and policies. This seems to be a common problem with “local” food system development that is focused on a “values” based food system. Once the “champion” leaves, there is often a vacuum and sales and interest drops off. Following up with such stores and institutions is much needed and a full time job. Again, a more formalized commitment could have made for better results in the stores that experienced a decrease in local produce sales.

Contact Person

Company/Organization Name	Lake County Community Development Corp		
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Additional Information

None

Production of Tetraploid Russian Olive (*Elaeagnus angustifolia*) for Use in Development of Sterile Horticultural Varieties

Project Summary

The escape and establishment of exotic plants from ornamental landscapes is causing significant ecosystem and environmental damage throughout the United States. These non-native plants have affected natural ecosystems in a variety of ways, including a reduction in diversity through the displacement of native species, reduced soil stability and water quality, interference with plant succession dynamics and wildlife habitat and foraging, and altered fire regimes and nutrient cycling. Economic costs associated with invasive plants total more than \$120 billion annually. Many of these exotic species, particularly among woody plants, originated as ornamental introductions.

Many of the most popular and profitable ornamental plants in the U.S. nursery industry are non-native plants that have become invasive. For example, in the western U.S. Russian-olive grows in a wide range of elevations from sea level to 8,000 feet. It can also grow without additional irrigation in climates with as little as eight inches of annual precipitation. Because of this adaptability it has become a popular ornamental as well as a valuable species for windbreaks, erosion control and creation of wildlife habitat. A number of state governments have banned, or are in the process of banning, the import and sale of invasive ornamentals, and Montana has now banned the sale of

Russian-olive. Fortunately, regulatory agencies are also recognizing the presence of the few low-fertility/sterile varieties that are available in the nursery trade and are making exceptions for these clones.

The goal of this project was to produce tetraploid individuals of Russian-olive that can then be used to breed sterile triploid clones. Because Russian-olive requires at least three years to produce flowers, the entire scope of this project is outside the time constraints of the Specialty Crop Block Grant Program. Therefore this project was directed at the most important and difficult portion of this process, the production of tetraploid individuals.

This project is timely because the banning of invasive ornamental plants is accelerating, greatly reducing the palate of usable plants. The availability of sterile, non-invasive Russian-olive cultivars will allow the use of this durable plant in areas where little else can be used for applications such as windbreaks, erosion control and creation of wildlife habitat. These varieties would also precipitate the elimination of fertile varieties from U.S. commerce.

This project is not built on a previous SCBG project.

Project Approach

1) Stratify Seed

Seeds of Russian-olive were obtained from several sources, and stratified for three months to allow for uniform germination. Germinating seeds were potted into containers in the greenhouse and the seedlings grown to approximately 12", at which time they could be used for treatments. Treatments were performed using 5 ml of the mitotic spindle inhibitor (MSI) treatment solution in a 50 ml conical centrifuge tube along with a control treatment of distilled water. Plant stems that had been trimmed-back to a node four days earlier to induce meristematic activity were inserted into the MSI solution, then placed into the dark for 24 hr. before being rinsed twice in distilled water and returned to the greenhouse.

2) Establish In-vitro callus cultures

3) Mitotic inhibitor treatments

Initial treatments of three MSI chemicals, colchicine, oryzalin and trifluralin, were performed on greenhouse-grown plants to determine an effective working range. These compounds were tested with and without the adjuvant dimethyl sulfoxide. It was determined that oryzalin and trifluralin were less reliable due to the low solubility of these compounds that resulted in generally poor and variable responses, even at relatively high rates. Therefore further treatments focused on colchicine.

Shoots were isolated in-vitro from five plants selected in the greenhouse for attractive foliage and good growth. Over an eight month period shoot cultures of these clones were stabilized to the point where they could be used for MSI treatments. It was determined that the best media for the production of shoot cultures for treatments was Woody Plant medium (WPM) supplemented with 1 μ M 6-Benzylaminopurine (BA).

The response of this species to these MSI chemicals was unlike any the PI has observed previously. Relatively low levels of MSI compounds resulted in significant damage to stems and buds and concentrations that did not result in tissue damage were so low that induction of tetraploid tissue did not occur. One-hundred and eighty-five treatments comprising 1,314 individual plant stems were performed over 10 months, without positive results (Table 1). All treatments were performed over a 24 hr. period in complete darkness. The PI's experience working with a number of other woody species found that a 24 hr. treatment period was generally most effective, and removing time as a variable allowed for less complicated experimental designs.

Table 1. Mitotic Spindle Inhibitor Treatments using Greenhouse Plants.

Number of Treatments*	Chemical	Concentration	Number of Tetraploid Shoots Obtained	Success Rate (%)
25	Colchicine	1 mM	0	0
30	Colchicine	3 mM	0	0
30	Colchicine	6 mM	0	0
25	Colchicine	12 mM	0	0
10	Trifluralin	50 µM	0	0
15	Trifluralin	1mM	0	0
20	Trifluralin	6mM	0	0
8	oryzalin	50 µM	0	0
10	oryzalin	1mM	0	0
12	oryzalin	6mM	0	0

* Treatments consisted of five to ten prepared stems placed into 50 ml conical centrifuge tubes containing the mitotic spindle inhibitor solution.

The ineffective response of greenhouse-grown Russian-olive plants to the MSIs prompted the focus of the project be shifted entirely to in-vitro tissue. These initial treatments using in-vitro shoots yielded responses similar to greenhouse-grown plants, with severe dieback and inconsistent bud response. However, preliminary MSI tests with callus showed promise. In-vitro callus treated with colchicine concentrations ranging from 1 mM to 12 mM demonstrated differential survival more typical of other woody species. Seventy treatments were then performed on callus from the five isolated clones (Table 2), using callus produced on WPM supplemented with 4 µM Thidiazuron.

Table 2. Mitotic Spindle Inhibitor Treatments using In-vitro Callus.

Number of Treatments*	Chemical	Concentration	Number of Tetraploid Callus Clumps Obtained	Success Rate (%)
10	Colchicine	1 mM	0	0
20	Colchicine	3 mM	1	5
20	Colchicine	6 mM	6	30
20	Colchicine	12 mM	8	40

* Treatments consisted of approximately 5 mm diameter callus clumps placed into 15 ml conical centrifuge tubes containing the mitotic spindle inhibitor solution.

4) Measure ploidy of treated tissues using flow cytometry

When performing MSI treatments on shoots, either in the greenhouse or in-vitro, putative tetraploid shoots can be readily identified. Because of the response of Russian-olive to MSI treatments on shoots, no tetraploid candidates resulted, and therefore flow cytometry was not performed on this material. Since the appearance of tetraploid callus is indistinguishable from diploid callus, flow cytometry needed to be performed on all callus clumps resulting from MSI treatments in order to identify tetraploid cells. Flow cytometric analysis revealed a total of 15 tetraploid callus lines produced from four of the five isolated clones.

Tetraploid callus lines were placed into two shoot-induction media, WPM supplemented with 1 μ M BA or 0.5 μ M meta-topolin (N⁶-(meta-hydroxybenzyl) adenine). Shoots have been regenerated from both types of shoot-induction media, and further refinement of this media and the rooting/acclimation of tetraploid shoots is ongoing.

No non-specialty crops benefited from this project.

Significant contributions were made by undergraduate students who performed MSI treatments on greenhouse-grown plants, provided required maintenance of these plants, and performed other miscellaneous greenhouse and laboratory duties. Dr. Hoch performed all in-vitro duties, including isolation and maintenance of callus and shoot cultures, MSI treatments on in-vitro material, and flow cytometry analysis on this tissue.

Goals and Outcomes Achieved

Goal: The new knowledge generated by this project will be used to increase public awareness of the environmental and economic costs associated with the invasiveness of Russian olive, and also provide information on the availability and use of the newly-developed sterile varieties. These goals will be achieved through a variety of local and regional presentations to public and industry groups.

Achieved: Presentations on Russian-olive were given to five public/professional groups:

- Noxious Weed Management Certification Program-Level 2; 4/2/2013; 26 attendees.
- Noxious Weed Management Certification Program-Level 1; 8/1/2014; 14 attendees.
- AGSC 441 Plant Breeding and Genetics; 4/13/2015; 11 attendees.
- HORT 447 Advanced Plant Propagation; 9/15/2015; 16 attendees.
- HORT 231 Woody Ornamentals; 8/26/2015; 28 attendees.

Retrospective survey questions were used to measure the participants' pre and post-presentation knowledge and awareness of the Russian-olive invasive problem and the environmental and economic impacts of this invasion, and their understanding of the availability and use of sterile, non-invasive varieties of invasive species. Of the 95 participants of these presentations, 88% indicated that their understanding of the impacts of Russian-olive was improved, 72% indicated that they were unaware of the efforts to develop sterile varieties of this invasive plant before the presentation, and 82% said they would utilize a sterile Russian-olive cultivar if one became available. **Overall, 100% of**

participants indicated post-presentation awareness and knowledge of the Russian-olive invasive problem, which meets the above 95% target for these surveys.

Presentations to public/industry groups will continue well beyond the granting period, and now that the project has produced positive results, this activity will increase. Two presentations have already been scheduled for spring 2016, and as this project progresses, interest will continue to build.

One hundred percent of the 95 individuals who participated in outreach activities indicated increased awareness and knowledge of the Russian-olive invasive problem and the related environmental and economic impacts, and an improved understanding of the availability and use of sterile, non-invasive varieties. In addition, the participants responded positively to the concept of sterile ornamental varieties, with 82% indicating they would plant a sterile clone of Russian-olive if it were available.

A total of 15 tetraploid lines of Russian-olive have been produced from four selected individuals. These tetraploid plants can now be used to breed triploid clones. The development of sterile cultivars of this ornamental will benefit the nursery industry in Montana and could save millions of dollars in removal and restoration costs.

Beneficiaries

Groups that will benefit from the development of sterile cultivars of Russian-olive include Montana wholesale growers and retail nurseries, Federal, State and local agencies, and organizations that are involved in the removal of invasive plant species from natural and agricultural area. Also, residents of the intermountain west region will benefit from the use of these varieties in areas where few other plants are available for use as ornamentals, windbreaks, erosion control and creation of wildlife habitat.

The availability of sterile cultivars of Russian-olive would benefit the more than 96 wholesale growers and retail nurseries in Montana and the over eight million residents of the intermountain west region. This project would provide unique cultivars of this useful ornamental for Montana nursery production that would be desirable in much of the U.S., and in many areas will be the only legally saleable varieties of this species. Therefore, these varieties can provide tens-of-thousands of dollars of new nursery sales, and because they will not contribute new invasive populations to the ecosystem, could save millions of dollars in removal and restoration costs.

Lessons Learned

Because this project involved several procedures that had yet to be performed on Russian-olive, a number of technical lessons were learned, including the best techniques for in-vitro shoot and callus culture, and MSI treatment techniques. These lessons may help future work with other related species.

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Additional Information

None