FY 2012 SPECIALTY CROP BLOCK GRANT PROGRAM- FARM BILL

North Dakota Department of Agriculture

FINAL PERFORMANCE REPORT
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PROJECT 1: Eliminating Sunflower Rust in Confection Sunflower through Aggressive Breeding and Isolate Identification

Final Report

Project Summary

Sunflower rust *Puccinia helianthi* is a serious disease that has been increasingly prevalent in much of the U.S. sunflower-producing region. Confection sunflower is particularly vulnerable to the disease because few rust resistance genes are available. Yield losses as high as 80% were recorded recently. Developing genetic rust resistance in confection hybrids is the most effective and economical solution for producers. This project is the last installment in an aggressive genetics project to integrate rust resistance genes into confection sunflower breeding material. The timeline for this work is on schedule and release of breeding material to the private seed industry will occur in early 2014. New to the overall four-year plan is the integration of multiple rust resistant genes pyramided or 'stacked' into a single host genotype to make resistance as sustainable as possible. This is critically important since the rust pathogen has a history of overcoming single gene resistance. The work is a continuation of our previous SCBGP funded project. In our previous project, we successfully transferred three rust resistance genes, R_2, R_4, and R_5, from oil sunflower into two acceptable confection genetic backgrounds. The proposed project will pyramid these genes with a new rust resistance gene in HA-R6 and create plants with more broad-spectrum and long-lasting rust resistance features. Each finished line will combine two rust resistance genes in a single genotype and make them available to the private seed industry for incorporation into finished commercial hybrids. The resistant genes will be molecularly 'marked' for ease of identity. Gene marking coincides with the National Sunflower Association (NSA) SNP Consortium. SNP is 'single nucleotide polymorphism', which is a new tool for sunflower geneticists and breeders. The NSA SNP Consortium is also a new addition to the original plan of this project. The SNP technology will significantly minimize the time requirement for backcrossing and integrating these resistant genes into sunflower hybrids for farmer use.

Project Approach

We have combined the rust resistance genes, R_2, R_4 and R_5 which are currently transferred to confection sunflower, with the new gene R_{13a} in HA-R6 to create new breeding lines with more broad-spectrum and long-lasting resistance features. Crosses were made between confection HA-R6 with homozygous confection lines carrying *R*-genes, R_2, R_4 and R_5, respectively. Approximately four generations (one cross and three selfing generations) with plant material containing two resistance genes were required for the final product. Pyramiding multiple resistance genes from diverse sources into a single host genotype reduces the possibility of resistance ineffectiveness resulting from pathotype evolution. However, the selection of individuals carrying several resistant genes is limited by classical breeding. The molecular markers developed from previous project provide a useful tool to select homozygous F_3 plants in this project. We continued to identify SNP markers associated with rust R-genes to facilitate the high-throughput selection. Each finished line combined two rust resistance genes together, such as $R_{13a} + R_2$, $R_{13a} + R_5$ or $R_{13a} + R_4$. We released the inbred lines by the early part of 2014. Stacking multiple genes leads to the simultaneous expression of more than one gene in a variety

to develop durable resistance. Use of the new germplasm will significantly reduce the occurrence of new rust disease pathotypes and resulting yield losses due to the disease. We continued to map new rust resistance genes in the lines RHA 397 and HA-R8.

Goals and Outcomes Achieved

The goals for 2013

1. Crosses of the confection lines carrying the genes R_2, R_4, and R_5 to the line HA-R6 were made in the 2012, respectively. Select F_1 hybrids using DNA markers linked to the genes R_2, R_4, and R_5 and advance them to F_2
2. Marker selection of homozygous F_2 plants combining two rust resistance genes and advance to F_3 generation
3. Grow homozygous F_3 families in Fargo field for agronomic performance
4. Greenhouse rust test of selected lines from 2013 field and prepare to release resistance inbred lines and publish research results
5. Molecular mapping of new rust resistant genes in the lines RHA 397 and HA-R8

Outcomes achieved

1. Select F_1 hybrids using DNA markers linked to the genes R_2, R_4, and R_5 and advance them to F_2

Crosses of the confection lines carrying the genes R_2, R_4, and R_5 to a confection line HA-R6 carrying the gene R_{13a} were made in 2012, respectively. The F_1 hybrids combined two genes, $R_2 + R_{13a}$, $R_4 + R_{13a}$, and $R_5 + R_{13a}$, were selected and advanced to F_2 generations.

2. Marker selection of homozygous F_2 plants combining two rust resistance genes and advance to F_3 generation

A total of 524 F_2 plants from the cross between the newly developed confectionary line, putatively harboring R_2 gene, and HA-R6 containing R_{13a} gene were screened by SSR markers, HA2077 and HT567 linked to R_2, and ORS316 and ZVG61 linked to R_{13a}. Eleven F_2 plants with the combination of R_2 and R_{13a} at the homozygous condition were identified and were advanced to F_3 generation.

A total of 368 F_2 plants from the cross between an R_5 line and an R_{13a} line were screened by DNA markers, ORS1197 and ORS653 linked to R_5, and ORS316 and ZVG61 linked to R_{13a}. Thirteen F_2 plants with the combination of R_5 and R_{13a} at the homozygous condition were identified and were advanced to F_3 generation.

From our previous mapping data, the genes R_4 and R_{13a} were placed on the same region of linkage group 13 linked to the common markers of ORS316 and ZVG61. Although the alleles amplified from the markers ORS316 and ZVG61 in R_4 and R_{13a} could be clearly discriminated between one another based on fragment sizes, we still cannot rule out the possibility that R_{13a} may be an allele of the R_4 locus. We tested 1,147 F_2 plants from the cross between confectionary lines respectively harboring R_4 and R_{13a} for rust resistance and found two susceptible plants, indicating that the two genes are very closely linked in a genetic distance of 0.09 cM. It means a less than one thousand percent chance that genetic recombination could occur between two

genes. Co-dominant DNA markers flanking these two genes are required to distinguish them in a segregated population. We genotyped 1,116 F_2 plants with two flanking markers, and did find one expected recombinant. We are working to develop SNP markers closely linked to R_4 and R_{13a} in order to further confirm this recombinant with R_4 and R_{13a} in coupling linkage.

3. Grow homozygous F_3 families in Fargo field for agronomic performance

Eight homozygous double resistant F_3 families with gene combination of $R_5 + R_{13a}$ and seven homozygous double resistant F_3 families with gene combination of $R_2 + R_{13a}$ were planted and evaluated for their agronomic performance in the Fargo field in the summer of 2013. The height and flowering date of the F_3 families were observed, and about 220 heads were bagged and harvested for germplasm release.

4. Greenhouse rust test of the selected lines from 2013 field and prepare to release resistance inbred lines and publish research results

All sunflower heads harvested from 2013 field were threshed. Plants with good fertility were selected for further marker and rust tests. For the double resistant line of $R_2 + R_{13a}$, a total of 88 plants were evaluated for their rust resistance, with 44 for each of rust races 336 and 777. Two and three DNA markers linked to R_2 and R_{13a}, respectively, were used to test 44 plants. Similarly, we did rust and marker tests for the double resistant line with gene combination of $R_5 + R_{13a}$. The results indicated that the all plants are homozygous for two gene combinations and highly resistant to rust. The documents regarding 'NOTICE OF RELEASE OF TWO DOUBLE RUST RESISTANT CONFECTION SUNFLOWER GERMPLASMS, HA-R12 and HA-R13' were submitted to USDA-ARS in Washington on April 21, 2014, waiting for final approval.

5. Molecular mapping of new rust resistant genes in the lines RHA 397 and HA-R8

We completed molecular mapping of the rust resistance gene R_{13b} in the line RHA 397. F_2 and F_3 populations were developed from the cross of HA 89 and RHA 397. A total of 140 F_3 families (20 plants for each family, ~2,800 individuals) were phenotyped with rust race 336. Out of 870 SSR markers screened in HA 89 and RHA 397, 417 showed polymorphism between the two parents. Bulk segregant analysis was performed with polymorphic SSR markers and revealed that the resistance gene is located on linkage group (LG) 13 of sunflower. Genotyping of the 140 F_2 individuals with 16 polymorphic SSR markers from LG13 confirmed the new rust gene, named R_{13b}, location on LG13, flanked by two SSR markers at an interval of 0.1 cM. In addition, we observed virulence/avirulence patterns of RHA 397 with 10 selected rust races including the predominant and the most virulent races. RHA 397 is highly effective against all rust races identified so far.

For molecular mapping of the rust R-gene in HA-R8, F_2 and F_3 populations were developed from the cross of HA 89 and HA-R8. A total of 140 F_3 families (~2,800 individuals) were phenotyped with rust race 336. Out of 877 SSR markers screened in HA 89 and HA-R8, 376 showed polymorphism between the two parents. Bulk segregant analysis was performed with the 376 polymorphic markers. Unfortunately, no marker-rust association was found, indicating that the rust R-gene in HA-R8 may reside a region with poor SSR maker coverage. To increase marker density, we are currently genotyping F_2 population with GBS (Genotyping by sequence) and will find some SNP markers linked to the gene.

Additional work

1. Reallocation of the R_2 gene in CM29

The previously published DNA markers by Australia group did not show close linkage to the rust gene R_2 in CM29. The unexpected results resulted in a delay of selection of homozygous resistant lines from BC_4F_3 of the cross between CONFSCLB1 with CM29 (Australia-origin carry the R-genes R_2 and R_{10}). No reliable marker for R_2 also affects selection of double-resistant plants in the F_2 population of the cross between an R_2 line and an R_{13a} line.

A new F_2 population derived from the cross of HA 89 and CM29 (USDA-origin carrying the rust R-gene R_2) was developed and F_2-derived F_3 seeds were harvested in 2013. A total of 126 F_3 families (2,520 individuals) were phenotyped with rust race 336. Subsequent bulked segregant analysis indicated that the gene R_2 was located on LG14 instead of LG9 as previously reported. Genotyping of 126 F_2 individuals with 13 polymorphic markers from LG14 confirmed the LG14 location of R_2. The closest SSR marker is located about 4 cM distal to R_2. To saturate the R_2 region, a total of 37 SNP markers possibly covering the gene R_2 were selected from NSA and public SNP maps. Two SNP markers were found to be closely linked to R_2 and used for the selection of the double resistant line of R_2 and R_{13a}.

2. Develop SNP markers linked to R_5, R_4, and R_{13a}

Single nucleotide polymorphism (SNP) markers have gained much interest in the scientific and breeding community because of their efficiency, repeatability, and high-throughput. Currently, a high density sunflower genetic map with 10,000 SNPs is publicly available. Our group has mapped an additional 5,019 SNPs from NSA SNP Consortium. A total of 44 SNPs were selected to screen two parents of HA 89 and HA-R2 (R_5), and 11 of them showed polymorphism between two parents and were used to genotype an F_2 population derived from HA 89/HA-R2. The gene R_5 was flanked by two SNP markers, NSA_001605 and NSA_00267, at a genetic distance of 0.7 and 1.2 cM, respectively, and these markers were used in the selection of the double resistant line of R_5 and R_{13a}.

Similarly, we screened 58 SNP markers among the parental lines, HA 89, HA-R3 (R_4), and HA-R6 (R_{13a}), and finally added seven and eight SNPs to R_4 and R_{13a} maps, respectively. All SNP markers were located at one side of the two genes, and no closely linked SNP marker was found on the other side.

Beneficiaries

The beneficiaries are broad and varied. It is estimated that 825 farmers nationwide (half of whom are in North Dakota) will benefit directly by rust resistant hybrids. The cost of a fungicide application varies between $14 and $24 per acre, depending on which fungicide is used. With an average cost of $17.30 per application, the costs would equate to $6 million nationally of which $3 million would be in North Dakota. In early and severe infestations confection sunflower fields would require up to three applications resulting in costs of $18 million nationally and $9 million in North Dakota. Those farmers choosing not to spray a fungicide could lose 80 percent of their potential yield and the remainder of the crop would not be marketable. In an experimental trip in 2008 near Minot, ND, the yield was reduced from 1,400 pounds/acre to 400 pounds/acre when no fungicide was used. That yield loss represents $350 per acre. The

unmarketable remaining 400 pounds of production due to low test weight and discolored seed would represent an additional $140 per acre. Host resistance is the most effective way to control the disease and reduce the yield loss.

The 2014 NSA Research Forum was held on January 8 - 9, 2014 in Fargo, ND. The postdoctoral researcher of this project described the significant advances that have been made in developing confection sunflower rust resistance utilizing all molecular tools that are available to breeders and other researchers. This meeting was attended by 150 individuals consisting of growers, industry and public researchers.

The Focus Group annual meeting was held on February 26, 2014 and the lead researcher provided an update on the results and progress of this research project. The Focus Group consists of 30-40 industry and grower leaders along with researchers who help formulate long range sunflower research strategy.

For the past four years the lead scientist or the post-doctoral scientist have reported their results and progress at the annual NSA Sunflower Research Forum held in Fargo ND. Approximately 30 growers and crop consultants* attend that meeting annually. These are growers who are leaders in the industry. These reports are archived on the National Sunflower Association (NSA) website. It is estimated that 200 growers and crop consultants have accessed these reports annually. The Research Forum audience also consists of public and private sunflower breeders. It is these individuals who will take the project to the final step of incorporating the identified resistant genes into their elite germplasm and then cross into finished hybrids, which would be ultimately planted by farmers in field. Hybrid seed companies will be advertising in public media that their confection hybrids have these new rust resistant genes. Dr. Sam Markell, North Dakota State Extension Pathologist (cooperating scientist on this project), will be providing information to growers and crop consultants at 20 information meetings over the next two years. An Extension publication may also be formulated. It is estimated that 50 crop consultants and growers will be reached by each of these meetings. The Extension publication will reach 2,000 growers, county agents and crop consultants.

The Sunflower magazine, a publication owned by the NSA, will be summarizing this project in an upcoming issue. This publication is mailed to all sunflower producers and will reach well over 10,000 growers. The article will be of special interest to the estimated 825 confection sunflower growers and another 500 crop consultants and will be archived on the NSA website for future reference for growers, consultants and breeders.

*Crop consultants are a very important group to reach since they advise their farmer clients on all aspects of crop production from seed selection to harvesting.

Lessons Learned

To extend the effectiveness of resistance genes, pyramiding genes conferring resistance to different races of the pathogen within the same genotype will reduce vulnerability of the U.S. sunflower crop to rust, especially in confection sunflower where few rust *R*-genes are available. Population size for selection of the double-resistant types is dependent on gene locations. For

genes located on different chromosomes, double homozygotes could be selected from a small F_2 population. With the aid of molecular markers, we obtained 11 and 13 homozygous individuals for the gene combinations of $R_2 + R_{13a}$ and $R_5 + R_{13a}$ from 524 and 368 F_2 plants, respectively. However, if *R*-genes are located on the same chromosome or chromosomal arm, the frequencies in which the double-resistant types are recovered vary, depending on the genetic distance between the genes. In the present study, R_4 and R_{13a} are located on the same chromosome and tightly linked. Only one putative recombinant was obtained from screening of more than thousand F_2 plants. In addition, co-dominant DNA markers flanking these two genes are required to distinguish them in a segregated population.

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Additional information available

Publications

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Qi LL, Gulya TJ, Hulke BS, Vick BA, Seiler GJ 2012. Molecular mapping of the rust resistance genes in sunflower: results and prospects. Presentation at the National Sunflower Association Research Forum, January 11-12, 2012, Fargo, ND. Available: http://www.sunflowernsa.com/uploads/resources/621/molecular-mapping-of-the-rust---qi.pdf

Germplasm release

NOTICE OF RELEASE OF TWO RUST RESISTNAT CONFECTION SUNFLOWER GERMPLASMS, HA-R10 and HA-R11, released on Dec. 2013

NOTICE OF RELEASE OF TWO DOUBLE RUST RESISTANT CONFECTION SUNFLOWER GERMPLASMS, HA-R12 and HA-R13, sent the notice to Office of National Programs of USDA released on July 18, 2014

Manuscript in preparation

1. Reallocation of a rust resistance gene R_2 and its marker-assisted gene pyramiding in sunflower (*Helianthus annuus* L.)
2. Registration of the two confection germplasms, HA-R12 and HA-R13, resistant to rust in sunflower

PROJECT 2: To Enhance the Competitiveness of Specialty Potato Variety MonDak Gold and Evaluate Multi-State Potato Breeding Lines for French Fry Processing, Fresh Pack and Fresh "Niche" Specialty Markets

Final Report

Project Summary

This project coupled the second year of potato variety research on "niche" market multi-purpose potato breeding lines with new mini-tuber and early generation seed potato production and limited test marketing of the MonDak Gold potato variety.

MonDak Gold is a multi-purpose red skin, yellow flesh potato variety low in acrylamides and reducing sugars with excellent culinary and processing attributes in making processed and fresh pack potato products from long term storage.

In limited test marketing, MonDak Gold potatoes showed excelled promise in the fresh pack, French fry, roasting, chips, niche, and traditional markets. MonDak Gold potatoes produced both lower acrylamides and reducing sugars than the industry standard Russet Burbank variety.

MonDak Gold potatoes showed the potential to extend the marketing period of potatoes produced by two months due to its resistance to sugar sweetening at low temperature storage, and produce golden yellow French fries without the dark sugar ends of Russet Burbanks and many other potato varieties.

The project has served as a catalyst for innovative potato products and uses to encourage the expansion of potato production and markets in western North Dakota and the Northern Plains area, to attract new interest by potato processors and fresh pack companies to locate in the MonDak region, and to deliver positive nutritional messages about potatoes to the trade and consumers. The disease free mini-tuber and MonDak Gold potato production in this project provide MonDak Gold seed potatoes for commercial production and limited test marketing.

The commercial production and additional test marketing of MonDak gold potatoes for new and innovative potato products in the processing and fresh market industries is needed and will bring this new MonDak Gold potato variety to the market place. The potato industry is ever changing and consumers are looking for innovative potato attributes to deliver positive nutritional messages about potatoes to consumers.

As the specialty markets for MonDak Gold develop, the MonDak Gold potato variety will not only improve the profitability for potato producers, but stimulate new potato production, processing, and create new sustainable economic wealth through growth of the potato industries in the MonDak region.

This project will build off of a previously funded project with SCBGP by addressing the "commercial" aspects of the MonDak Gold in market place and test marketing of MonDak Gold potatoes. Once commercial test marketing is completed (takes 2-3 years by potential customers)

quantifiable affect will be accurately addressed based on pounds of product produced, and hundredweight of fresh potatoes sold to fresh packers, restaurant chains, and other end users.

This project included newly bred specialty cultivators/breeding lines from University of Minnesota, North Dakota State University, and the Tri-State Potato Breeding Programs in Idaho, Washington, and Oregon and identified specialty potato varieties for the fresh marketing having superior culinary attributes and well suited for processing with superiority over the industry standards in making specialty and traditional potato products.

Project Approach

This grant project provided a second year of evaluations of "niche" market potato lines (see attachments) and strip trial production and testing of advanced "niche" market potato lines for yield, disease resistance, desired agronomic characteristics and fry, market and fresh market qualities (see attachments).

Valley Tissue Culture, Halstad, MN produced 579 pounds of mini-tubers of the MonDak Gold potato variety in the winter of 2012-2013 that were planted at the Enander Seed Farm in Grenora, ND in 2013 for G0 seed potato production of the MonDak Gold potato variety. The Enander Seed Farm also successfully produced generation 1 class seed of the MonDak Gold potato variety for use as generation 2 seed production by the potato growers for test marketing and commercial production in 2014.

A limited supply of the MonDak gold potato variety was produced by the Oliver Schroeder Farm near the 29 mile corner north of Williston, and the Countryside Potato Seed Farm in Alliance, Nebraska. The harvested potatoes from the Oliver Schroeder Farm and Countryside Potato Seed Farm were utilized in potential end user markets with fresh pack, French fry, chips, and other niche market potato customers.

Consultant Chuck Stadick coordinated the mini-tuber production and the generation 0 and generation 1 seed production. Progress of planting and emergence of the MonDak seed plantings and the research breeding lines/cultivars progressed well and produced good yields and quality despite the delayed planting weather that occurred in the spring of 2013.

Dr. Susie Thompson, NDSU potato breeder participated in our MonDak Ag Showcase at Williston, ND and the Nesson Valley Irrigated field day events held on July 10-12, 2013. Special presentations were made during these events on potato research, varieties, and market development by Dr. Susie Thompson, NDSU Potato Breeder and Tyler Tjelde, WREC Irrigation Scientist. An estimated 300 stakeholders participated in the MonDak Ag Showcase.

A September Potato Showcase held September 26, 2013 was hosted at the WREC Ernie French Center for potato researchers, potato consultants, community leaders, economic developers, and infrastructure investors. Local Chefs from The Williston, Cash Wise, and Black Gold prepared potato dishes from the MonDak Gold potato variety and the standard Russet Burbank potato variety. Potato dishes included potato salad, roasted Au Gratin potatoes, scalloped potatoes, French fries, and baked potatoes. Attendees were asked to rate the two varieties for each dish for

appearance, texture, flavor, and overall rating. MonDak Gold received higher ratings for all the potato dishes in overall ratings. MonDak Gold potatoes were also distributed to all attendees for home use consumption. An estimated 75 stakeholders participated in the September Potato Showcase.

Potato Consultant Chuck Stadick met with the following Boise, Idaho restaurants: Willow Creek Grill, The Dish, and Boise Fry Company in November 2013 and sent them informational packets on the MonDak Gold potato variety. MonDak Gold potato product was delivered to the Boise restaurants for testing.

The Williston Area Ag Diversification Group (WAADG), formerly the Williston Area Diversification Group (WAADG), participated in the National Potato Council Expo and Trade Show held in January 10-11, 2014 in San Antonio, Texas. Attendance was estimated at 1,500. Chuck Stadick, Potato Consultant, Tom Rolfstad, Director, Williston Area Ag Diversification Group, and Christian Thill, University of Minnesota potato breeder represented our group in a WAADG trade show booth to promote the production and test marketing of the MonDak Gold potato variety and other promising niche potato breeding lines for specialty markets for roasted, tablestock, fry and chip processing, and other specialty end uses.

Attendees at the National Potato Council Expo and Trade Show surpassed 1,500 including growers, suppliers, and brokers. Wendy's Fast Food Chain Ohio, met with Chuck Stadick regarding the MonDak Gold potato variety and its marketing opportunities.

Following the National Potato Expo, flyers and promotional materials were set to interested contacts, and included Ben Holmes Potato Company, Becker, MN., Riser's Salad Company, Topeka, KS., Four Rivers Potato Company, Big Lake, MN., Barrel O'Fun, Perham, MN., Perham, MN., Tri-Campbell Potato Company, East Grand Forks, MN., Terra Gold Potato Farms, Othello, WA., Pro-Health, Carrolton, TX., and A&L Potato Company, East Grand Forks, MN.

Dr. Christian Thill and Dr. Susie Thompson presented results on the MonDak Gold potato variety and other "niche" marketing potato breeding lines/varieties tested at Williston during the Northern Plains Potato Growers Association (NPPA) Annual Meeting and Research Reporting Conference held Tuesday, February 18, 2014 at the Alerus Center, Grand Forks, ND. Dr. Jerald Bergman, Williston Research Extension Center, also participated in the NPPA conference and met with potato companies and growers. An estimated 150 potato growers attended this event.

A limited quantity of MonDak Gold potatoes were distributed to restaurants and consumers in western North Dakota for edible uses and/or for planting purposes to compare to potato varieties to help us assess MonDak Gold cooking and culinary qualities compared to the other potato varieties and positive feedback was received from survey respondents.

Commercial potato growers in Minnesota, North Dakota, Texas, Idaho, and Alaska planted 50-2,000 pounds of MonDak gold potatoes in May-June 2014 to produce and compare the MonDak Gold potato variety and its yield and quality attributes to the commercial potato varieties currently grown and marketed by these growers.

The Mini-tubers of MonDak Gold potatoes were planted at the Enander Certified Seed Farm for growout and the generation 1 MonDak Gold seed potatoes were planted at the NDSU Nesson Valley Irrigation Research Center for future test marketing.

Advanced potato breeding lines identified for further advanced testing include NDSU entries ND8068-5 Russets, AND00618-2 Russets, ND 081478B-2, ND 081586B-3 Russets, and ND 091933ABCR-7 Russets. University of Minnesota advanced lines identified for further testing and evaluations in addition to the MonDak Gold Potato variety include dual purpose entries MN18747, MN02467, MN02586, and MN04844-07, potato chip varieties MN02588 and MN03339-4, and special purpose varieties MN02574 and MN02419.

Goals and Outcomes Achieved

Newly bred "niche" market potato breeding lines and advanced potato breeding lines from the University of Minnesota (U of M) Potato Breeding Program and the North Dakota State University (NDSU) Potato Breeding Program were planted, harvested, and evaluated in 2013-2014 at the NDSU Williston Research Extension Center Nesson Valley Irrigated Research Site 23 miles northeast of Williston. Multipurpose advanced potato breeding lines from U of M and NDSU were identified that are adapted to western North Dakota and the northern Great Plains area that exceed industry standards for processing and for specialty market uses.

Limited quantities of MonDak Gold potatoes were test marketed by end users in both the processing and fresh market industries helped and demonstrated its "niche" market opportunities in French fry processing with lower acrylamides and greater resistance to sugar ends than Russet Burbanks (see attachments).

The results of the Nesson Valley Irrigated "niche" market NDSU and U of M breeding lines/cultivars (30) were published in the 2014 Northern Plains Potato Growers Association Potato Research Conference Proceedings, February 18, 2014, Grand Forks, ND.

Valley Tissue Culture produced 579.5 pounds of mini-tubers for production at the Enander Seed Farm to meet over target goal of 500 pounds of mini-tubers. The Enander Seed Farm successfully produced 335 cwt. of generation 0 MonDak Gold seed potatoes in 2013 (2nd year) to provide generation 1 MonDak Gold potatoes for replant as seed and for "niche" marketing testing.

This project has created a nucleus of MonDak Gold virus free mini-tubers and generation 0 and generation 1 seed to provide more seed potatoes (generation 2) in 2014 for replant purposes and to commercial growers for small scale commercial production and limited test marketing in 2014.

This project has generated considerable interest in the MonDak gold potato variety by commercial potato growers and the potato processing and fresh market industries for expanded test marketing.

Beneficiaries

This project serves as a catalyst for innovative potato varieties, potato products, and uses to deliver positive nutritional message about potatoes to the trade and consumers and to interest and attract potato processors and fresh pack operations to the MonDak region. The project has created an interest in a group of investors to consider western North Dakota as one of two (formerly three) possible locations under consideration for a specialty potato processing facility. Cavendish Farms Processors, with a Jamestown, ND French fry processing facility, also has leased irrigation pivots 29 miles northeast of Williston for 2014 potato production and looking at the MonDak region for possible niche market potato production in the future. Williston Area Ag Diversification Group has also met with potential commercial potato and seed growers from Idaho and Washington State interested in moving or exploring potato operations in the MonDak region and in building a fresh pack operation in the MonDak region once the specialty potato varieties market develops.

An estimated 300 stakeholders have participated in the MonDak Ag Showcase and the MonDak September Fall Potato Harvest Showcase at Williston, ND including potato growers, French fry processors, restaurant owners/chefs, fresh potato market suppliers, and the general public/consumers. Attendees at the National Potato Council Expo and Trade Show January 10-11, 2014 surpassed 1,500 including growers, suppliers, and brokers with many visiting our WAADG trade show booth that promoted the production and test marketing of the MonDak Gold potato variety and other promising U of M and NDSU niche potato breeding lines.

An estimated 150 potato growers attended the Northern Plains Growers Association Annual Meeting and Research Reporting Conference February 18, 2014 at the Alerus Center where Dr. Christian Thill, U of M Potato Breeder, and Dr. Susie Thompson, NDSU Potato Breeder presented the test results of the MonDak Gold potato variety and other “niche” market potato breeding lines tested at Williston, ND.

Lessons Learned

This project is an extensive collaborative effort of the potato research programs at the University of Minnesota and North Dakota State University Breeding Programs, and the North Dakota State University Williston Research Extension Center with the Williston Ag Diversification Group, Chuck Stadick, Spud Viking Potato Consulting, and the Northern Plains Potato Organization provided much valuable assistance. All these organizations and individuals working together conducting potato research and varietal test marketing have promoted MonDak Gold and other advanced specialty potato breeding lines nationwide.

This project has helped develop and promote the MonDak Gold potato variety and identify newly developed (developing) potato breeding lines for specialty markets and adaptation to the MonDak and Northern Plains region. Valley Tissue Culture, Halsted, MN, and Enander Seed Farm, Grenora, ND played a major role in the positive outcomes of a supply of MonDak Gold certified seed for commercial production and test microwave cooking products.

The product test marketing of MonDak Gold potatoes is still underway and the product test marketing is vital to introduce MonDak Gold potatoes to the market place.

Contact

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Email Address: Jerald.bergman@ndsu.edu

Additional information available

2014 Potato Research Reporting Conference Proceedings. NPPGA and MN Area II Potato Council, February 18, 2014, Alerus Center, Grand Forks, ND

2013 Agricultural Research Update, Regional Report No. 19, December 2013. NDSU Williston Research Extension Center/ MSU Eastern Agricultural Research Center

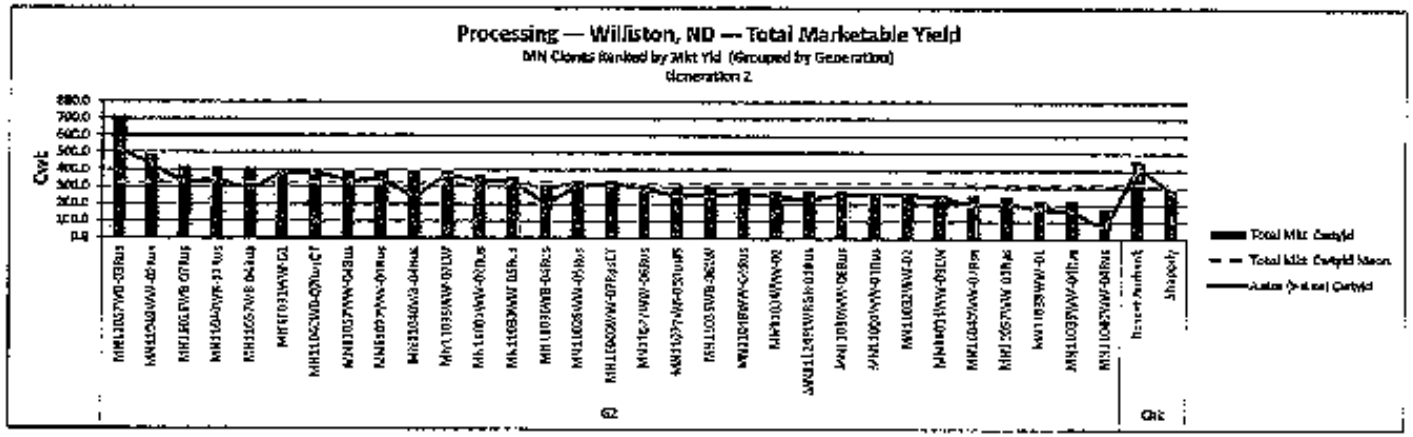
Website: http://www.ag.ndsu.edu/WillistonREC/

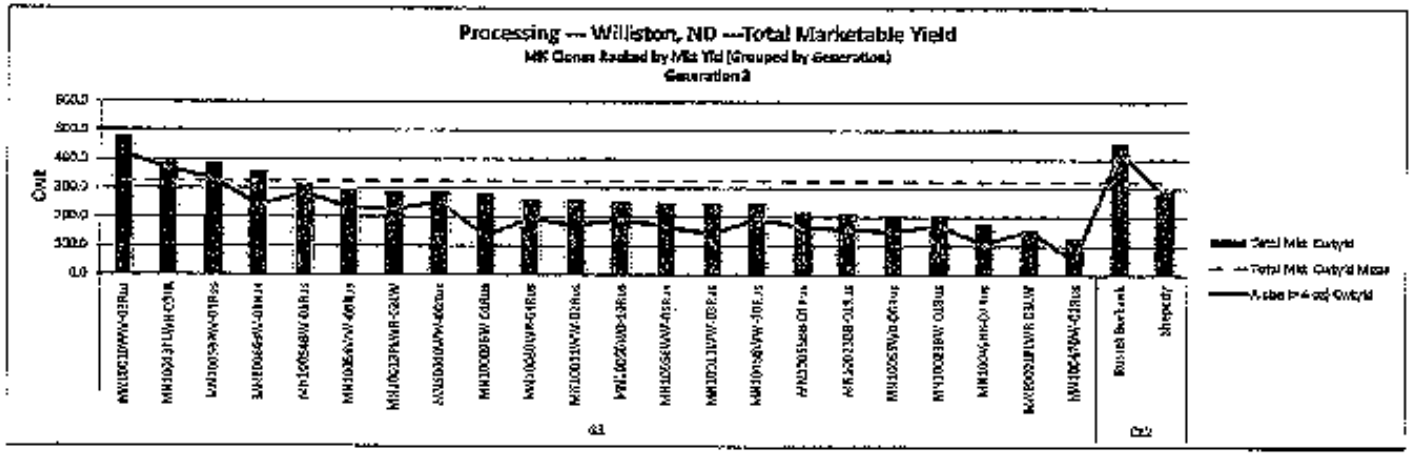
See Attachments 1-11 below:

Location: Williston, ND

Trial: Processing 25 Sept. 2013

Table 6



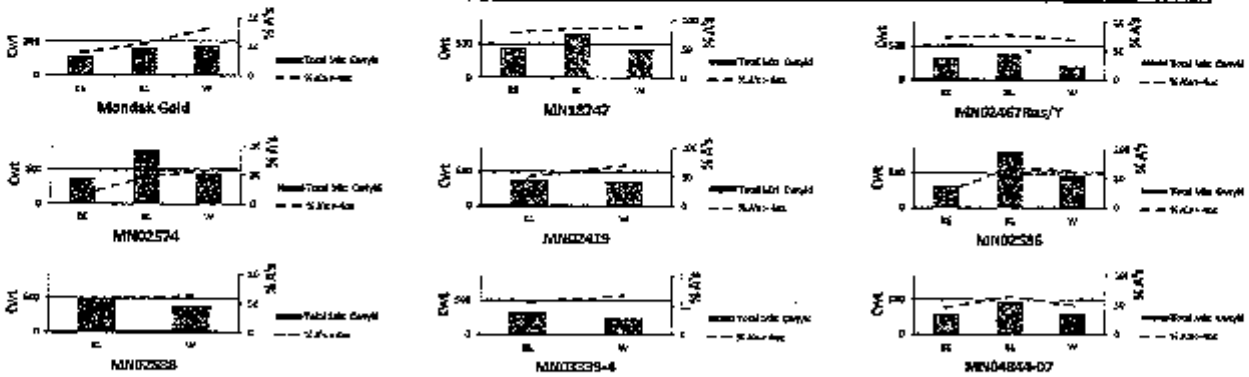


2013 University of Minnesota Potato Breeding and Genetics

Most Advanced Clones Overview

Table 1

Clone	Loc	2013 Trial	Stat	Skin Color	Cull Cwt/ac	Cull %	B Size (>4 oz) Cwt/ac	B Size (>4 oz) %	4-6 oz. Cwt/ac	6-12 oz. Cwt/ac	12-16 oz. Cwt/ac	Over 16 oz. Cwt/ac	A Size (>4 oz) Cwt/ac	A Size (>4 oz) %	Total Mkt. Cwt/ac
Mondak Gold	EC	G13	Yellow	Red	0.94	2.22	181.16	58.31	111.55	71.68	3.30	0.00	133.19	39.58	304.35
	EL				61.87	12.37	113.37	31.80	104.74	69.09	11.49	12.53	203.88	35.21	445.15
	W				37.04	7.43	58.93	17.53	137.29	83.03	55.05	68.95	184.50	31.54	474.90
MN02570	EC	G13	Purple	Lin	5.03	4.15	84.21	21.33	217.05	51.17	18.40	30.21	319.33	78.22	408.60
	EL				38.84	8.81	59.64	8.69	35.53	206.53	61.00	97.12	561.44	85.23	646.97
	W				13.85	3.93	51.02	7.69	118.66	137.23	53.75	65.47	324.03	46.06	463.89
MN02457Ras/Y	EC	G11	Purple	Red	1.34	0.39	84.91	28.77	137.18	63.48	42.87	3.85	247.38	70.44	338.19
	EL				34.54	6.42	82.25	24.53	151.87	109.40	17.55	43.66	323.15	77.54	380.35
	W				56.44	14.66	34.29	15.26	60.13	47.41	14.84	19.33	137.47	59.99	234.07
MN02574	EC	G11	PM	W	0.00	0.00	374.60	60.79	24.54	3.85	0.00	0.00	53.86	18.88	377.79
	EL				8.17	1.04	414.70	84.22	345.46	49.75	0.00	0.00	395.15	40.24	774.45
	W				26.83	5.89	175.97	38.12	242.48	51.57	11.34	9.90	315.49	57.92	437.96
MN02419	EC	G11	HP	LPV	190.40	31.34	107.88	18.24	146.33	92.72	26.93	14.36	280.82	53.15	387.51
	W				87.35	9.57	53.87	7.61	148.13	74.34	25.33	31.58	279.36	44.69	361.07
MN02586	EC	G11	Purple	W	6.47	0.14	348.88	73.04	31.11	8.63	0.00	0.00	39.74	20.82	388.61
	EL				0.19	0.00	353.85	35.76	528.26	102.84	20.17	0.00	651.84	47.55	804.87
	W				6.55	1.58	147.79	39.61	133.82	21.28	8.53	0.00	223.66	60.78	460.77
MN02588	EL	G11	C	W	3.89	0.71	211.79	43.79	227.24	58.92	14.48	7.15	304.07	63.38	515.28
	W				18.79	3.75	343.23	59.65	217.60	62.28	4.74	2.90	334.13	62.18	407.74
MN02639-4	EL	G10	C	W	0.07	0.03	164.34	44.14	135.24	43.51	3.34	3.20	185.34	49.84	377.04
	W				1.60	0.43	70.30	33.58	64.31	38.60	18.83	3.64	125.13	59.81	209.08
MN04844-07	EC	G9	Purple	W	0.00	0.00	180.41	54.30	91.43	38.89	9.62	7.93	146.86	45.54	326.97
	EL				0.00	0.00	170.34	36.91	193.73	83.09	17.50	7.83	302.15	65.64	472.27
	W				1.88	0.51	140.34	30.22	115.30	34.47	3.45	9.65	163.17	45.25	364.21



Acrylamide levels in French Fries - Feb 25, 2014

Sample #	Potato Variety	Acrylamide (ppb)	Average Acrylamide (pg) in 0.1 g french fries	Acrylamide ug per kg french fries
1	Russet Burbank - Light - Hot extraction	1412.57	1512.88	756.44
2	Russet Burbank - Light - Cold Extraction	1613.18		
3	Russet Burbank - Dark - Hot Extraction	3378.99	3271.71	1635.85
4	Russet Burbank - Dark - Cold Extraction	3164.43		
5	Mondak Gold - Light - Hot extraction	853.09	966.92	483.46
6	Mondak Gold - Light - Cold Extraction	1080.75		
7	Mondak Gold - Dark - Hot extraction	1579.58	1602.48	801.24
8	Mondak Gold - Dark - Cold extraction	1625.38		
9	Burger King	408.20		204.10
10	McDonald	820.43		410.21

Samples were run for Acrylamide from LIGHT and DARK FF of MonDak Gold and Russet Burbank.
Two methods were used to extract Acrylamide from the FF; COLD and HOT

Table 1. MonDak Gold processing quality and acrylamide levels from Williston strip trial 2013.

Storage @ 55F September harvest to November
Storage @ 48F November storage to February

Fry date 2/10/14

FF were made by USDA East Grand Forks, MN using JR Simplot protocol
Samples were divided into QSR acceptable & QSR reject for fry color.

MonDak Gold

	FF grams			
	QSR reject DARK FF	QSR accept LIGHT FF	Total	% QSR accept LIGHT FF
MG	113.4	105.1	218.5	48
RB	136.9	70.8	207.7	34

Russet Burbank

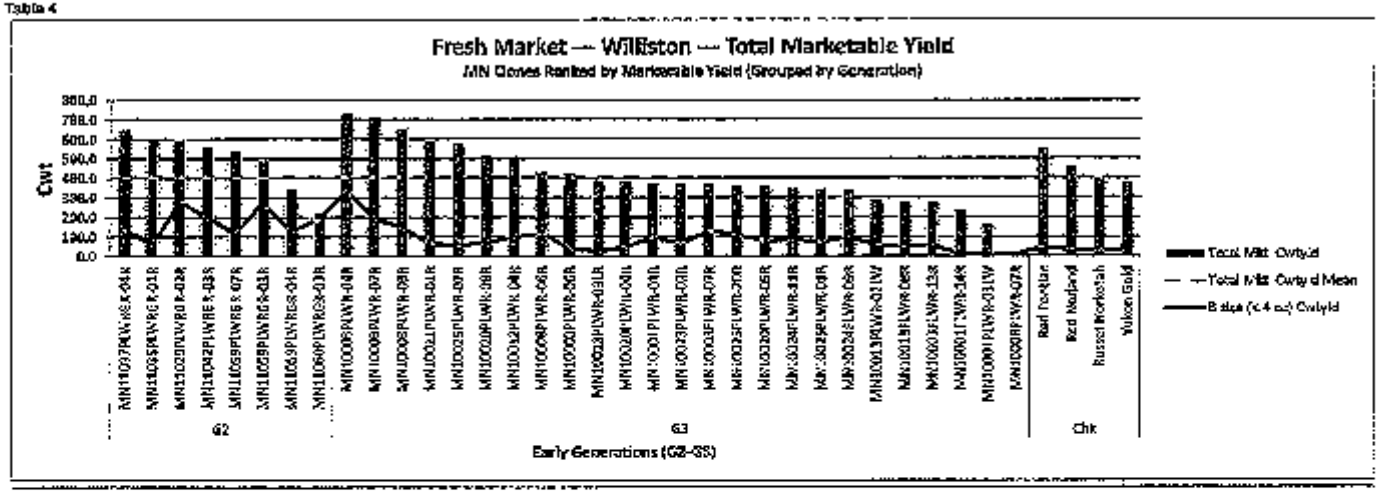
Burger King

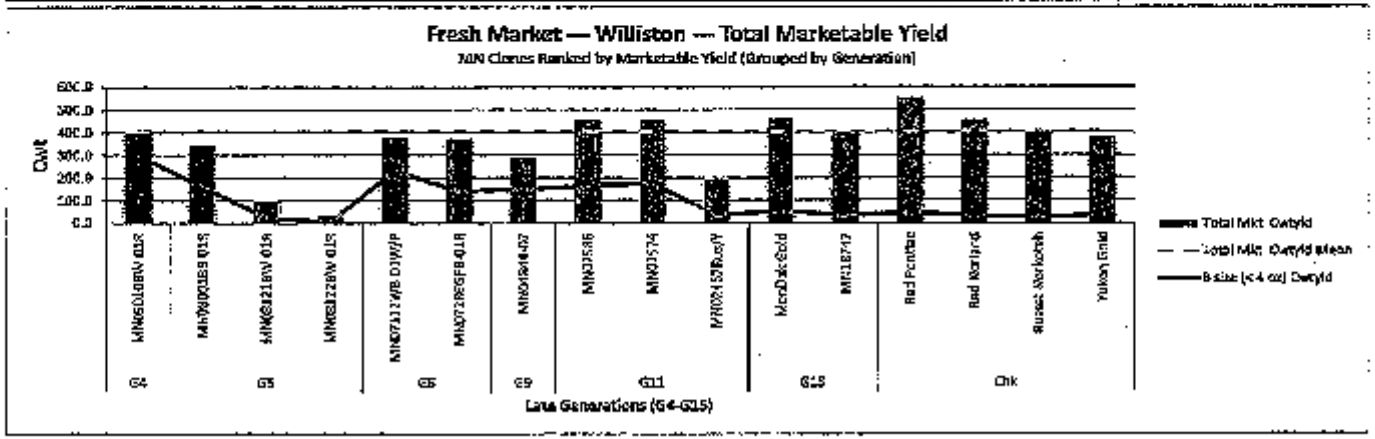
McDonalds

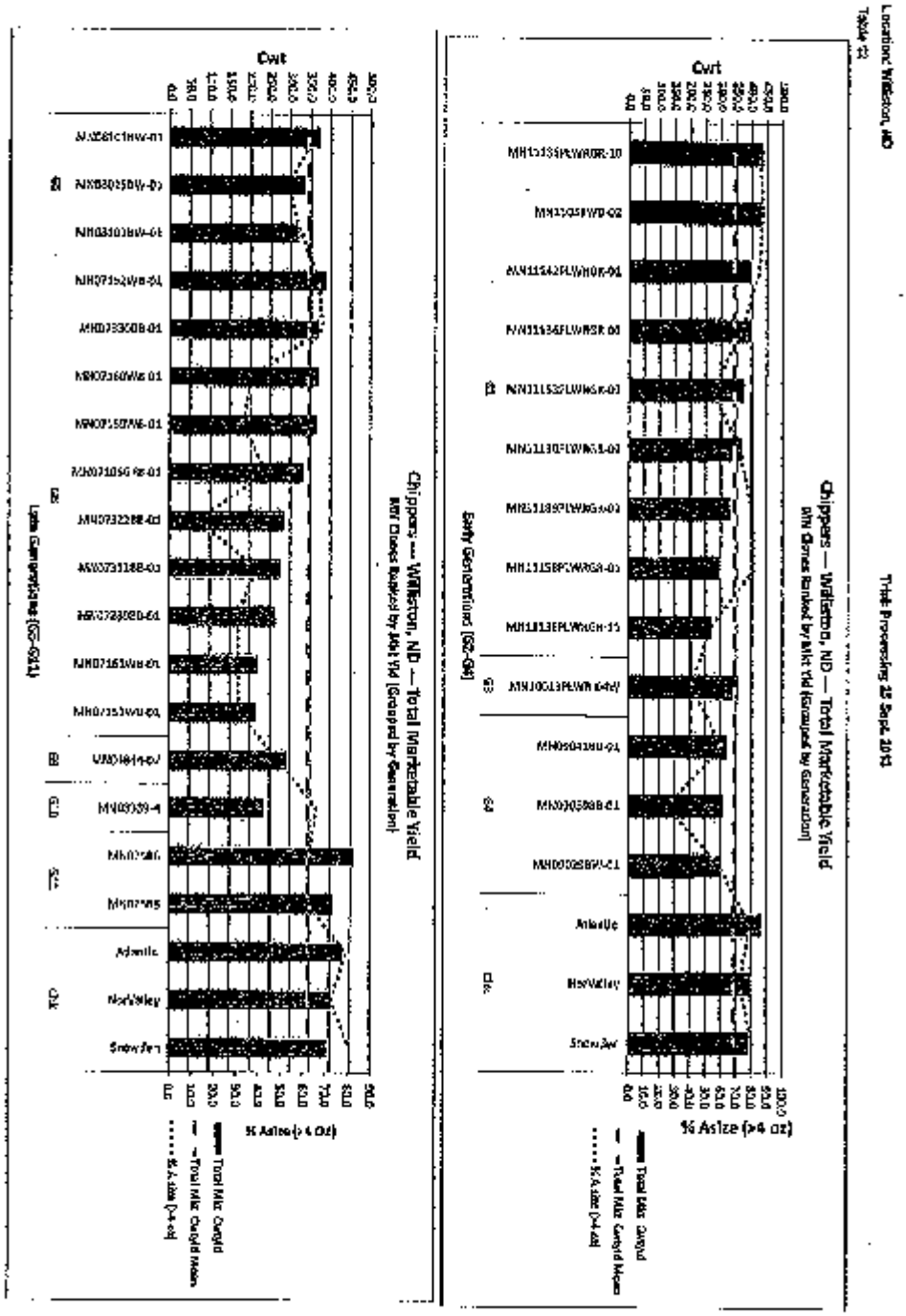
Location: Williston, ND

Trial: Processing 25 Sept. 2013

Table 4






Location: Williston, ND
Table #2
Trial Processing 18 Sept 2013
Chippers — Williston, ND — Total Marketable Yield
MN Clones Ranked by Mkt Yld (Grouped by Generation)
Early Generations (G2-G6)
Late Generations (G5-G14)
Cvrt
% Asize (>4 oz)
Total Mkt Cwtgld
Total Mkt Cwtgld Mean
% Asize (>4 oz)
Snowflake
NorValley
Atlantic
Chippers — Williston, ND — Total Marketable Yield
MN Clones Ranked by Mkt Yld (Grouped by Generation)

2013 Williston Spacing Trial
MonDak Gold

Table 18

Yield Data

Clone	Size	Pattern	Cwt 4-4oz Mean	4-6 oz Mean	6-10 oz Mean	10+ Mean	culls Mean	Mkt Yld Mean	Total Yld Mean
MonDak Gold @ 4.5"	LR	Y	48.67	63.70	126.41	214.11	22.25	452.83	485.34
MonDak Gold @ 6"	LR	Y	51.19	55.81	116.28	133.93	15.53	360.62	380.15
MonDak Gold @ 9"	LR	Y	73.28	93.37	150.65	142.44	46.30	470.59	516.53
MonDak Gold @ 12"	LR	Y	57.86	72.01	133.79	191.02	18.41	454.68	473.08
Russet Burbank @ 6"	Rus	C	53.54	55.70	122.76	69.26	134.00	281.06	386.06
Russet Burbank @ 9"	Rus	C	112.09	76.03	112.17	116.61	103.72	415.27	525.98
Russet Burbank @ 12"	Rus	C	45.55	33.23	58.25	128.73	66.32	264.10	330.40

Defect Data

Clone	External Knobs	External GC	External Grn	External Bruise	Internal HH	Internal IN	Internal VD	Internal BC	Internal Shulled	Fry	SPGR
	%				%						
MonDak Gold @ 4.5"	0	0	0	0	0	0	0	0	11	1	1.085
MonDak Gold @ 6"	0	0	0	5	0	0	3	0	11	1	1.087
MonDak Gold @ 9"	0	0	8	11	0	0	0	0	11	1	1.089
MonDak Gold @ 12"	0	8	3	6	0	0	6	9	6	1	1.088
Russet Burbank @ 6"	0	0	8	9	0	0	8	0	8	0	1.077
Russet Burbank @ 9"	0	0	5	25	1	0	0	0	25	0	1.085
Russet Burbank @ 12"	0	0	25	8	0	0	0	17	8	0	1.076

2013 Williston Strip Trial
Williston, ND

Table 19

Clone	Skin	Flesh	Cwt Yield 4-6 oz	6-10 oz	10+ oz	Culls	Total	B Size < 4 oz Cwt	%	A Size > 4 oz Cwt	%	US #1% %
MN018747	W	W	30.5	82.0	259.2	7.5	395.3	20.5	5.2	374.8	94.8	94.8
MN02487Russ/Y	Russ	C	38.8	90.8	30.9	0.6	161.8	40.6	25.1	121.0	74.9	74.9
MN02916R/Y	R	Y	111.9	152.3	44.0	2.0	334.2	75.0	19.8	308.2	80.2	98.2
MN04844-07	W	Y	68.5	33.4	2.6	0.0	232.6	150.4	65.1	102.2	34.9	34.9
MN07112WB-61WP	WP	Purple	90.2	81.0	16.6	0.0	360.8	174.0	48.2	186.7	51.6	51.6
MN10001PLWR-03LW	LW	W	25.6	103.6	242.3	28.7	397.7	18.2	4.1	375.5	95.9	95.9
MN10013PLWR-02LW	LW	W	75.7	70.8	18.3	38.3	223.4	58.6	54.0	164.8	146.0	146.0
MN10013PLWR-03LR	R	W	48.0	105.1	231.3	10.4	444.7	28.3	6.4	416.4	93.6	93.6
MN09360-1Y	W	Y	154.4	77.1	19.0	9.0	428.5	212.1	49.4	212.1	49.4	49.4
MonDak Gold	R	Y	52.9	122.6	165.7	34.7	419.2	47.2	11.3	386.2	88.2	88.2

Clone	Skin	Flesh	External Defects Knobs	GS	Crw	Wrinkles	Internal Defects HH	IN	VD	HC	Bruise	Chip	SG-PR
			%				%						
MN018747	W	W	0	0	0	27	0	0	0	0	33	0	1.077
MN02487Russ/Y	Russ	C	0	0	0	0	14	0	14	0	0	1	1.080
MN02916R/Y	R	Y	0	0	0	0	0	0	0	0	0		1.079
MN04844-07	W	Y	0	0	0	0	0	0	0	0	0	1	1.083
MN07112WB-61WP	WP	Purple	0	0	17	0	0	0	0	0	0		1.085
MN10001PLWR03-LW	LW	W	0	0	0	33	0	0	0	0	33	0	1.082
MN10013PLWR-02LW	LW	W	0	0	0	0	33	0	0	0	0	0	1.077
MN10013PLWR-03LR	R	W	0	0	0	0	0	0	0	0	0	0	1.072
MN09360-1Y	W	Y	0	0	0	0	0	0	0	0	0	0	1.083
MonDak Gold	R	Y	0	0	0	0	0	0	67	0	67	1	1.087

MonDak Gold

Grower: University of Minnesota

Inspection Report

Date Sampled: 01-Nov-13
Date Inspected: 13-Nov-13

GROSS WEIGHT: 346

Field Number: MG Strip Trial
Storage Number: 0

	Total Exam	Washed Weight	Water Gain	Net Sample Weight	FM Dirt
Lbs.	346.0	342.4	3.4	339.0	7.0
%			1.0%		2.0%

	Graded Weight	Unusable	Size Breakdown: Under Size	US No 2 for Processing: 4oz	8 oz	10 oz+	Unusables Breakdown: Soft Rot	Freeze Dmg	*Symptoms Scored	Sun Burn	Insect Dmg	Other	Pitted Scab	Pink Eye
Lbs.	242.4	79.7	14.7	32.0	52.0	64.0	0.0	0.0	78.2	0.0	0.5	0.0	3.0	0.0	0.0
Internal		2.2		0.0	0.0	2.2									
Total:	242.4	81.9	14.7	32.0	52.0	61.8	0.0	0.0	78.2	0.0	0.5	0.0	3.0	0.0	0.0
%	100.0%	33.8%	6.1%	13.2%	21.5%	25.5%	0.0%	0.0%	31.4%	0.0%	0.2%	0.0%	1.2%	0.0%	0.0%

Size	Lbs Exm	L.B.S.	Evn Con	H.H.	Not Neo	VRB	Other	Total	T.H.H.
4 oz +	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
8 oz +	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
10 oz +	20.0	0.0	0.0	0.0	0.0	0.7	0.0	0.7	0.0
		0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	3.5%	0.0%

	Lbs.	%
Bruise	27.7	32.7%
Bruise Free	57.1	67.3%
Total	84.8	100.0%

INTERNAL UNUSABLES BREAKDOWN

	L.B.	H.H.	Net	VRB	Other	T.H.H.
Lbs.	0.0	0.0	0.0	2.2	0.0	0.0
%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%

Fry Color Analysis

	0	1	2	3	4	SE	HS	DE	Strips	Fry Points
Strips	55	0	0	0	0	0	0	0	55	0
%	100%	0%	0%	0%	0%	0%	0%	0%		

Specific Gravity Measurements	CPP	*Avg Temp*	
1.0816		Water	48
1.0811			
1.0822		Tuber	55

Uncorrected Average Specific Gravity: 1.0817 Ticket #:
Specific Gravity Correction: 0.0004
Corrected Average Specific Gravity: 1.0821

Comments: MG Strip Trial- Symptoms (characteristic of late blight).

Sample Method: Submitted

*Symptoms = Characteristics of Late Blight/Pink Rot/ Pink Eye
Noticeable symptoms are not included in Unusables.

2013 POTATO BREEDING UNIVERSITY OF MINNESOTA RESEARCH SUMMARY – THILL

Project Title: **Potato Breeding and Genetics University of Minnesota**

Project Leader: Dr. Christian A. Thill, University of Minnesota, 1970 Folwell Avenue, St. Paul, Minnesota 55108. Voice: 612.624.9757 Fax: 612.624.4941, e-mail Thill003@umn.edu

Research Scientist: Tyler Tjelde and Jerald Bergman, NDSU Williston Research Extension Center, 14120 Hwy 2 W, Williston, ND 58801, Voice: 701.774.4315 Fax: 701.774.4307, email tyler.tjelde@ndsu.edu, jerald.bergman@ndsu.edu

GOALS OF THIS RESEARCH

The objective of this research is to develop and release potato varieties adapted to Minnesota and North Dakota. Selection will emphasize lines having superior yield, quality, and host plant resistance to biotic and abiotic stress.

SUMMARY

Research emphasized the development, evaluation and release of potato varieties with improved yield, quality, and resistance to biotic and abiotic stress.

SELECTION AND CLONAL ADVANCEMENT:

Breeding lines advance through the UM program in generations. Early generations are Single hills, and Generation 1 (G1); Mid-generations are G2, G3, and G4; Late-generations are G5 and G6. By the time a selected clone moves to G2 and beyond, sufficient breeder's seed is available for multi-location evaluations.

Single-hills. Represent selected clones from new hybrid crosses. After a cross and sowing of new hybrid seed, seedlings are first grown in the greenhouse to produce mini-tubers. These mini-tubers are planted to the field as *single-hills*. In 2013 we had 57,000 SH from 168 families. Single hills were grown at Pine Lake Wild Rice (35,000), Williston (15,000), and Missouri (Black Gold Farms) (7,000). We selected 1525 at PLWR, 25 at Williston, and 66 at Missouri.

Generation1: Single-hills selected from the *previous year* are planted for the first time in the field using normal plant spacing and production practices as *G1*. Typically, only 4 to 8-hills of each clone are available for planting. In 2013 we selected 53 from 260 planted at PLWR, and 20 from 88 planted at Williston.

PLWR, and 20 from 88 planted at Williston.

Processing Potato Trial
Williston, North Dakota
2013

Asunta (Susie) Thompson, Jerald Bergman, and Tyler Tjelde

Agronomic and quality evaluations, yield and grade, and French fry quality for the Williston processing trial entries are summarized Tables 1, 2 and 3, respectively. Selections tended to have earlier maturity than most of the check cultivars. This is desirable due to the short growing season in North Dakota. Stems per plant is indicative of seed quality (physiological age), tuber eye number, and length of dormancy (generic). Stem numbers per plant were good for all selections with the exception of ND060796AB-1Russ. Total yield ranged from 125 cwt./acre to 597 cwt./acre. Several advancing selections and industry standards had outstanding French fry color when fried at harvest and after storage at 45F for 8 weeks. Many demonstrate sugar end resistance. These sugar ends are not manageable by the processing industry.

The most promising advancing dual-purpose russet selection is ND8068-5Russ. ND8068-5Russ has early maturity, about seven days earlier than Russet Norkotah, and it processes from the field and 45F storage. AND00618-2RussY is also advancing as a dual-purpose specialty due to its beautiful yellow flesh. This trial has identified three selections early in the evaluation process with potential for the Nesson area. They are ND081478B-2RussY, ND081586B-3Russ and ND091933ABCR-7Russ. All are high yielding. The ND081478B-2RussY has yellow flesh and late blight resistance breeding. ND081586B-3Russ also has late blight resistance breeding, and ND091933ABCR-7Russ has resistance breeding for aphids, potato viruses, Colorado Potato Beetle and Corky Ringspot disease. All will be increased in 2014 for further evaluation.

PROJECT 3: Ensuring Accessibility and Suitability of Vegetable Varieties: Trialing Vegetable Varieties for Traits and Qualities Needed by North Dakota's Market Growers

Final Report

Project Summary

- The specific need addressed is to provide information about varieties of garden crops of special interest to gardeners and market growers so that they can grow the easiest to grow and most productive varieties that are of greatest interest to consumers. We surveyed growers to find out which crops were especially important to them and set out to evaluate five of these in order to meet this major goal.

- The number of Farmers Markets and interest in local foods have both increased in North Dakota in recent years, but information about the utility and marketability of varieties of major garden fruit and vegetable crops has not kept pace. Variety evaluation information for vegetables and fruits is severely lacking and our variety trial has been met with some enthusiasm as it clearly addresses a need.

- This was our first Specialty Crop Block Grant project from which we have developed further work on vegetables for the Northern Plains.

Project Approach

- **Activities Performed: Objective 1. Hold Statewide Vegetable Variety Trials.** Seeds for 10 varieties each of five species (tomato, pepper, snap bean, carrot, cucumber) were planted in a mother-daughter variety trial based at NDSU with the daughter sites on eight collaborating farms across the state (two species on each farm). The tomatoes and peppers were shortly terminated due to TSWV infection (see below), and there were flooding problems at NDSU (see below). However, data concerning vigor, development, maturity, yield, and taste were collected from most sites. It is too early to document changes in variety use based on these trials, but some of the collaborating farmers report new favorites already. **Objective 2. Identify Breeding Goals for Variety Development.** We conducted a survey of market gardeners at the ND Farmer's Market and Growers Association meeting in Bismarck. Forty-five growers provided us with their needs for thirty-nine different vegetable crops. This provided insights into the species and types of varieties of greatest interest and showed that our trial results may help North Dakota market farmers find varieties that meet their desires for specific product qualities and production characteristics. **Objective 3. Outreach to North Dakota Market Farmers.** The project was featured by at the Carrington Research Extension Center field day (@ 50 in attendance) and at an NPSAS field day south of Mandan, it has been presented regularly in NPSAS communications, carrot taste tests were carried out informally by a farm collaborator with farmer's market customers and at the Fort Berthold Community College dining room, and we have also discussed the project and its methods with specialty crop growers in South Dakota and Minnesota. Farm collaborators recorded their data and these are being compiled for a report to the growers across the state. In 2013 the team held two trainings about variety evaluation,

one at the NPSAS Winter Conference and another at the ND Farmer's Market and Growers Association meeting, along with an additional review at the NPSAS Farm Breeding Club meeting. We continue to expound on the participatory evaluation methods at every opportunity.

- The funds were spent solely on specialty crops (tomato, pepper, green bean, carrot, cucumber).

- Frank Kutka, Theresa Podoll and Steve Zwinger coordinated the project. Kutka also presented the preliminary data at the NPSAS Winter Conference and the 2014 North Dakota Local Foods Conference. Podoll led the organization and delivery of the survey of market growers at the 2013 Local Foods and Farmers Market Growers Conference in Bismarck. Chiwon Lee grew tomato and pepper seedlings at NDSU's horticulture greenhouse for all the project partners and grew the "mother" trial of all the crops in Fargo and collected performance data on all the varieties. Theresa Podoll, Steve Zwinger, Annie Carlson, Brian McGinness, Heather Vestre, Marvin Baker, Sue Isbell, and Joe Bear each grew single replicates (daughter trials) of two of the five species at their locations, although the tomato and pepper trials had to be terminated a few weeks after planting. Growers collected and provided data to the coordination team and the McGinness' hosted an NPSAS Summer Field Day.

Goals and Outcomes Achieved

- Our major activities for meeting the proposed outcomes are described above. We have collected all of the data from our collaborators for analysis and planning for the 2014 season. We have disseminated progress reports from the 2013 trials to our broader audience via NPSAS's quarterly newsletter, The Germinator, our NPSAS FBC Facebook page and website. We discussed the plans for 2014 at our FBC meetings in December 2013 and March 2014, as well as during our NPSAS Winter Conference in January 2014. To help overcome the deficit of tomato and pepper trials in 2013, we have enlisted the collaboration of additional growers for the second project for 2014 and will support the extra work of these grower members with funds from our own Grants to Grow program. Project staff will visit with and offer support to each of our collaborating growers in the field during the growing season, especially at field days whenever possible. This groundwork sets the stage for an even more successful set of variety trials in 2014 and additional data to increase the value of observations from 2013.

- Providing solid information about vegetable variety performance really requires additional evaluations that were proposed and are now being carried out as part of our second year of this project. We expect to have two year's of data for cucumbers, green beans, and carrots (eight environments) and one year of evaluation data for peppers and tomatoes (seven environments) to provide to growers during the 2014-2015 winter season and beyond. Discussions are also underway for expanding this work through collaborative partnerships with growers and researchers in Montana.

- Our initial survey of market growers was completed in spring 2013 with 45 surveys; our vegetable growers who successfully completed the season provided data for analysis and presentation by January 2014. A second survey was completed in spring 2014 with >20 surveys.

- Forty-five growers identified the specialty crops of greatest interest to them in spring 2013 and our team of university and farm researchers made observations, took photos, and helped to provide this information to the public at the NPSAS and North Dakota Local Foods Conferences (more than sixty audience members from both events). Steve Zwinger, Marvin Baker, and Frank Kutka provided information about variety trials to our farm collaborator team and the public (more than seventy audience members from all four events).

- A video with highlights from our Organic Field Day with the Carrington Research Extension Center was published in early 2014 (https://www.youtube.com/watch?v=jnsVMVx3p4Q). This featured Theresa Podoll and Chiwon Lee making comments about our Specialty Crop project to evaluate vegetable varieties. Viewing was far lower than anticipated, with just over 300 views as of this report, although only seven since we moved it to the new NPSAS Farm Breeding Club Channel.

- A video about our carrot evaluations was produced by Theresa Podoll and posted to YouTube in July, 2014 (https://www.youtube.com/watch?v=1HmlsM6qteo). We have had six views as of this report. Links to both videos have been sent to NPSAS members.

Measureable Outcome #1 – Increase the use of top performing vegetable varieties with documented agronomic and market traits. We expect by the end of the multiyear project that two thirds of those who hear and see the information will report adopting the best performing varieties. In our outreach we have emphasized that one season's data is not enough information to determine the best performing varieties. We have shared our preliminary data of the bean, cuke, and carrot trials from the first season at the NPSAS Winter Conference, 2014 Local Foods Conference, and at the Dakota Garden Expo.

Measurable Outcome #2 – Gain farmer input and guidance for further cultivar improvement and development. The survey passed out to the 2013 NDFMGA and Local Foods Conference was a success (forty five responses from ninety seven attendees) and we were able to obtain input from growers about their interest in and opinions about thirty-nine specialty crops. They rated the crops by their current satisfaction with field performance and consumer traits and also by the importance of the crop to their operations. This information has been shared with NDSU vegetable breeder Chiwon Lee and verified our crop choices for variety trials. The major intent of this outcome was to aim it at this critical audience. We did not get the hoped for 75% of them to provide input (46% responded), but were pleased nonetheless. However, our field days did not come together well in 2013, so those secondary audiences were not surveyed at all. Several of our growers had crop growing disasters and nothing to show, bad weather prevented some field events, some growers just did not hold events, and the PI forgot to get surveys to the one field day that was otherwise a big success. In the second year of the project

field days are being better organized and surveys are getting to those audiences, but this outcome has not been achieved as of 2013.

Measurable Outcome #3 – Increased knowledge of varietal differences, desirable quality traits, potential gains in varietal suitability, and the value of participatory variety evaluation. During three training events for the public and our variety evaluator team we reached more than seventy growers with information about how to do variety trials and why we do them. Surveys of knowledge change were not always conducted at every event because of some confusion among the training team, and when they were the response rate was too low to be meaningful. We will impress upon all of our growers and attendees at summer field days and fall meetings in 2014 the importance of getting survey forms filled out and returned. Our team is also discussing how better or organize. This outcome has not yet been achieved as of 2013.

Beneficiaries

- All gardeners and market growers in the region could benefit from the information we are developing. However, one season's data is not enough information to make any changes to varietal selections. We are, however, building on the current findings with a second year of evaluations and a follow-up project as described above.
- Outreach from Jan, 2013 through May, 2014 included quarterly progress reports through the NPSAS Germinator with a circulation 575 per edition with five editions for a total circulation of 2,875; our FBC Facebook page had a reach of 3,388 people during the life of the project; and we have had several hundred views of our field day video. We had >125 attendees at two successful farm tours; 55 people were registered for a third farm tour, which was called off due to an early winter storm on October 5. We attended and distributed project information to >750 conferees at the following winter conferences: NPSAS Winter Conference with an attendance of 525; Minnesota Organic Conference with attendance of over 500; Organic Seed Growers Conference with 450 attendees, with 518 proceedings distributed; North Dakota Local Foods Conference with 200 attendees; South Dakota Local Foods Conference with >75 attendees; and Dakota Garden Expo with over 6,000 attendees. North Dakota Living magazine ran an article on the diversity and growth of local foods, highlighting our project with distribution to >75,000 households.
- The potential economic impact of this project is dependent upon the identification of superior varieties, uniquely adapted to North Dakota's growing environment and all the challenges that a variety has to face to deliver performance. Variety trials across multiple seasons are the key to identifying superior performance and we have laid the groundwork for ongoing variety trials. 2014 variety trials mark a second season to overcome some of the weather disasters, implement our team experience and learning, and to provide additional data so that clear conclusions may be reached. This will provide growers with replicated results across multiple seasons with which to make informed varietal selections, at which time we can assess any changes in varietal choices and the economic impact of those changes.

Lessons Learned

- The primary difficulties faced during the year of 2013 were bad weather and disease. The wet, cold spring and cool summer certainly delayed planting and slowed development of some crops from what we would normally expect. Those varieties that came through seem pretty tough and worth another look. Much of the site at NDSU was flooded in June and several of the trials had to be postponed. Dr. Chiwon Lee is looking for higher ground at NDSU for the 2014 season and considering land off-site but within the Fargo-Moorhead area. Snowy weather also caused us to cancel one of our field days in early October. Our growers will likely work around whatever comes just as they did in 2013 by adjusting planting dates as needed. We will discuss these issues during project discussions throughout the season.

- The biosecurity challenge we faced this year was the infection of our tomatoes and peppers with Tomato Spotted Wilt Virus at the greenhouse where our transplants were grown. This resulted in the plants not thriving and threatening the crops at each of the farms: these sick plants were terminated once the NDSU Diagnostic Lab identified the disease. We will ask each grower to start their own plants in 2014 to avoid this biosecurity hazard and will discuss with them in spring and early summer how to stay ahead of TSWV should it reappear. None of them had seen this problem before, so we are confident this approach will prevent further outbreaks. Rapid contact of the Diagnostic Lab was crucial to our preventing further spread of this disease.

- Another challenge was getting all of our team organized and focused. With the weather and disease issues, there was some discouragement, but also some growers did not follow through on field events and the PI was sometimes more focused on the seeds and growing problems and less so on surveys. Trainers were also more focused on the training than on assessment tools. However, it was a good year in which we collected useful information, learned how to work together more efficiently, have matured this statewide collaboration.

- A smaller but still important challenge is getting increased feedback from our growers and event participants. NPSAS FBC staff will emphasize the participatory nature of this project and will demonstrate how participant's feedback will be utilized to further target project efforts to meet grower needs. Surveys for variety input went very well in 2013 and we will follow that approach at the Local Foods Conference in 2014. As we conduct our outreach in 2014, we will champion the participatory evaluation approach of this project and the unique opportunities it provides for critical dialogue between farmers and researchers in identifying cultivars that truly meet the needs of growers and their customers. NPSAS will use existing evaluation tools from FBC collaborators across the nation and assist our growers to make efficient use of them.

- One last challenge we experienced was getting all the data into a final format for reporting this winter. Staff members had to work to encourage growers to finish their reports in time for winter meetings. During project calls and staff visits in 2014 we will make it clear that **the expectation** is to have all of the collaborators' data submitted by

the end of November in order to prepare for broader outreach next winter.

Contact

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Additional information available

- Information about this project is included on the NPSAS Farm Breeding Club website (http://npsas.org/about-us/farm-breeding-club.html), the Farm Breeding Club Facebook page (https://www.facebook.com/pages/Farm-Breeding-Club/165221056860513), and in files and photographs we are accumulating for publication of our two year's of data late this year or early in 2015.

PROJECT 4: Local Foods Initiative

Final Report

Project Summary

Since 2008 the North Dakota Department of Agriculture (NDDA) has played an integral role in the promotion of specialty crops in North Dakota. Through the help of this specialty crop block grant the department was able to achieve many successes to help further the competiveness of specialty crops in ND. This project helped raise consumer awareness of the specialty crop industry in ND along, with continuing to provide marketing opportunities for our specialty crop producers in the state. This project is timely in that the buying local movement that is sweeping the country has many consumers, restaurants and retailers looking for local sources of specialty crops such as fruits and vegetables. During this grant cycle the mobile food processing unit aiding in the department achieving the purpose of this grant by promoting more local consumption of specialty crops and helped in allowed local producers the opportunity to direct market their products to more people. Through the efforts of this grant the NDDA was able to impact over 50 farmers markets and over 150 growers of fruits and vegetables in our state.

This project has built upon previous SCBGP funded projects by enhancing the project activities by using prior years' lessons learned and feedback. One example is using the evaluations and feedback from local foods conference participants to provide feedback on specialty crop topics they would like to see at future conferences and these suggestions were taken into consideration when planning for this project. This ensures that attendees that come back each year to get new ideas and fresh information. Another example of building on previous years' work is the restaurant program. In a prior SCBGP funded project we identified that there was demand from the hospitality industry to source more locally grown specialty crops. We have used that information for this project to help link the specialty crops grown locally with the demand by hospitality businesses.

Project Approach

Hunger Free North Dakota Garden Project

The awareness of the Hunger Garden Project continues to grow. Early in the spring of 2013 a letter from both the Agriculture Commissioner and the director of the Great Plains Food Bank was sent out to encourage organizations to participate in the program. Since the main measure of success of the program is weighing the produce donations, in past years it was identified that some pantries do not have the means to weigh produce when it comes in. In response to this, we offered scales this year to these pantries that needed one. We distributed six scales to six different pantries this year. Media coverage of numerous events throughout the year helped to raise awareness of the project. In the late fall, with help of our consultant, we reached out to the participating organizations and recorded the total produce donations they had during the growing season.

Mobile Food Unit

The mobile food processing unit was acquired in 2010 and continues to be a stage for the local foods initiative and a promotional piece for agriculture and specialty crops across

the state. The Mobile Food Unit (MFU) was used at six events to directly enhance the competiveness of specialty crops during 2013. The first one was a Jr. Iron Chef educational event. At this event, the MFU was utilized to cook and prepare dishes that contained specialty crops and educate youth on the cooking process. The second event was a field day at the NDSU Research Station in Minot. The MFU was used to sample and raise awareness of specialty crops that are grown and produced in our state. The third event was at the USDA-ARS Northern Great Plains Research Laboratory's annual "Friends and Neighbors Day" open house. This event provided an opportunity to promote and serve fruit ice cream toppings grown and processed in ND to raise awareness of the diverse specialty crops grown in our state. The toppings were made from chokecherries, juneberries, strawberries, and rhubarb. The fourth event provided an opportunity for a small business to process a honey recipe to sell at regional trade shows. The MFU is a certified commercial kitchen and making their product in a certified kitchen allows this business to sell their product through retail marketing opportunities. The fifth event was the Farmers Market Day at the Capitol. Fruit ice cream toppings were served to raise awareness of specialty crops that are grown and produced in our state. The toppings were made from chokecherries, juneberries, strawberries, and rhubarb. The sixth and most publicized event was a farm dinner that was held at a fruit and vegetable CSA. The MFU provided an opportunity to have all specialty crop dishes grown, prepared and served on location. Specialty crops used in those dishes were: tomatoes, green beans, cucumbers, lettuce, a variety of squash, and basil along with other culinary herbs. This event allowed current members of the CSA and potential members to gather. The CSA was able to gain many new members and educate current members because of this evening event.

Riverbound Farm dinner Blog 2013 - http://rhubarbandvenison.com/2013/09/celebrating-the-harvest-dinner-at-riverbound-farm/

The mechanisms used to ensure these activities conducted are used for the sole purpose of enhancing specialty crop include tracking each event. The MFU was used 3 times during this grant cycle that was not related to the grant. Expenses for these events came out of general marketing (state) dollars and not grant (federal) dollars.

Social Media.

We continue to expand our reach on social media. Currently we have 1,179 Facebook fans on the Going Local Facebook page. Our Facebook community is a very active group. The Facebook page has proven to be a great medium to spread the word about what is going on in North Dakota related to specialty crops and local foods.

The Going Local Twitter account is tied to our Going Local Facebook page. Every post that is posted on Facebook is also posted on Twitter, which saves time not having to double post. Currently we have 408 followers on Twitter. Being on Twitter allows us to successfully reach out to others that may not be on Facebook. Not only are we able to send out information quickly and more frequently on Twitter, but our followers also are able to retweet for their followers, giving us a bigger audience

Social media and blogging outreach:

The purpose of this outreach was to tap into the talents of local bloggers to help promote specialty crop production in North Dakota. Five bloggers from around the state were selected and given a new specialty crop blogging challenge each month. The topics are listed below. Bloggers were giving specific instructions that the blog had to be about specialty crops and focused around cooking.

July – Zucchini
August – herbs
September – Apple Cider
October – Pumpkin
November – Thanksgiving Dinner Side Dish Challenge
December – Bloggers Choice

Blogs were featured on the Going Local North Dakota Facebook page. A logo was also created to identify the written blogs as part of our challenge. The logo also created an identity for the challenge.

SPECIALTY CROP Challenge

Local Foods/Pride of Dakota Restaurant Program

In March of 2014 the Local Foods Marketing Specialist, Pride of Dakota marketing specialist and the marketing director met to determine the best way to proceed forward with this program to achieve the goals set forth by the grant. Out of the meeting it was identified that we needed a partner in the restaurant industry to help us to promote specialty crops across the state. The NDDA partnered with the North Dakota Hospitality Association. The

goal of the restaurant program was to increase visibility of specialty crops that restaurants use. With the help of the Hospitality Association it was decided to offer grant dollars to restaurants to help them market and feature locally grown specialty crops. In June a press release was sent out announcing that grants were available to hospitality associations to help them market specialty crops in their menus. This was a competitive grant and open through the end of July. Local TV stations, radio stations and papers picked up the story and promoted it. The ND Hospitality Association also sent out emails to its member encouraging them to participate in the program. At the end of July the NDDA received no grant application so the deadline was extended to the middle of August. Again, the Hospitality Association sent out the grant application to its membership. The NDDA also followed up with another press release announcing the extension of the grant deadline. Despite all our efforts no grant applications were received. In September a meeting was held at the NDDA and we discussed what our options were to try to still achieve the goals of the grant.

Taking a different approach to achieve our goal, a mailer was sent out in November to restaurants in ND that would most likely source their ingredients locally. The ND Hospitality association provided the NDDA with the mailing list, the mailer was sent out to 695 restaurants across North Dakota. It was also determined to focus this mailer on specialty crops and not Pride of Dakota. The mailer contained information on what is considered a specialty crop, List of common specialty crops they may use in their menu and a book containing specialty crop producers in the state to try to connect those restaurant owners with local sources of specialty crops. The North Dakota Hospitality Association expressed to us that in the restaurant industry there is a growing demand for sourcing products locally. The mailer identified specialty crops and local sources for restaurant owners to source those products. The mailer increased the competitiveness of specialty crops compared to other ingredients that a chef/business owner might use when preparing a menu.

Local Foods Conference & NDFMGA Annual Meeting

The 2013 Local Foods Conference & NDFMGA Annual meeting was held on April 12. Ninety-seven people attended the conference held in Bismarck, ND. Seventy-seven percent of the attendees were specialty crop producers. Marketing dollars were used to pay for those expenses that were not directly related to specialty crops and divided based on the attendance of specialty crop producers to non-producers. To achieve this success save the date cards were sent out to promote the event. The local foods marketing specialist worked closely with specialty crop producers in the state, taking their input to develop an agenda that specialty crop producers and consumers would find educational and valuable. Topics included: Conducting a successful vegetable variety trial; fruit and vegetable varieties that do well in high tunnels; Hunger Free ND Garden project; Getting your specialty crops to market, and many more topics that interested both producers and consumers.

Schedule of Events
Friday, April 12, 2013

7:15 - 8:00 a.m.	Registration
8:00 a.m.	Welcome & Introductions - Doug Goehring (North Dakota Agriculture Commissioner), Marvin Baker (President, ND Farmers Market & Growers Assoc.) and Holly Mawby (Director, Entrepreneurial Center for Horticulture)
8:45 a.m.	Climatology - Greg Gust
9:15 a.m.	Varieties that do well in High Tunnel - Mark Boen (Bluebird Gardens)
10:00 a.m.	Break
10:15 a.m.	Conducting a Successful Vegetable Variety Trial - Steve Zwinger
11:00 a.m.	New & Exciting in North Dakota - Jake Coryell (NDSU landscape architecture & ND Farmer's Markets) and Karen Ehrens (SNAP/EBT & ND Hunger Garden Project)
11:20 a.m. - 12:50 p.m.	North Dakota Farmers Market & Growers Association Annual Meeting and Lunch

Break Out Sessions

SESSION I	PRODUCTION	MARKETING
1:00 - 1:55 p.m.	***Getting Your Speciality Crops to Market*** *Ilene Baker (farmers markets), Brian McGinness (CSA), Lora Peterson (Wholesale), Stuart Tracy (Restaurant), Deb Egeland (DPI)*	***Building Customer Relationships*** *Beth Schatz Kaylor (Rhubarb & Venison), Melanie Hoffman (Pickle Me Too), Lori Martin (Roving Donkey Farm), Dwight Duke (Skyline Ranch Natural Produce)*
SESSION II	**PRODUCTION**	**FOOD SAFETY**
2:00 - 2:55 p.m.	***Getting Your Speciality Crops to Market*** *Ilene Baker (farmers markets), Brian McGinness (CSA), Lora Peterson (Wholesale), Stuart Tracy (Restaurant), Deb Egeland (DPI)*	***Food Safety Rules & Regulations*** *Dr. Andrea Grondahl (Meat, NDDA), Wayne Carlson (Dairy/Eggs, NDDA)*
SESSION III	**MARKETING**	**FOOD SAFETY**
3:45 - 4:45 p.m.	***Agri-Tourism*** *Julie Kuennen (IDEA Center)*	***Food Safety Rules & Regulations*** *Dr. Andrea Grondahl (Meat, NDDA), Wayne Carlson (Dairy/Eggs, NDDA)*

4:00 p.m.	Why Local Foods Speakers-Heidi Demars, Abby Gold (NDSU Extension), Pam Thompson, Lora Peterson (Marketplace Food & Drug)
5:00 p.m.	Social

Agenda and speakers subject to change.

All are welcome to attend the Dakota Garden Expo held at the Bismarck Civic Center, starting Friday, April 12, and continuing Saturday, April 13.

Goals and Outcomes Achieved

Hunger Free North Dakota Garden Project

In 2013, the season grand total of produce was 181,303 pounds. The following is a breakdown of the organizations that participated and the amount of produce donated by pound. Working with the Great Plains food bank and the consultant all donation totals were reviewed and cross checked to avoid double counting:

Dakota Boys and Girls Ranch	45
Michigan Food Pantry	315
Bismarck Emergency Food Pantry	798
Mountrail Community Food Pantry	335
Burleigh County Senior Adult program	1952.5
AID Inc.	1184
Our Lady of Grace Food Pantry	4000
The Salvation Army-Minot	300

Recovery House	12
St Joseph Social Care	6,795
North Dakota FFA Foundation	7,000
POD Harvest Showcases	550
Heaven's Helpers Soup Café	1420
Total	24,707
Total from Great Plains Food Bank direct donations	99,011
Total report to Great Plains Food Bank partners (Pantries listed above are not partners of the Great Plains Food Bank)	57,585
2013 Season Grand Total	**181,303**

In the spring letters were mailed out to 282 food helper organizations across the state. We initially got responses back from 55 organizations. At the time of reporting 65 organizations reported totals back to us. Our goal was to work with 85. Even though we fell short of our goal we still reached out to 282 organizations across the state and raised awareness of fresh produce donations to those in need.

We set a very lofty goal of 500,000 lbs. of produce donated throughout the year and we fell short. However, we know there is a lot of produce that gets donated that does not get recorded by the project.

Mobile Food Unit

This year the Mobile Food Unit was utilized at six events directly enhancing the competiveness of specialty crops. We set a goal of using the unit for four specialty crop related functions across the state and we surpassed that goal.

We set a goal of 5,000 individuals being reached with the Mobile Food Unit and we fell short with less than half of that amount at approximately 1,795. In the future we will use a better system to ensure we have all people accounted for. With the increase in educational experiences going forward, we will also increase our outreach to individuals.

Social Media.

Currently we have 1,179 Facebook fans on the Going Local Facebook page. Our target was to reach a fan base of 1,000. Through very active posting on the page and promoting many specialty crop opportunities across the state we were able to surpass our target and reach more people.

Currently we have 408 followers on Twitter. The target was to get a follower base of 125. We are encouraged by this number.

The numbers show that we are posting information that many want to follow and find relevant. Based on these numbers we will continue to actively share information on social media and share with our audience the many specialty crop opportunities in the state.

Social media and blogging outreach:

The Challenge started with a lot of momentum and commitment by five bloggers but as the deadlines approached we were averaging two to three bloggers posting a month. Monthly emails were sent out to all the bloggers reminding them of the topic of the month. As we promoted the challenge we were contacted by a blogger who wanted to participate. Our initial goal was to reach out to five bloggers, but we were able reach out to six. Participation was on a voluntary basis, even though there was less participation than expected, the overall goal of the project of reaching five bloggers was met.

Local Foods/Pride of Dakota Restaurant Program

The project's goal to develop a statewide mission, value and goals for a restaurant program was unsuccessful because of lack of participation from restaurants and businesses. A logo featuring brand recognition didn't seem to be an incentive for businesses to promote specialty crops. The grant's goals shifted after two separate unsuccessful efforts to pilot a specialty crop program.

To move the project forward, the NDDA partnered with the ND Hospitality Association to develop an informational program designed to highlight five specialty crops in restaurants across the state. A restaurant mailer was created and shipped to almost 700 establishments. With this outreach material we identified at least six businesses interested in promoting specialty crops, and worked with them to implement a specialty crop education program.

Local Foods Conference & NDFMGA Annual Meeting

Ninety-seven people attended the conference held in Bismarck, ND. Seventy-seven percent of the attendees were specialty crop producers. Marketing dollars and additional marketing staff were used to pay for expenses that were not directly related to specialty crops and money was allocated based on the attendance of specialty crop producers to non-producers. With such a high percentage of attendees producing specialty crops, the knowledge gained at the conference was able to directly impact specialty crop businesses.

Beneficiaries

Stakeholders and groups include, over 200 food pantries and soup kitchens across the state that benefited from donations through the Hunger Free ND Garden Project. Over 74 specialty crop producers that attended the Local Foods Conference. For each project in this grant the number of people impacted is listed below through education and outreach of specialty crops or the promotion of them in the state.

Hunger Free North Dakota Garden Project - With the assistance of the Great Plains Food Bank over 63,602 under-privileged individuals were reached through our efforts with this project.
Mobile Food Processing Unit – approximately 1,795 people
Social Medial – 1,587 Fans and followers
Blogging outreach – 2,180 followers plus over 2,500 individuals following blogging sites
Local Foods/Pride of Dakota Restaurant Program – 695 Hospitality businesses directly reached
Local Foods conference – 97 attendees
Total: 72,456

Lessons Learned

It was difficult to complete the Specialty Crop/Pride of Dakota Restaurant Program part of the project since it is a new idea with no history. The Local Foods and Pride of Dakota Specialists met with the marketing director and came up with a plan to execute the goal of the restaurant program that aligned with original scope. Many different approaches were tried and were not as successful as we had hoped. The main lesson learned was to keep trying different ways of reaching out to people and eventually one will take. The mailer ended up being the key to raising awareness of the specialty crop industry in North Dakota to hospitality businesses.

Another lesson learned involved the specialty crop blogging challenge/social media outreach. We may not have hit our goal of having five bloggers blog during the whole challenge, but we did identify five bloggers and even had one additional blogger reach out to us and want to get involved to help educate followers about specialty crops. The challenge was voluntary and having someone commit to blogging for six straight months proved to be a challenge.

Contact

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Additional information available

Specialty Crop Blogging Examples
July 2013 Challenge
Zucchini: In Abundance and Scarcity - http://pagesofparadigm.com/2013/08/15/zucchini-in-abundance-and-scarcity/

Zucchini Bread with Pineapple - http://rhubarbandvenison.com/2013/07/zucchini-bread-with-pineapple/

The other staff of life and a recipe to prove it - http://gardeninguru.areavoices.com/2013/08/12/the-other-staff-of-life-and-a-recipe-to-prove-it/

August 2013 Challenge
Herbed Stuffed Green Peppers - http://rhubarbandvenison.com/2013/08/herbed-stuffed-green-peppers/

All things are possible, with tomatoes - http://pagesofparadigm.com/2013/09/05/all-things-are-possible-with-tomatoes/

September 2013 Challenge
Coming to Fruition - http://pagesofparadigm.com/2013/09/23/coming-to-fruition/

November 2013
How Eating Local Changed Thanksgiving - http://pagesofparadigm.com/2013/11/28/how-eating-local-changed-thanksg

December 2013
Lettuce, Think About It - http://pagesofparadigm.com/2014/01/08/lettuce-think-about-it/

Local Foods/Pride of Dakota Restaurant Program

Please Pass the Honey
Example Grant Idea
Did you know...
North Dakota Produces 23%
of the Honey in the United States

PROJECT 5: North Dakota Community Orchard Grant Project

Final Report

Project Summary

The purpose of the North Dakota Community Orchard Grant Project is to continue the work we cultivated with the manual and orchard grants awarded in 2012. Many of our rural communities have open parcels of land with access to water. These plots could be future sites of orchards where communities can host local events plus grow food for their families.

In 2012 over 27 applications and numerous inquiries were received. Of the 27 applications only five communities received funding. Just under $20,000 from the total $154,834.36 requested. Due to the overwhelming response by communities and organizations it showed a continued need in the state for such projects.

Through this project the NDDA was able to assist seven more communities in North Dakota in developing a community orchard for outreach and education. The NDDA received 25 applications a great response to the project. This response again confirmed our expected measureable outcomes for the need for community orchards in North Dakota. The grant proved to be timely in that it allowed some communities to purchase more trees for an existing orchard to rebuild after a harsh winter in North Dakota. Another project that was funded allowed for the purchase of irrigation lines to be installed and more fruit trees to be planted making the orchard sustainable for years to come.

Project Approach

To accomplish our goals for this project work started in January of 2013 with the development of the grant application. The grants were advertised via press releases, emails, social media and word of mouth. Through all of this promotion 25 grant applications were received with over $107,000 in project requests. Grants were independently reviewed and scored on a 1-100 point scale, based on the below 7 criteria.

1. **Project description and the needs being addressed**-Projects should provide significant beneficial impact to communities, organizations, education, etc. Are beneficiaries actively involved in the project? - Does the project demonstrate how it increases will accomplish its purpose and does it have a clear need or benefit?
2. **Location priorities**-Orchard development and access, location, stakeholders established, irrigation established, security and fencing? - The trees/bushes/berries have been thought out and well planned
3. **Community Participation & Support**-Does the project include partners through organizations, identified individuals, schools? -Is the primary sponsor of the orchard established and prepared to handle the project? -Have groups been established to care for the orchard? -Has an experienced individual or group been identified to participate in the orchard project?
4. **Project is new and/or innovative**-Is the project added on to an established, successful orchard or is it a new project?

5. **Funding Priorities**-Is there additional funding sources for this project? -Is the project sustainable once this one-time grant is awarded?
6. **Budget and matching funds**-Is the budget financially realistic and reasonable? - Does the budget give evidence of cash and in-kind match?
7. **Overall quality of proposal**-Does the project have clear and identifiable goals and objectives and describe how it plans to meet them? - Does the project describe how it will benefit the community as a whole rather than just one individual? - Is it likely that the project can be completed (given the organization's capacity) within the budget and timelines as submitted?

Once the application were independently scored, grants were awarded to the highest scoring applicants. In April of 2013 seven application were awarded grants. The winning orchard projects then entered into a contract with the NDDA. Funds were awarded on a reimbursement basis only after receipts were submitted and all expenses could be verified as allowable and only enhance the competitiveness of specialty crops per each application. Contracts and dollars were managed internally by the NDDA. From April of 2013 to April of 2014 the winning orchard projects were monitored and required to submit both an annual and final report to the NDDA. These reports helped keep the grantees accountable. Site visits were done on three of the projects, FARRMS, Hettinger Park District and United Tribes Technical College.

One of the partners of the grant was NDSU Extension. During planting of one of the orchards the fruit project manager from an NDSU research center came out and gave a demonstration to the students of the local school the proper ways to plant and care for fruit trees. Many of the orchards had reached out to NDSU Master Gardeners in their communities to assist in the planning and care of their orchard. The partnerships created with NSDU will allow each orchard to be more sustainable for years to come.

Goals and Outcomes Achieved

One of the goals of the grant was to provide grant opportunities to six communities across North Dakota. Though the selection process were able to surpass our goal and award grants to seven deserving communities. The goal was achieved by sending out press releases, by social media advertising, and word of mouth.

Orchards take several years to mature and develop into fruit producing assets. Since this is the case it is very important that grantees did a good job in selecting sites, preparing land, buying hardy plants, having groups dedicated to caring for, and planting an orchard that will be sustainable for years to come. The second goal of increasing access to local foods was achieved through a thorough application and scoring process that allowed the NDDA to easily evaluate the sustainability of each project. The information gained will be valuable to future North Dakota orchards.

Through annual and final reports and sight visits all but one grantee successfully completed all the tasks outlined in their application. Below is a brief description of the seven successful grantees.

- James Valley Career and Tech Center, Jamestown – Developed an orchard surrounded by bush berries and other perennial fruit crops. Provided educational experiences including planting, orchard care, harvesting, marketing and nutrition. Once the orchard starts producing the fruit will be used in school meal programs and by local food banks. Two pear trees, three plum trees, two Chestnut Crab trees and 18 apple trees were planted.
  This orchard is only a part of the "master" buildings and grounds plan encompasses all land owned by Jamestown Public Schools. As per the buildings and grounds plans, there appears to be several areas that could serve to unite "form and function". An outdoor theatre and the shade of fruit trees or a Frisbee golf course intertwined with fruit trees are examples areas that incorporate form and function. The school master buildings and grounds plan will enable a long term tree placement and replacement areas. Since receiving this grant and working with the idea of a fruit orchard, a list of interested sponsors and supporters has made this project more affordable and will make future fruit tree developments projects more financially attainable.

- FARRMS, Medina - Developed the Medina Community Apple Orchard as a gathering space for the community and the annual Medina Fall Festival. Volunteers and agriculture education classes planted and will maintain the orchard. 12 apple trees were planted.
  Plans to use future apples on school lunch trays, for fresh fruit and vegetable snacks and as a focal point for Medina's fall festival were shared with the community.

Page 6 Tri-County News

Medina students plant community orchard on Earth Day

Golf team

Can You Identify Our

- Hettinger Park District, Hettinger - Restocked the orchard at Mirror Lake Park, provided educational opportunities for children and adults. The orchard serves as a model for growing food locally that will be used in schools or food pantries. 53 apple trees, 10 cherry trees and 20 plum trees were planted.
  As the orchard matures, the Hettinger School District, the local Boy Scout troop, area master gardeners, and the "For the Beauty of Hettinger" group will be able to utilize the orchard for educational programming and expand the programs to include horticulture and healthy living.

- Elgin-New Leipzig Public School, Elgin – The school was able to increase the size of the orchard started last year, the orchard continues to serve as an educational resource for the entire community. Ten pear trees, seven plum trees, seven black currant bushes and six raspberry bushes were planted. The school recognized that proper tree shape is vital to fruit production. For this reason, wooden limb spreaders were made over the winter months and placed so the branches will have a horizontal angle for the best fruit production and prevent bark inclusion. A strong tree framework will support fruit product. Plans are in the works to have continued educational opportunities for students in the spring.

- St. Peter's Lutheran Church, Leonard - A community orchard was developed as an extension of the church's youth garden project. The orchard has provided opportunities for fellowship and education, once the trees start to produce, the fruit will be donated to local food banks. 12 tress; pear, apple, plum and cherry were planted. Also planted were four grape plants and two varieties of strawberries.

- Marion Horizons Beautification Committee, Marion - Replaced trees and added grapevines, chokecherries, and rhubarb to two orchard sites planted in 2011. Two chokecherry trees and two plum trees were planted. Valiant grapes were planted in June 2013. The grant also allowed the committee to purchase better supplies that will continue to make caring for the orchard easier to help the orchard grow, develop and be suitable for years to come.

- United Tribes Technical College, Bismarck - Improved irrigation in a fruit orchard located in a five-acre research and demonstration garden. The fruit orchard provides local, healthy food to the UTTC Community and campus garden-to-cafeteria program.
  UTTC is anticipating is first real crop this next year! We will coordinate and collaborate with other campus departments to offer extension programing to learn the skills of maintaining orchards and harvesting/preserving the fruit. Workshop attendees will be able to take home fresh and preserved fruit. Any additional fruit will be donated to our campus cafeteria.
  Our mission is always to improve the quality of life through culturally appropriate and scientifically based education that will strengthen Tribal communities, sustain natural resources, and promote healthy lifestyles for citizens of Tribal nations. We are seeing the positive outcomes with greater participation in workshops and increased campus wellness policies. This year the North Dakota Public Health Association awarded the UTTC Wellness Committee the 'Team of the Year' award. This is reflected through Land Grant Extensions efforts to promote healthy lifestyles through policy, programing and community activities.

Beneficiaries

The stakeholders and groups that benefited include the cities that will be utilizing the orchards located in Jamestown, Medina, Hettinger, Elgin, Leonard, Marion, and Bismarck. Beneficiaries of the fruit produced include but are not limited to schools, nursing homes, and food shelters/pantries in each town and surrounding area. In many of the towns the orchards will also be used for education to teach about fruit production and orchard care.

The Community orchards are in public spaces and accessible by the whole community. For this reason below are the numbers of beneficiaries for each grant.

- James Valley Career and Tech Center, Jamestown – 15,323 people
- FARRMS, Medina – 303 people
- Hettinger Park District, Hettinger – 1,204 People
- Elgin-New Leipzig Public School, Elgin -615 people
- St. Peter's Lutheran Church, Leonard – 226 people
- Marion Horizons Beautification Committee, Marion – 131 people
- United Tribes Technical College, Bismarck – 86,508 people

Total Beneficiaries – 104,310

Lessons Learned

There were numerous lessons learned by the grantees. Many of the grantees held planting events where specialists were brought in to educate groups on proper tree selection, planting techniques and protecting the trees from wildlife. Other lessons learned were dealing with the unexpected weather events, one grantees orchard suffered damage after a wind storm and the schools vocational education classes had to provide more reinforcement for developing trees.

Some lessons learned were more logistical in nature. Working with planning and zoning committees proved to be a challenge for some grantees. Others learned how to work better with venders in getting trees and supplies ordered.

For the NDDA our lesson learned was related to grant administration. Initially eight grantees had scored high enough to receive funding. However, one of those grantee had issues getting the grant signed due to changes where the orchard would be placed. This issue was out of the control of the NDDA or the grantee. In the end that grantee did not start or compete their project. This resulted in only seven projects being successfully completed. The seven projects listed above were the only project that the NDDA requested funds for from the USDA. The NDDA learned site agreements are very important and in the future we are planning on asking more specific questions about the site agreements to make sure qualified projects can proceed as planned with minimal delays.

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PROJECT 6: Developing New Market Strategies in the Foodservice Industry for Pulses Grown in North Dakota, Montana and South Dakota

Final Report

Project Summary

The Northern Pulse Growers Association (NPGA) is the producer organization representing producers and processors of pulse crops in North Dakota and Montana. The mission of the NPGA is to provide leadership for a sustainable and profitable pulse industry through research, market development and education. Pulses are valuable crops for the region's agriculture and are primarily grown in rotation with wheat and other cereal crops. Pulses provide producers with rotational benefits such as increasing yields and breaking disease cycles commonly found in cereal grains. North Dakota and Montana comprise the largest pulse producing region in the United States and currently account for approximately 71% of the pulse crop production. Pulses are well recognized by health organizations globally and are recommended as part of healthy eating.

The United States food industry is increasingly interested in utilizing healthy ingredients like dry edible pulses/beans in the development of new value-added foods. Therefore, there is great potential for the domestic market growth of dry peas, lentils and chickpeas/garbanzos (also called pulses) within the United States and the World.

Pulse ingredients, namely pulse flour, protein, starch, and fibers, are starting to appear into the market due to the nutritional value, clean-label, low-allergenicity, and wide range of product applications. Among the pulse ingredients, pulse flour ranked highest in terms of usage (Mintel GNPD, 2013). It is used in thirteen different food categories including snacks (33%), followed by bakery (21%), soup (14%), meat substitute (10%), baby food (8%), dessert and ice cream (4%), sauces and seasonings (3%), and pasta and noodles (3%) (Mintel GNPD, 2013). Even though the usage of pulse is growing, we still see challenges in promoting nutritious pulses to United States food companies because of its uniqueness to the market.

The objective of this proposal was to increase the use of the regions peas, lentils and chickpeas in the United States as an ingredient in food products and food-service menus. The NPGA requested funds to collaborate with the USA Dry Pea & Lentil Council (USADPLC) to host a product development course that educated food processors and food service professionals, etc. on the benefits of using pulses in product and menu development. The project included an educational hands-on training symposium at the Culinary Institute of America (CIA) in St. Helena, CA.

National companies within the food manufacturing and foodservice industry are willing to embrace dry edible pulses as new functional ingredients yet they need more training in order to fully incorporate these products. The NPGA and the Northern Crops Institute have developed technical quality specifications for pulses grown in the states and also developed various formulations for pulse-based product prototypes that have not traditionally contained legumes as raw materials. There has been limited introduction of these products to food industry professionals at trade shows throughout the United States and it has created a great interest

among some companies in the market place. Feedback about the taste and texture has been very positive when using pulses to create functional foods.
With the new interest in using pulses as ingredients, food industry professionals need to be adequately trained to understand how pulses function. This training provided companies with the tools and contacts that they needed to develop new pulse based products. To accomplish this, the NPGA requested funds for a two-an-a-half-day educational hands-on symposium targeted to U.S food processing companies that manufacture food products for retail and foodservice.

The course was hosted at the Culinary Institute of America Greystone in St. Helena, California which is equipped with classroom and high-tech kitchen/bakery teaching facilities. Participants were selected from a range of over 60 professionals including nutritionists, research chefs, food scientists, manufacturers and marketing representatives from companies such as General Mills, Frito Lay, Campbell Soup, Dunkin Brands, Ingredion, etc.

The CIA requires a limit of 1 chef per 18 students in the kitchen and bakeshop, therefore we were limited to 36 participants for the event. The course curriculum included the itinerary, speaker bios, a series of new formulas which were developed by the NCI and the CIA and technical guidelines. Outreach and ongoing follow up was conducted after the course with the participants, including the distribution of photographs and a promotional video. In addition, the curriculum is being sent to additional companies that were unable to attend the event.

Past courses have been funded through the SCBGP however this course was more technical orientated and was focused on the different applications of pulse ingredients for healthy baking, high fiber baking, gluten free baking, and gluten free quality systems and testing. In addition other topics included pasta production and cereal production, pulse nutrition and functionality and sensory. Trained NCI and CIA staff taught the course and formulas and technical information from past projects were used to enhance the event.

Project Approach

Planning

- **Location and Date**

The first step in the planning process was to identify the location and date for the event. The NPGA originally planned to hold the course at the CIA in Hyde Park, New York, however the CIA informed us that they were unable to host the event at that location due to a large construction project. Because the CIA did not commit to Hyde Park location, the project was amended to extend the grant period from 12/7/2012 – 12/31/2014. The location was then moved to the CIA Greystone Campus in St. Helena, California and the date scheduled for the event was September 9-11, 2014. The CIA was chosen for a variety of reasons including the following:

1. The facility is equipped with the staff, classroom and kitchen facilities necessary to fulfill the requirements of the course.
2. The CIA assisted in the creation of the curriculum for the course and compiled all information necessary for the course manual. This course manual was distributed to all participants in the course.

3. The CIA has contacts with several well-named speakers and chefs, which allowed us to better access to expert speakers.
4. It is an appealing location for food industry representatives.
5. It is an attractive location for technical and culinary speakers.

- **Program**

The NPGA consulted with the ND Department of Agriculture in December of 2012 about adding to the project. The objective of the project was to increase pulse ingredients in processed food products and food-service menus with an emphasis on school foodservice. Currently school foodservice cannot serve processed products that contain "hidden" ingredients, added for nutritional value. Since school foodservice products are limited, we expanded the scope of the project to include all foodservice and processed food products. It will be very important for our region to continue to promote whole pulses and pulse ingredients such as pulse flours, proteins and starches. There are currently several companies within the region processing these pulse ingredients which has added great value to the entire industry.

The final itinerary for the program can be found in Appendix 1. The course focused on the different applications of pulse ingredients for healthy baking and processed food products. To accomplish this goal experts were brought in to speak about the following topics:

- Pulse fractions and functionalities including pea, lentil and chickpea flours, proteins, starches and fiber
- Applications in baked goods, beverages, pastas, snacks, cereals
- Gluten free quality systems and testing
- Nutritional properties and how pulses play an important role in human nutrition & health
- Sensory properties of pulse fractions
- Pulse and pulse fraction supply in the United States market

Trained NCI and CIA staff taught the course which was divided into a two and a half day event. Day one included the welcome and opening remarks, a nutritional overview, an interactive tasting and a historic tour of the Greystone Campus. Day two focused on the introduction of pulse ingredients and a hands on baking session in the CIA Bakeshop. In addition presentations were done on, gluten free baking, gluten free food safety, quality systems and testing, pea protein as an egg replacer and pulse flour, protein and starch processing. Day three featured pulse snack extrusion and a hands on baking session in the CIA Bakeshop and a discussion and evaluation of all pulse bakery and snack products that were made by participants.

- **Curriculum**

The curriculum for the course was developed through resources and technical experts from the CIA, NCI, NPGA, USADPLC and North Dakota State University. A conference call was set up in early March to discuss content of the program with all the organizations. Participants on the call included the following: Courtney Koehn, Consulting Services Manager, Greystone; Ted Russin, Director of CIA Consulting; Chef Richard Coppedge, Professor, Baking & Pastry, CIA; Dr. David Hahn, Director of Technical Service & Business Development, Northern Crops Institute; Kaye Effertz, Northern Pulse Growers Association; Mackenzie Femreite, Food Marketing Manager, USA Dry Pea & Lentil Council.

The title of the program was Pulses: Bakery & Snack Product Development Course and the focus was the use of pulse flours, fiber, protein and starch as ingredients in healthy bakery and snack products. Content for the curriculum included the following:

- Course itinerary
- Chef and speaker biographies
- Greystone teaching floor and operational overview
- An introduction to pulses
- Pulses as functional ingredients
- The nutritional overview of peas, lentils and chickpeas
- Pea protein as an egg replacer
- Gluten free baking.

The course curriculum also included a series of bakery and snack food formulas that were created by the CIA and the NCI. In addition six different flour blends were shown for gluten free baking. The formulas were divided into categories including quick breads, cookies/brownies, yeast raised and other breads, cakes and desserts, snacks and bars and purees and dips. The 105 page manual was printed for each participant to take to work as a resource in their R&D labs. A copy of the curriculum can be found in Appendix 2.

- **Speakers**

Speakers for the course included technical experts from the CIA, NCI, North Dakota State University, Washington State University and private companies. A list of the topics and speakers is shown below. The biographies for each speaker can be found in Appendix 3 and copies of the speaker presentations can be found in Appendix 4.

- **Opening Remarks and Session Overview** *Kaye Effertz, Marketing Director, Northern Pulse Growers Association*
- **Pulses in the United States** *Mackenzie Femreite, Food Marketing Manager, USA Dry Pea & Lentil Council*
- **Nutritional and Health Attributes of Pulses** *Dr.Clifford Hall, Ph.D., Associate Professor, North Dakota State University*
- **Interactive Presentation & Tasting** *Ted Russin, MSc, Director of Consulting, Culinary Institute of America (CIA)*
- **Introduction of Pulse Ingredients and Application**
  Naggie Jeradechachai, M.S., Northern Crops Institute
- **Gluten-free Demo -** *Chef* Coppedge , C.M.B, CIA Baking and Pastry Chef
- **Gluten-free Bakery Production: Food Safety, Quality Systems and Testing**
  Dr. David Hahn, Ph.D., Northern Crops Institute
- **Pea Protein as an Egg Replacer and High Fiber Baking**
  Dr. David Hahn, Ph.D., Northern Crops Institute
  Dr.Clifford Hall, Ph.D., Associate Professor, North Dakota State University
- **Protein, Starch Processing**
  Mehmet Tulbek, Ph.D., Director of R&D, Alliance Grain Traders

- **Snack Extrusion with Pulse Ingredients** *Dr. Girish Ganjyal, Ph.D., Washington State University Naggie Jeradechachai M.S., Northern Crops Institute*

➢ **Pulse Product Sponsors**

Pulse industry processors were asked to donate pulse flours, proteins, starches, fiber and whole and split pulse products for the course. Three companies donated the ingredients including AGT Foods, Inland Empire Milling and Harvest Innovations. In addition Best Cooking Pulses was in attendance during the course. In April the companies shipped ingredients to Chef Coppedge and his staff at the CIA in Hyde Park, NY for product development. Mid-August, additional flours, proteins and starches were shipped to the CIA in St. Helena, CA for usage during the course. Precooked and raw flours were sent along with protein concentrates and isolates. In addition the NCI shipped extruded ingredients that were processed in their lab. These ingredients were used in baking and bar applications.

Promotion

➢ **Web Page**

Prise Design group designed and managed the URL for the event. The address was within the USADPLC website. The URL went live in the beginning of March just in time to use the information for the Research Chef's Association Expo in Portland, OR. The webpage included an introduction page to the course with the course name, date and location. The name of our organizations and our contact information was also displayed. In addition, the homepage included the statement "Funds for this project are provided in part by the ND Department of Agriculture USDA Specialty Crop Block Grant." Participants were asked to register directly through the site which included contact information and a brief questionnaire. Once the application was submitted our staff reviewed it for acceptance. All applicants were notified within a week on the status of their application (accept or deny). The application form can be found in Appendix 5.

The webpage also promoted the NPGA website at www.northernpulse.com and the USADPLC website at www.pea-lentil.com.

➢ **EBlast Invitation**

An EBlast invitation was sent out in mid-April before our attendance at key national trade shows. An EBlast is an electronic invitation and it was sent to the USADPLC database of over 1,000 contacts. The EBlast can be found in Appendix 6.

➢ **Promotional Postcard Invitation**

A promotional 6x11 postcard was designed and printed to advertise the event to a large audience which included R&D chefs, food scientists, marketing representatives, product developers and nutritionists. To launch the promotional campaign, the NPGA and USADPLC distributed the cards at the Research Chefs Association luncheon sponsored by our organizations. The event which was held in in Portland, OR gave our organizations great publicity to over 350 key decision makers. The post cards were also distributed at national trade shows throughout the United States. The promotional postcard can be found in Appendix 7.

- **Trade Shows/Sponsorships**

The NPGA and USADPLC exhibited and attended several key trade shows throughout the year to promote the event. The shows gave our organizations the opportunity to promote peas, lentils and chickpeas and the fractions to a wide food industry audience. During the events all of our formulas and resource materials were promoted including the product development course. The course was promoted at the following shows in 2014:

Research Chefs Association – Charlotte, NC	March 6-9, 2013
Research Chefs Association – Portland, OR	March 12-15, 2014
Natural Products Expo West – Anaheim, CA	March 2014
Protein Trends & Technologies Seminar – Chicago, IL	April 2014
National Restaurant Association Expo – Chicago, IL	May 17-20, 2014
Institute of Food Technology Expo – New Orleans, LA	June 22-24, 2014

Execution

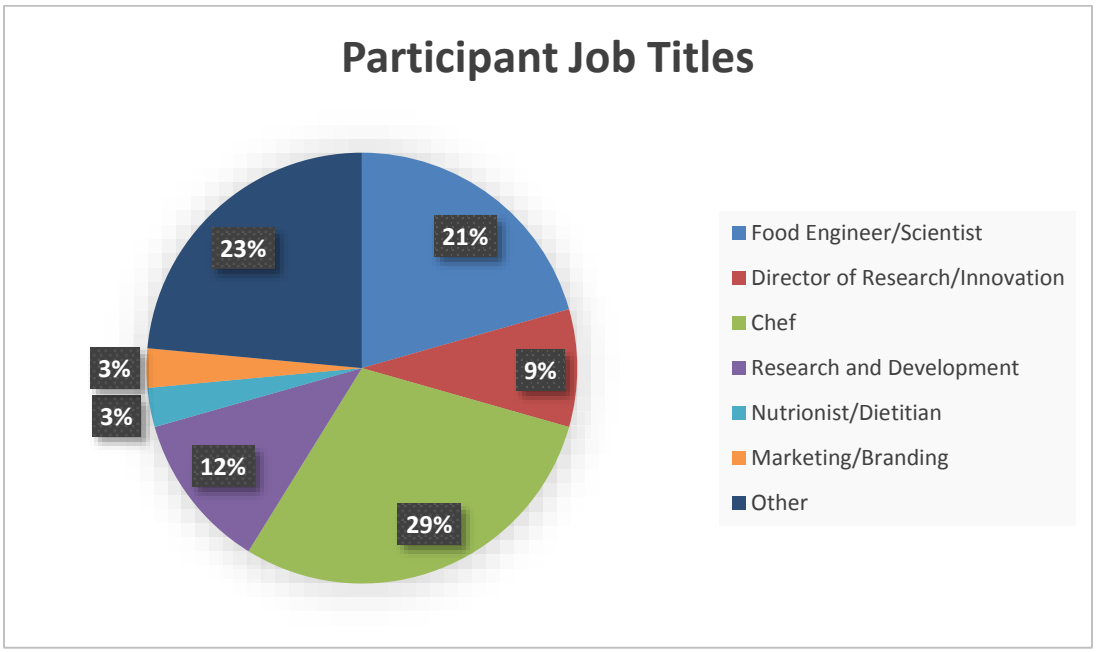
Sixty one applications were received for the course and 36 companies were accepted to attend and participate in the hands on training during the event. There were 49 total people in attendance including companies, speakers, staff and pulse industry representatives.

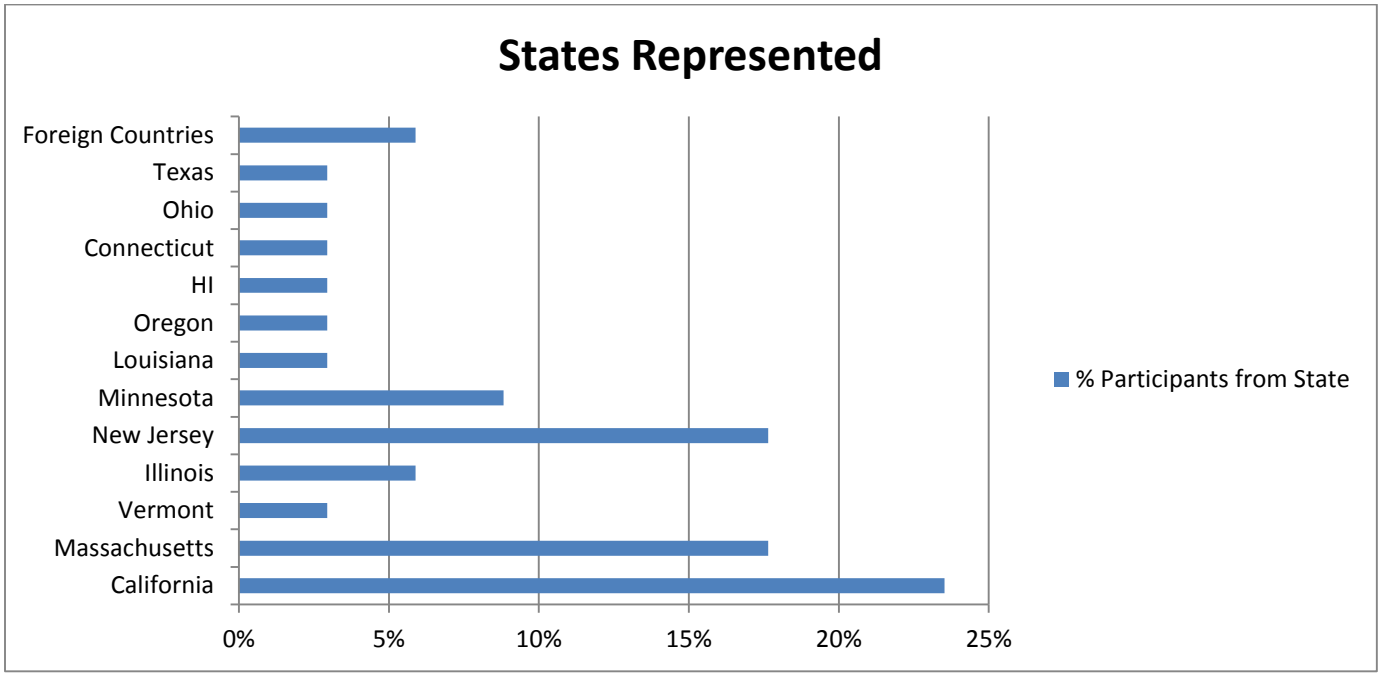
NAME	COMPANY NAME	TITLE
1. Maria Vargas	Independent Contractor	Nutrition Specialist
2. Susanna Tolini	Kayem Food Inc	Certified Research Chef
3. Sue Gray	King Arthur Flour	Other
4. Joshua Gomes	Dunkin Brands	R&D Kitchen Chef
5. Edward Tolini	Whole Foods	Other
6. Evelyn Gonzalez	Independent Contractor	R&D/Scientist/technical
7. Chris Follari	Sodexo	Corporate Executive Chef
8. Selene Segura	MINSA	R&D, Test Kitchen Chef
9. Monila Junkins	Jaali Bean	Co-founder, Chief Flavor Officer
10 Angelyn Weiss	Diversified Foods and Seasonings	Research Chef
11. Susan Murray, CRC	Northwest Naturals	Other
12. Bonnie Chau	The National Food Laboratory, LLC	Food Scientist/Technologist/Engineer
13. Gina Boux	CIGI	Food Scientist/Technologist/Engineer
14. Libby Roark	CCD Innovation	Product Development Chef
15. Jan Tsukazaki	Food Solutions International	General Manager
16. Nicholas Ahrens	Bay State Milling Company	Product Development Chef
17. Cheri Myers	Popchips, Inc.	Other R&D/Scientific/Technical
18. Edward Reinwald	Pepperidge Farm	Product Development Chef
19. Andrew Odom	Coalescence, LLC	Research Chef

20. Holly Ramage	Frito Lay, Inc.	Senior Food Scientist
21. Akhilesh Gautam	Frito Lay, Inc.	Other R&D/Scientific/Technical
22. Maia Lapic	Campbell Soup Company	Food Scientist/Technologist/Engineer
23. Alison Demadis	Department of Defense	Food Scientist/Technologist/Engineer
24. Anthony Lee	Natick Soldier RD&E Center	Food Scientist/Technologist/Engineer
25. Cynthia Machado	General Mills	Food Scientist/Technologist/Engineer
26. Morgan Patrick	General Mills	Food Scientist/Technologist/Engineer
27. Christine Shiinoki	Safeway	Research Chef
28. Elsa Pong	Dole	Innovation/Marketing Director
29. Gil Oetzel	Dole	Director of Research/Technical Director
30. Janet Carver	Ingredion	Culinary Group Manager
31. Dilek Uzunalioglu	Ingredion	Senior Assoc. Bakery & Snack
32. Patrick Obrien	Ingredion	Manager, Strategic Business Dev.
33. Jordan Grevis	Barilla	Research Specialist
34. Matt Tom	Hampton Creek	Director of Process Innovation (Engineering)
PULSE INDUSTRY REPRESENTATIVES		
35. Mark Sterner	Inland Empire Foods	President
36. Becky Starr	Harvest Innovations	Western Region Sales Manager
37. Jerry Schauble	Inland Empire Milling	President
38. Herman So	AGT Foods	Director, Marketing and Innovation
39. Mararget Hughes	Best Cooking Pulses	Owner
SPEAKERS/STAFF		
40. Clifford Hall	North Dakota State University	Associate Professor
41. Girish Ganjya	Washington State University	Extension Food Processing Specialist
42. Mehmet Tulbek	AGT Foods	Ph.D., A.Ag.
43. Naggie Jeradechachai	Northern Crops Institute	Crop Quality Specialist
44. David Hahn	Northern Crops Institute	Director of Technical Services
45. Kaye Effertz	Northern Pulse Growers Assoc.	Marketing Director
46. Mackenzie Femreite	USA Dry Pea & Lentil Council	Food Marketing Manager
47. Emily Edlund	ND Department of Agriculture	Specialty Crop Grant Administrator
48. Richard Coppedge	The Culinary Institute of America	CIA Baking & Pastry Chef, CMB

49. Ted Russin	The Culinary Institute of America	Director of Consulting

Execution (continued)





The NPGA's mission is "To promote dry peas, lentils and chickpeas through industry education, market development, research coordination and government affairs providing the highest quality

food and feed products to the consumer." The NPGA is committed to the development of the pulse industry in this region therefore peas, lentils and chickpeas were the only commodity featured and promoted during this course. The dedication and expertise of the NCI and the USADPLC in cooperation with the NPGA created an opportunity for the project to meet all goals and expectations. To show the commitment of the NPGA, the organization gave matching funds and in-kind contributions of over $30,000. This includes the following: Personnel - $15,000 in-kind, Travel - $8,000 cash match, Other - $7,000 cash match. The execution of this proposed project will create economic opportunities for the regions' pulse industry

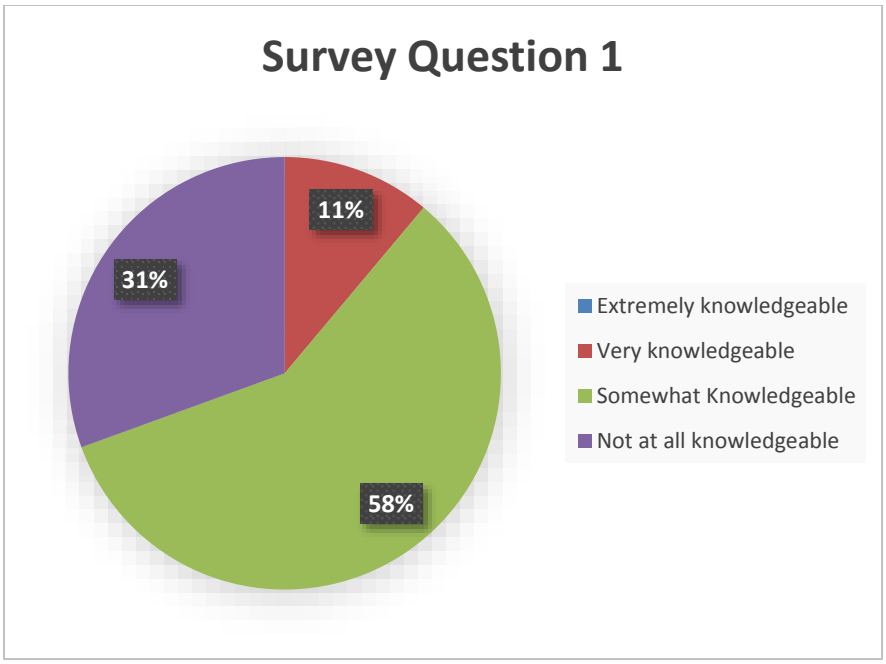
Goals and Outcomes Achieved

Overall the course was a huge success and the NPGA achieved most of the goals and objectives that were determined for the project. Food processing and foodservice companies are very excited about the new opportunities that exist when using pulses and pulse ingredients in their product lines. The main goal of the project was to educate companies about the benefits of using pulse ingredients in new products, current value added project lines, as an ingredient offering, or a new foodservice menu and this was accomplished during the event. The survey that was done after the course shows that a hands on course is an extremely effective way to introduce and educate people about the functionality of pulse ingredients. This course will help companies accelerate the R&D process which will lead to new pulse product lines in the food industry. Goals and outcomes are listed below that will help analyze the success of the project.

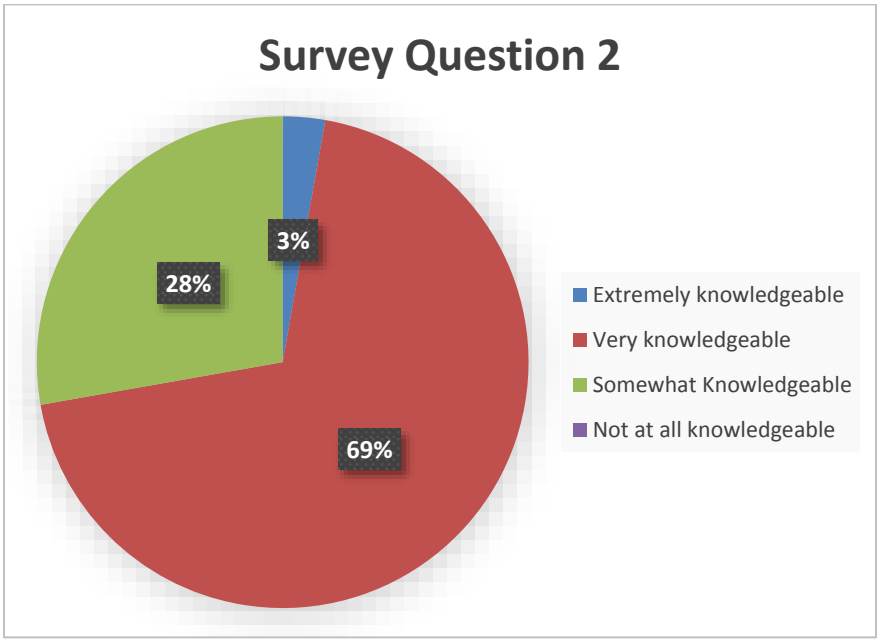
Goals

- ***Goal One –*** Increased awareness within the food industry on utilization of dry peas, lentils and chickpeas (DPL & C) integrated into food products.
- **Outcome:** After the course 100% of the participants were somewhat knowledgeable about peas, lentils and chickpeas as ingredients. It was also very exciting to note that before the course, only 11% of the participants indicated that they were very knowledgeable about pulse ingredients and after the course 69% said that they were very knowledgeable.

Survey Question 1 - Please rate your knowledge about dry peas, lentils and chickpeas as ingredients coming into the course.



Survey Question 2- Please rate your knowledge now that you have completed the course.



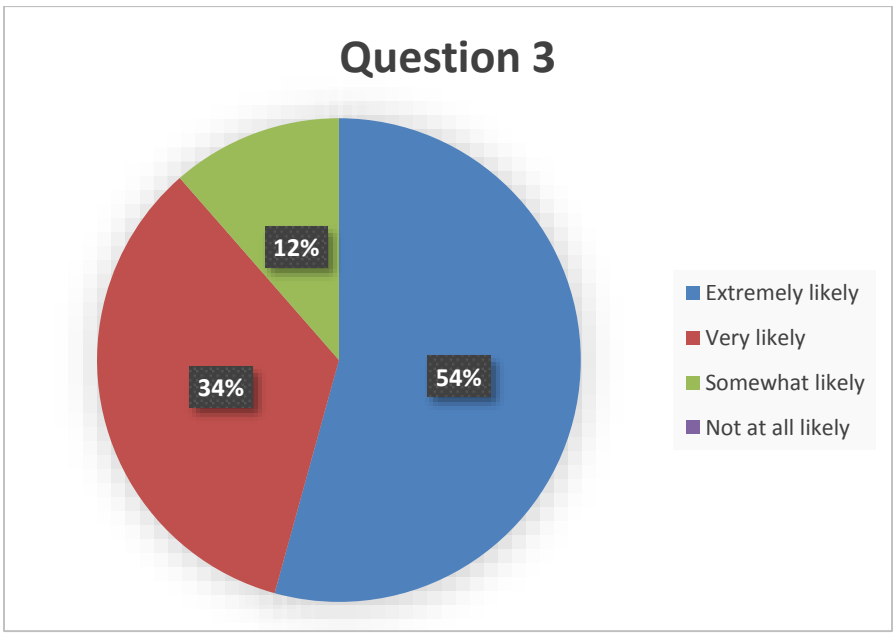
- ***Goal Two*** – Increase the production of U.S. peas, lentils and chickpeas
- **Outcome: <u>Peas</u>** - In 2013 there were 675,000 acres harvested in ND/MT and there was a 45% increase in production from 2012; The region accounts for 82% of the U.S. production. **<u>Lentils</u>** – In 2013 there were 255,000 acres harvested in ND/MT and there was a 9% decrease in production from 2012; The region accounts for 74% of U.S. production. **<u>Chickpeas</u>** – In 2013 there were 27,200 acres harvested and there was a 21% increase in production from 2012. The region accounts for 14% of U.S. production.

The target was a 50% increase in production from the 2012 crop. We did not hit this high target but we did come close. We did achieve a 45% increase in pea production which is very beneficial to the processors that are now milling these products. The drop in lentil acreage was due to extreme weather.

- ***Goal Three*** **–** Increase the number of U.S. value added processor memberships with the
- **Outcome:** To date we have not sold any new memberships to course participants although there has been a request for membership information from one of the milling companies in attendance. Most of the companies that attended the course are large companies and are more difficult to recruit for memberships. A final mailing will be sent to the participants which will include a group photo and a letter encouraging them to contact our organizations for additional information on pulses. The letter will also promote the NPGA/USADPLC memberships which we hope will generate new value added associates.

- ***Goal Four*** – Incorporation of dry peas, lentils and chickpeas into commercial products.
- **Outcome:** The target was that at least 25% of participants will be working on a pulse ingredient project post-course. According to our survey, participants from the course stated that 54% of them would be extremely likely to use peas, lentil and chickpeas ingredients in their product lines and 34% said they would be very likely to use pulse ingredients in their products. Considering the quality of the companies in attendance at the course this is excellent news for the pulse industry. The companies are primarily interested in learning more about the pulse proteins and pulse flours as ingredients.

Survey Question 3 - How likely are you to incorporate dry peas, lentils and chickpeas as ingredients in new product lines, a current value added product line, an ingredient offering, or new foodservice menu item?



Post Course Follow Up and Survey Results

This course included some of the largest food processing companies in the United States. Because of the great interest from these large companies, it was very important to conduct a survey to determine the success of the course for our industry. A post course survey was conducted after the event and 36 people participated.

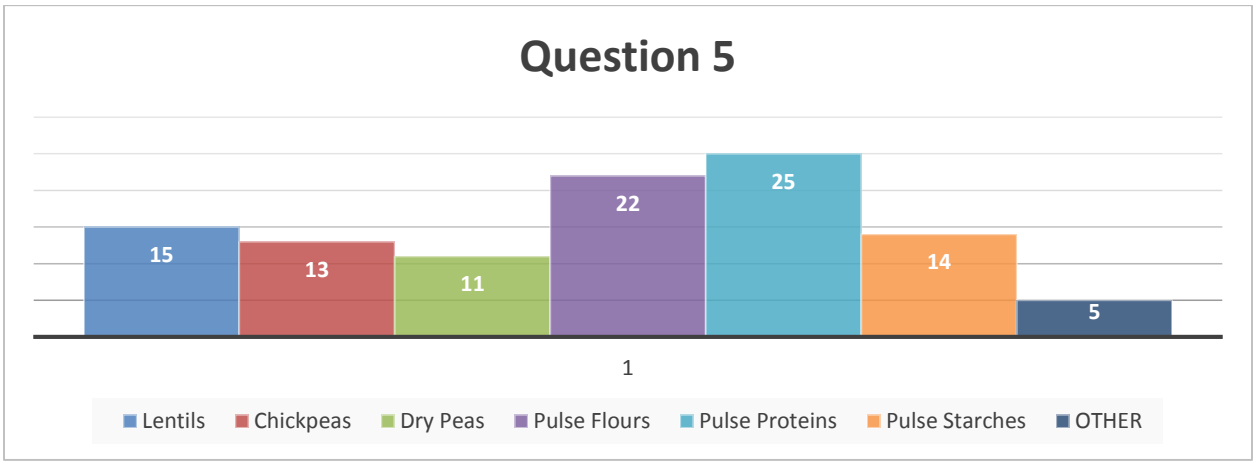
Comments from the participants.

- Excellent – all presenters were very knowledgeable - well done - thank you
- Hands-on exercise/practical application - liked group work and being assigned to teams
- Great learning experience and networking
- Very well organized
- Great opportunity for suppliers to connect with customers
- Good balance of hands-on time vs. lecture time
- Excellent food science & nutrition presentations
- Very informative

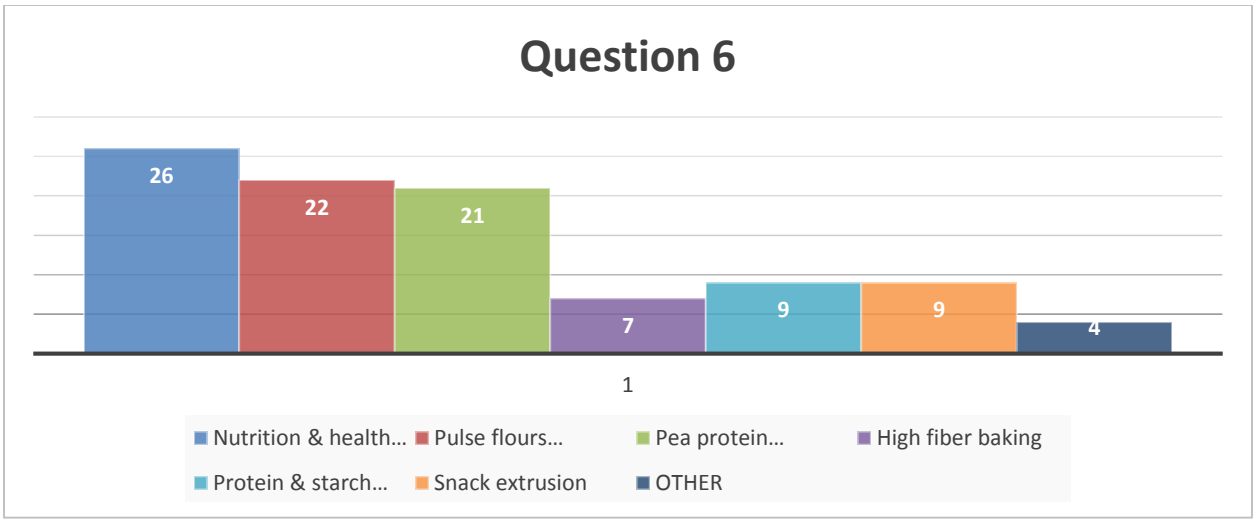
Future ideas

- Focus hands-on session more on pulse products vs. just gluten free.
- Need more information on claims
- More information on nutrition function to meet high protein label claim
- Would welcome a short course on beverage development
- Need more industry data
- Culinary instructors should work closer with technical suppliers

Survey Question 5 – After attending the course are there any pulse related topics you would like to learn more about.



Survey Question 6 – Which of the following session topics did you find most useful?



Beneficiaries

The primary beneficiaries of the project will be the region's pulse producers who grow dry pea, lentil and chickpea crops. In 2013, the value of pulse crop production represented more than $441 million dollars. The USDA Farm Service Agency in North Dakota reported that 1,289 producers planted peas and lentils in North Dakota in 2014. This number was not available in Montana, however since the acreages are similar in both states, the number of producers in the region is estimated at 2,500. The industry is successful in marketing pulses through food aid and commercial channels internationally. Over the past several years, domestic interest in pulses has increased dramatically as a result of a more health conscious approach to the U.S. consumer diet although the availability of pulse products in the retail and foodservice markets remains limited. An expanded domestic market for peas, lentils and chickpeas will create more opportunities for processing companies in the region creating a higher net value back to the producers. An example of this economic development is the recent addition of a large milling facility in Northwest North Dakota which sources pulse products from North Dakota and Montana. To track existing and new economic development in the region, the NPGA has recently retained North Dakota State University to conduct an economic analysis of the pulse industry in North Dakota and Montana and that analysis is tentatively scheduled to be completed by early 2015.

Lessons Learned

Problems and Delays

In December 2012, the project was amended to extend the grant period from 12/7/2012 – 12/31/2014. The NPGA originally planned to hold the course at the CIA in Hyde Park, New York, however the CIA contacted our office to inform us that they are unable to host the event at that location. They informed us that they could accommodate us at the CIA Greystone Campus in St. Helena, CA and therefore we re-scheduled the Course at the CIA Greystone for September 9-11, 2014.

In addition the NPGA consulted with the ND Department of Agriculture in December of 2012 about expanding the scope of the project. The objective of the project was to increase pulse ingredients in processed food products and food-service menus with an emphasis on school foodservice. Currently school foodservice cannot serve processed products that contain "hidden" ingredients, added for nutritional value. Since school foodservice products are limited, we expanded the scope of the project to include all foodservice and processed food products. It will be very important for our region to continue to promote whole pulses and pulse ingredients such as pulse flours, proteins and starches. There are currently several companies within the region processing these pulse ingredients which has added great value to the entire industry. Once the expansion of the project was established a new timeline was put together. The budget remained the same.

We did learn that the pulse flours are very versatile and work within many different types of products. One of the larger companies that participated in the course said the following "I haven't seen anything you can't make with it yet. You can put the flour in almost everything".

Contact

Shannon Berndt, NPGA Executive Director
701-222-0128
berndt@northernpulse.com

Kaye Effertz, NPGA Marketing Director
701-222-0128
effertz@northernpulse.com

Additional information available

Appendix 1.

Itinerary

Pulse Bakery & Snack Product Development Course
USA Dry Pea & Lentil Council / Northern Pulse Growers Association
The Culinary Institute of America at Greystone
September 9th - 11th, 2014

Day One: September 9, 2014

3:00 PM Welcome and Opening Remarks - DeBaun Theater, 1st Floor
Kaye Effertz, Marketing Director, Northern Pulse Growers Association,
Mackenzie Femreite, Food Marketing Manager, USA Dry Pea & Lentil Council

3:30 PM Nutritional and Health Attributes of Pulses
Dr.Clifford Hall, Ph.D., Associate Professor, North Dakota State University

4:15 PM Interactive Tasting
Ted Russin, MSc, Director of Consulting, Culinary Institute of America (CIA)

5:00 PM Tour of Historic Greystone Campus

5:30 PM Group Dinner - Wine Spectator Greystone Restaurant

7:00 PM Group Departs for the Evening

<u>Day Two: September 10, 2014</u>
7:30 AM Group Arrival on Campus/Continental Breakfast – Teaching Kitchen, 3rd Floor

8:00 AM Introduction of Pulse Ingredients and Application – DeBaun Theater, 1st Floor
Naggie Jeradechachai, M.S., Northern Crops Institute

9:00 AM Discussion of Hands on Production in CIA Bakeshop

9:30 AM Hands on Production in CIA Bakeshop - Bakeshop, 3rd Floor
Chef Coppedge, C.M.B, CIA Baking and Pastry Chef
Ted Russin, MSc, Director of Consulting, Culinary Institute of America
Naggie Jeradechachai M.S., Northern Crops Institute

12:30 PM Lunch from Greystone Student Production - Teaching Kitchen, 3rd Floor

1:15 PM Tasting of Student Morning Production
Review/Critique of Kitchen Exercise - DeBaun Theater, 1st Floor
Chef Coppedge, C.M.B, CIA Baking and Pastry Chef
Ted Russin, MSc, Director of Consulting, Culinary Institute of America
2:00 PM Gluten-free Demo - DeBaun Theater, 1st Floor
Chef Coppedge , C.M.B, CIA Baking and Pastry Chef

2:45 PM Gluten-free Bakery Production: Food Safety, Quality Systems and Testing
Dr. David Hahn, Ph.D., Northern Crops Institute

3:30 PM Pea Protein as an Egg Replacer and High Fiber Baking
Dr. David Hahn, Ph.D., Northern Crops Institute
Naggie Jeradechachai M.S., Northern Crops Institute

4:15 PM Protein, Starch Processing
Mehmet Tulbek, Ph.D., Director of R&D, Alliance Grain Traders

4:45 PM Introduction of Pulse Processors

5:15 PM Group Departs for Dinner on Own

<u>Day Three: September 11, 2014</u>
7:30 AM Group Arrival on Campus/Continental Breakfast - Teaching Kitchen, 3rd Floor

8:00 AM Snack Extrusion with Pulse Ingredients - DeBaun Theater, 1st Floor
Dr. Girish Ganjyal, Ph.D., Washington State University

Naggie Jeradechachai M.S., Northern Crops Institute

9:00 AM Discussion of Hands on Production in CIA Bakeshop

9:30 AM Hands on Production in CIA Bakeshop – Bakeshop, 3rd Floor
Chef Coppedge, C.M.B, CIA Baking and Pastry Chef
Ted Russin, MSc, Director of Consulting, Culinary Institute of America
Naggie Jeradechachai M.S., Northern Crops Institute

12:30 PM Lunch from Greystone Student Production - Teaching Kitchen, 3rd Floor

1:15 PM Tasting of Student Morning Production

Review/Critique of Kitchen Exercise - DeBaun Theater, 1st Floor
Chef Coppedge, C.M.B, CIA Baking and Pastry Chef
Ted Russin, MSc, Director of Consulting, Culinary Institute of America

2:00 PM Program Concludes; Participants Depart for Airport

Appendix 2.
Curriculum cover page and sample recipes. Please contact the Northern Pulse Growers Association for the entire curriculum.

THE CULINARY INSTITUTE OF AMERICA®

Northern Pulse Growers Association

USA Dry Pea & Lentil Council

PULSES: BAKERY & SNACK PRODUCT DEVELOPMENT COURSE

CIA Consulting Department, Hyde Park, New York

DARK CHOCOLATE TOASTED COCONUT CRISPY BAR

Ingredients	Grams	%
Vegetable shortening	60	8.7
Marshmallows	240	34.8
Coconut extract	3	0.4
Vanilla extract	2.1	0.3
Lentil/corn (50:50) crisps	159	23.0
Toasted coconut	114	16.5
Dark chocolate	112	16.2
Total amount	690.1	3.0

Method

1. Spray a 9x13 inch pan with nonstick cooking spray.
2. In a large saucepan melt shortening over low heat.
3. Add marshmallows and stir until completely melted. Do not over heat.
4. Remove marshmallow mixture from heat and add in the extracts.
5. Add the lentil crisps and coconut to the marshmallows and mix until well coated.
6. Spread mixture into the prepared pan and let cool.
7. Once cooled, cut into 2 inch bars and drizzle with melted dark chocolate and garnish with a pinch of toasted coconut.

Source: Northern Pulse Growers Association and Northern Crops Institute

Nutrition Facts

Serving Size (22g)
Servings Per Container

Amount Per Serving

Calories 100 Calories from Fat 45

	% Daily Value*
Total Fat 5g	8%
Saturated Fat 3g	15%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 10mg	0%
Total Carbohydrate 13g	4%
Dietary Fiber 1g	4%
Sugars 7g	
Protein 1g	

Vitamin A 0% • Vitamin C 0%
Calcium 0% • Iron 2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

		Calories:	2,000	2,500
Total Fat	Less than		65g	80g
Saturated Fat	Less than		20g	25g
Cholesterol	Less than		300mg	300mg
Sodium	Less than		2,400mg	2,400mg
Total Carbohydrate			300g	375g
Dietary Fiber			25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

CHOCOLATE CHICKPEA BAR

Ingredients	Grams	%
Dry ingredients		
Chickpea/corn (50:50) crisps	90	13.6
Sliced almonds	45	6.8
Wheat germ	45	6.8
Wheat bran	45	6.8
Flax seed	30	4.5
Wet ingredients		
Salt	1.5	0.2
Unsalted butter	27	4.1
Dark brown sugar	75	11.4
Dry vanilla extract	1.5	0.2
Brown rice syrup	105	15.9
Maltitol	30	4.5
Top drizzle layer		
Baking milk chocolate (melted)	30	4.5
Mini semi-sweet chocolate chips	30	4.5
Bottom layer coating		
Baking milk chocolate (melted)	75	11.4
Coconut oil (melted)	30	4.5
Total amount	660	100.0

Method

1. Toast all dry ingredients.
2. Put wet ingredients into a sauce pan and bring it to boil.
3. Mix wet and dry ingredients together.
4. Shape the mixture into a bar and let it cool and harden.
5. Place mini semi-sweet chocolate chips on top of the bar.
6. Drizzle melted milking chocolate on top.
7. Dip the bottom of the bar in chocolate/coconut oil mixture.
8. Let the bar sit and harden.

Source: Northern Pulse Growers Association and Northern Crops Institute

Nutrition Facts

Serving Size (35g)
Servings Per Container

Amount Per Serving

Calories 160 Calories from Fat 70

	% Daily Value*
Total Fat 7g	11%
Saturated Fat 4g	20%
Trans Fat 0g	
Cholesterol 5mg	2%
Sodium 40mg	2%
Total Carbohydrate 22g	7%
Dietary Fiber 3g	12%
Sugars 12g	
Protein 3g	

Vitamin A 2% • Vitamin C 0%
Calcium 2% • Iron 6%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

		Calories:	2,000	2,500
Total Fat	Less than		65g	80g
Saturated Fat	Less than		20g	25g
Cholesterol	Less than		300mg	300mg
Sodium	Less than		2,400mg	2,400mg
Total Carbohydrate			300g	375g
Dietary Fiber			25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Appendix 3.
Chef and speaker biographies

Chef Richard J. Coppedge, Jr., CMB
Rich Coppedge is a professor of baking and pastry arts at The Culinary Institute of America (CIA). Chef Coppedge currently teaches Advanced Baking Principles to students pursuing their bachelor's and associate degrees from the CIA. During his tenure at the CIA, he has taught various bread baking courses. Chef Coppedge is the author of Gluten-Free Baking with The Culinary Institute of America (Adams Media, 2008). He also helped develop and provide content for the CIA's bread baking instructional video series.

Prior to joining the college's faculty in 1992, Chef Coppedge held positions in such prestigious properties as The Ritz-Carlton Hotel Company and Walt Disney World. Chef Coppedge was also the bread baker for The Dunes Club in Providence, RI and the Narragansett Bay Baking Company in Newport, RI. For 10 years he was an assistant professor in the baking program at Johnson & Wales University in Providence.

Chef Coppedge is a Certified Master Baker (CMB). He holds an associate degree in culinary arts and a Bachelor of Science degree in food service management from Johnson & Wales University.

Ted Russin, MSc
The director of CIA Consulting, Ted Russin brings an invaluable mix of scientific and culinary expertise to his position. Before joining the CIA, he was research scientist for customer support and applications at CP Kelco in San Diego, CA. In that role, Mr. Russin was responsible for food product development and technical support for chefs, foodservice, and retail food product customers. Earlier in his career, he was a research chemist for the Canadian government agency Agriculture and Agri-Food Canada. In addition, Mr. Russin was a consulting expert and editor for several chapters of Nathan Myhrvold's groundbreaking book, Modernist Cuisine, and has worked with chefs Thomas Keller, Wylie Dufresne, Corey Lee, and Adrian Vasquez, among others. Ted Russin holds a master of science in food science and agricultural chemistry from McGill University in Montreal, Canada; bachelor's degrees from the University of Manitoba and the University of Winnipeg; and a certificate in cooking from Pierre Radisson Collegiate in Winnipeg.

Dr. Clifford Hall III, Ph.D
Dr. Clifford Hall completed his bachelor (1988) at University of Wisconsin - River Falls, masters (1991) and doctoral (1996) degrees at the University of Nebraska-Lincoln in the area of Food Science and Technology. Dr. Hall is currently an associate professor in the in the Cereal and Food Sciences programs in the Plant Sciences Department at North Dakota State University (NDSU). He is currently the Food Science Coordinator for the Institute of Food Technologist approved Food Science program at NDSU. In 2013, he completed the LEAD 21 leadership program.

He has taught 80 courses at NDSU since 2006 and has advised 8 Ph.D. and 8 masters students to completion and currently advises 2 Ph.D. and 4 masters students. He has also mentored 30

undergraduate researchers and has served on over 30 graduate student committees. His primary research areas include the utilization of non-traditional crops in food products. Examples include omega-3 fortification, from flaxseed, in extruded bean snacks, use of pulse proteins as egg replacers, effects of extrusion on pulse components and sensory and stability characteristics of pulses, pulse flours and pulse fortified products.

Dr. Hall has served as the Secretary/Treasurer (2003), Vice Chairperson (2004) and Chairperson (2005-2007) for the Lipid Oxidation and Quality Division of the American Oil Chemist's Society. He served as the Chair of the Best Paper Competition Committee for the Lipid Oxidation and Quality Division (2003-2006). He has also served as the Chairperson of the Education division for AACC International (2007-2009) and on the AACC International Foundation board member (2008-2012) and Chair (2009). He has also served as an Associate Editor (1998 to 2006) and Senior Associate Editor (2006 -2013) for the Journal of the American Oil Chemist's Society. Recently, he was appointed to the Institute of Food Technologists' Higher Education Review Board.

Dr. David Hahn, Ph.D.
Dr. David Hahn, Ph.D. is the Director of Technical Services and Business Development at the Northern Crops Institute. Dr. Hahn has over 30 years of experience in research, manufacturing, product development and technical support at several American food companies.
Dr. Hahn began his career with Hershey Foods Corporation where he worked in product development from 1984 to 1994. He was a Senior Staff Scientist from 1994 to 1999 from Pasta & Grocery Group of Hershey Foods. In 1999, New World Pasta Company purchased Hershey Pasta Group, and Hahn became the Director of Research and Technical Service for New World Pasta until 2008. He served as Vice President of R&D Product Innovation for Flower's Foods, where he was responsible for their new product program from June 2008 to January 2011. Most recently, Hahn has worked as a consultant for Doherty Food Advisory, Thomasville, GA.

Thunyaporn Jeradechachai (Naggie), M.S.
Naggie is a food scientist at the Northern Crops Institute in Fargo, North Dakota. She provides technical solutions to food manufacturers on the quality and utilization of pulse and oilseeds. Naggie travels in the U.S. and internationally to teach seminars and consult with food manufacturers on the value of the U.S. northern grown crops. Her specialties are traditional and gluten-free baking, pasta processing, snack, and cereal extrusions. Naggie is a professional member of American Oil Chemists Society (AOCS) and Institute of Food Technologists (IFT). Naggie is originally from Bangkok, Thailand.

Dr. Girish Ganjyal, Ph.D., MBA
Dr. Girish Ganjyal is a faculty in the School of Food Science at the Washington State University (WSU). Girish received his Ph.D. from the University of Nebraska-Lincoln (UNL) in Food Processing. After graduating from UNL, he worked as a Principal Scientist at MGP Ingredients, Inc. in the areas of protein and starch modifications and extrusion processing. Later he worked at PepsiCo in their Advanced Research Team on extrusion and frying processes, before joining WSU. Girish has over 9 years of industry experience in food ingredients, process technologies and food product development. Girish currently offers extension and research services for food

companies of all sizes and types through the WSU Food Processing extension and research programs. Girish is based in Pullman, WA

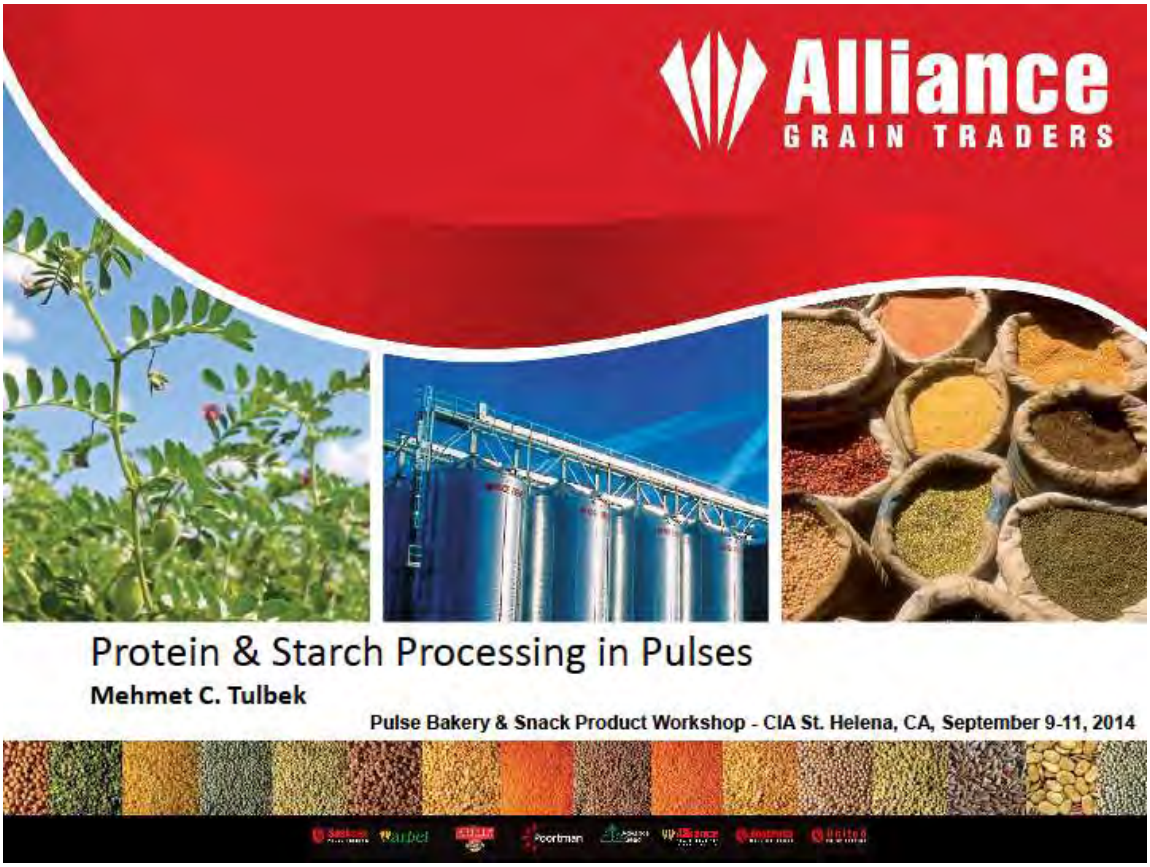
Mehmet Caglar Tulbek, Ph.D.
Mehmet Tulbek is the Director of Research and Development at Alliance Grain Traders Company in Saskatoon, Canada. He is in charge of strategic pipeline research, product development, innovation & commercialization and technology development projects within the group. Mehmet concluded his B.Sc. in Agricultural Engineering with the emphasis of Food Science and Technology at Ankara University, his M.Sc. in Food Engineering at Istanbul Technical University and his Ph.D. in Cereal Science at North Dakota State University. Before joining Alliance Grain Traders, he worked at Northern Crops Institute (NCI) as Technical Director and Crop Quality Specialist and led development of NCI pulse, oilseed and specialty crop technical, educational and international outreach programs. Mehmet is a member of American Association of Cereal Chemists International, American Oil Chemists' Society and Institute of Food Technologists.

Mackenzie Femreite
Mackenzie Femreite is the Food Marketing Manager for the USA Dry Pea & Lentil Council, the national organization that represents growers, processors, exporters, and traders of dry peas, lentils, and chickpeas grown in the United States. She is responsible for the development of new markets for dry peas, lentils and chickpeas in the U.S., promoting new applications of legumes as ingredients and provides education to the US food industry on these new uses across the country. Mackenzie earned her bachelor's degree in Food and Nutrition from the University of Idaho. Upon graduation, Mackenzie worked as a Nutrition Advisor for the University of Idaho Extension Eat Smart Idaho program, working with limited resource families and schools to make better food choices and lead healthier active lifestyles. Mackenzie has always been passionate about connecting people to food. In fact she sits on the Backyard Harvest (BYH) Board of Directors, a nonprofit that connects low-income families, seniors, and individuals with fresh local produce. BYH relies on volunteers to share their backyard bounty and extra fruit, making sure everyone in our community has healthy food to eat.

Kaye Effertz
Kaye is the Marketing Director for the Northern Pulse Growers Association which represents pulse producers from North Dakota and Montana. The mission of the Association is to promote dry peas, lentils and chickpeas through industry education, market development, research coordination and government affairs. Kaye graduated from North Dakota State University with a degree in Agriculture Economics. After graduation Kaye worked for the North Dakota Department of Agriculture as a Marketing Specialist and Marketing Director. In 1994 Kaye joined Image Printing to sell printing and design concepts to North Dakota companies. In 1997 Kaye accepted the Marketing Director position with the National Sunflower Association (NSA). While at the NSA, Kaye was responsible for marketing and promotion of sunflowers in the United States, Germany and Spain. Kaye started KR Marketing Company in 1999 where she continued her work with the NSA, ProBeef Company, Red River Commodities and AmeriFlax. While managing the AmeriFlax account, Kaye was responsible for marketing of flaxseed throughout the United States. Kaye has been with the Northern Pulse Growers Association for over six years.

Appendix 4.

Presentation title slides. Please contact the Northern Pulse Growers Association for complete speaker presentations.



Gluten-free Bakery Production: Food Safety, Quality Systems and Testing.

David Hahn, Ph.D.
Director Technical Services & Business Development

Connecting in the Global Marketplace

Snack Extrusion with Pulse Ingredients

Girish Ganjyal
Extension Food Processing Specialist
School of Food Science

High Fiber Baking

David Hahn, Ph.D.
Director Technical Services & Business Development

Connecting in the Global Marketplace

Connecting in the Global Marketplace

Nutritional and Health Attributes of Pulses

Clifford Hall, Ph.D., North Dakota state University

Thunyaporn Jeradechachai, Northern Crops Institute

Introduction of Pulse Ingredients and Application

NORTHERN CROPS INSTITUTE

BY: Naggie Jeradechachai
CROP QUALITY SPECIALIST

Evaluation of Peas Protein as a non-traditional ingredients in foods.

Clifford Hall III, North Dakota State University

Appendix 5.
Website homepage and attendance application

Home
- Attend Course
- Event Details

Pulses: Bakery and Snack Product Development Course

Discover the Versatility of Dry Peas, Lentils and Chickpeas as Value-Added Ingredients

- **What:** Bakery and Snack Product Development Course
- **When:** September 9-11, 2014
- **Where:** Culinary Institute of America's Greystone Campus in Napa Valley

Brought to you by:

Northern Pulse Growers Association & USA Dry Pea & Lentil Council

Join the USA Dry Pea & Lentil Council and the Northern Pulse Growers Association for a two-day, hands-on educational seminar at the premier culinary college, The Culinary Institute of America, in the beautiful Napa Valley.

Pulses — dry peas, lentils and chickpeas — are powerful ingredients that deliver great flavor and nutrition. Learn about the health benefits of pulses and their flours, proteins, starches, and fiber; we'll provide the tools to help you add nutrient rich value to your bakery and snack food products.

Course registration and lodging are provided by the USA Dry Pea & Lentil Council and the Northern Pulse Growers Association. Apply for registration and *confirm your attendance by August 8, 2014*. Space is limited.

Email Mackenzie Femreite or Kaye Effertz with any questions.

Funds for this project are provided in part by the North Dakota Department of Agriculture USDA Specialty Crop Block Grant Program.

- *Apply Today*

Fill out our application form today to attend

-

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Attendance Application

If you are interested in attending the free educational event "Pulses: Bakery and Snack Product Development Course," please complete the below application form.

Once we've received your application, we will contact you within 3-5 business days to confirm your attendance.

Registration closes August 8, 2014.

Contact Mackenzie Fennema for assistance.

Your Information

First Name
Last Name
Address
Number, Suite, etc.
City
State Select
Zipcode
Email
Phone
Fax
Company Name
Company Website
Job Title Select

Questionnaire

1) Please describe any products or menu items you currently offer (or that you are working on) that incorporate any form of dry peas, lentils and/or chickpeas.

2) Were these items specifically designed to be gluten free?

○ Yes ○ No

3) Have you ever used pulse flours as an ingredient?

○ Yes ○ No

4) Have you experienced any issues/challenges when working with dry peas, lentils or chickpeas (or their flours)?

○ Yes ○ No

5) If you have any questions about using dry peas, lentils and chickpeas (or their flours) as ingredients, please list them below.

Download Agenda

Download the latest agenda (PDF)

twitter facebook

6) Have you created (or are you looking to create) new menu items based on any of the following health or nutrition factors? Check all that apply.

- ☐ Gluten-free
- ☐ High protein
- ☐ High fiber
- ☐ Low glycemic index/glycemic load
- ☐ Full serving of vegetables
- ☐ Food allergies
- ☐ Other

7) Which foodservice trends and consumer demands are top-of-mind for your company/operation? Check all that apply.

- ☐ Vegetarian/meatless dining
- ☐ Lowering ingredient cost
- ☐ Ethnic/world cuisine
- ☐ Popularity of snacking
- ☐ Other

8) Have you created (or are you looking to create) new products or menu items based off of those trends? Check all that apply.

- ☐ Vegetarian/meatless dining
- ☐ Lowering ingredient cost
- ☐ Ethnic/world cuisine
- ☐ Popularity of snacking
- ☐ Other

9) What do you hope to learn from the workshop?

10) Which types of post-program takeaways or resources would you find most effective? Check all that apply.

- ☐ Recipes
- ☐ Brochures/info sheets
- ☐ Ingredient guides and sources
- ☐ USB drive with presentation
- ☐ Samples
- ☐ Other

Appendix 6.
Promotional e-blast

The Heart of Healthy Food

Pulses
peas, lentils & chickpeas

Add Nutrient Rich Value to Foodservice, Bakery and Snack Food Products

Join Us for a Free Educational Course:

Bakery and Snack Product Development Course
September 9-11, 2014
Culinary Institute of America's Greystone Campus in Napa Valley

A hands-on technical program focused on the use of pulse flours, fiber, protein, and starch ingredients for healthy bakery and snack products. Also a look at gluten free quality systems and testing.*

Registration and hotel accommodations provided by the USA Dry Pea & Lentil Council & the Northern Pulse Growers Association.

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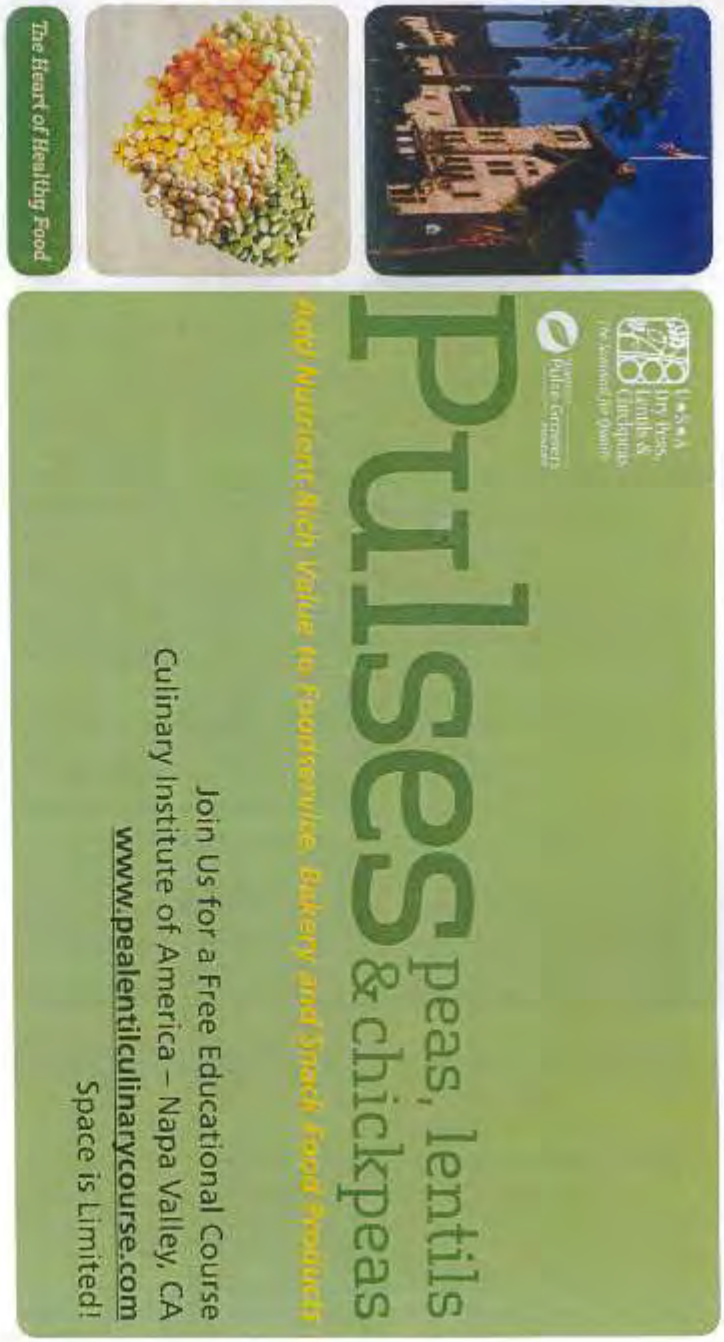
*Funds for the Healthy Baking & Snack Product Development Course were provided in part by the North Dakota Department of Agriculture USDA Specialty Crop Block Grant Program

Appendix 7.

Promotional postcard



Join Us for a Free Educational Course:

Bakery and Snack Product Development Course

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PROJECT 7: Increasing the Use of Specialty Crops in Schools with a Farm to School Coordinator Position

Final Report

Project Summary

North Dakota does not have a funded farm to school coordinator. As one of the last states to become a recognized farm to school state, both the schools and specialty crop producers have asked for assistance in partnering to provide more locally grown fruits and vegetables to schools. Surveys based on a prior Specialty Crop Block Grant (SCBG) indicated a need for someone to network farmers and schools.

Also, according to a survey conducted through the SCBG *"Increasing fruit and vegetable production to supply North Dakota Farm to School programs,"* schools use less than five percent locally produced specialty crops for school lunches. This survey identified barriers to the use of specialty crops in schools including the role of farm to school coordinator.

New nutrition guidelines set by the USDA require school cooks to double fruit and vegetable portions of school meals beginning with the 2012-2013 school year. This provides an opportunity to increase the purchase of locally grown specialty crops to schools.

A farm to school coordinator educates and trains specialty crop farmers and schools, encourage schools to use more local fruits and vegetables for meals and connects activities in the state to the National Farm to School Network. Farm food safety training is also provided to producers. Specialty crop materials (posters, recipes, etc.) specific to North Dakota Farm to School Programs will be created to be used statewide through the new farm to school website at www.ndfarmtoschool.org.

Project Approach

A webpage was created at www.ndfarmtoschool.org for the purpose of connecting farmers, parents and schools. Four schools were identified as using specialty crops regularly in schools and interviews were conducted with the food service staff. These schools became the models in the best practices publication, "How North Dakota Does Farm to School." This was distributed to all 410 schools in the state using the Department of Public Instructions mailing list. The National Farm to School and Regional USDA Farm to School team distributed the publication for legislative committee work using it as an example of the growing use of specialty crops in the state. It is available in .pdf form on the website.

Harvest of the Month materials solely based on specialty crops were created and distributed to schools inquiring about farm to school. A list of producers and schools is updated regularly and all materials are available on the website. The coordinator answered emails and phone queries about farm to school; and will continue to act as state lead for the NFSN in this capacity.

Farm to School activities have increased greatly in farm to school over the past two years. There have been news stories statewide. Photos and stories are shared on the website, Facebook and Twitter feeds from FARRMS.

The coordinator worked with the governor's office to proclaim Farm to School Week in 2013 and 2014.

Recorded Farm to School activity in 2013 was small. With the mailing of the best practices publication, the coordinator received confirmation that more than 5,369 students were exposed to specialty crops through farm tours, art projects and local lunches. Schools are also encouraged to celebrate Farm to School month in October, outside the end date of this grant using the tools on the website.

Attendance at the National Farm to School conference in 2014 increased from 2 North Dakota attendees in 2012 to 10 due largely to information provided by the coordinator.

The coordinator obtained scholarships for two residents of New Rockford working on specialty crops in schools as part of a community local food project to assist in transportation costs to the national conference.

Partners were involved in connecting schools and farmers to the farm to school coordinator; providing input on projects and proofreading documents; sitting on the farm to school steering committee; sharing the web page, Facebook posts and other social media; the Entrepreneurial Center for Horticulture at Dakota College in Bottineau provided the staff for farm food safety training and certification of specialty crop producers.

The food service director at the ND Department of Public instruction provided contact information, distributed information via the state newsletter and website and allowed a session on farm to school at the ND School Nutrition Association annual meeting. Both participants from New Rockford presented on their experience at the national conference and Bob Gorman, USDA Farm to School Mountain Region Representative, also provided farm to school information.

The coordinator also escorted Mr. Gorman farm tour to one of the new farmers providing specialty crops to the Jamestown School district.

Goals and Outcomes Achieved

Activities performed throughout life of grant include, but are not limited to:

- Created a web page at www.ndfarmtoschool.org.
    - 2013 – Views 1,182
    - Visitors – 479
    - Views per visitor = 2.47
    - 2014 – Views 2,284
    - Visitors – 1,194
    - Views per visitor = 1.91

- Visited Jamestown High School greenhouse took photos and notes.
- Was contacted by Jamestown School Board president and encouraged to work with Jamestown Schools.
- Went to Fort Yates and met with a team to implement farm to school as part of the back to school community event in August. We are seeking funds and ideas. Met with seven members of the community.
- Connected with Wishek High School and Hettinger School to follow the school gardens and assist as much as possible.
- Visited the Bismarck Career Academy greenhouse in Bismarck.
- Spoke to a group of about 20 about farm to school at economic development conference in Warren, Minn., (hosted by UND in Grand Forks.)
- Spoke about farm to school to a group of 65 Bismarck Garden Club members.
- Had a booth at Northern Plains Sustainable Agriculture Society Winter Conference in 2012 and 2013. Attendance at this event is about 300+.
- Attended workshops on procurement and education at MOSES in Eau Claire, Wis.
- Completed an online John Hopkins course on U.S. Food Systems.
- Participated in marketing panel at NPSAS Winter Conference to a room of 30 members.
- Had a booth at the NDDA local foods conference in Bismarck, attendance of 100 people.
- Held a farm food safety training in Valley City with five students. Have 5 students for the second one set for May 2.
- Sent out survey on sizes and quantities of vegetables purchased. Of the 50 mailed only 4 were returned.
- Planned harvest of the month materials to be used with schools that responded to the survey as well as the best practice schools.
- Met with Valley City School Food Service Director and new farmer to implement the purchase of specialty crops in the school.
- Was contacted by Sharon Buhr, director of Young People's Healthy Heart Program at Catholic Health Initiatives, Valley City, to partner with Farm to School activities in the fall.
- Held a webinar on a centralized food hub software program that may work for networking farmers and schools.
- Attended National Farm to School regional state lead annual meeting in Omaha, Neb., in May.
- Continue to be liaison between farmers and schools.
- Work on ND Farm to School week, Farm to School Month and Food Day. Requested ND Farm to School Week, Sept. 15-21, 2013.
- Prepared Harvest of the Month materials for participating schools. (Posters, recipes, surveys)
- Hosted a booth at the School Food Nutrition Assn. meeting June 4 in Fargo with Sadie Melie from USDA and Deb Egeland, ND Department of Public Instruction. Also a short presentation about how ND does farm to school. About 300 food service directors attended.
- Conducted survey with YCC and Granville School food directors for best practices publication.

- Became HACCP certified to assist with the connection between locally grown food and food service.
- Facilitated a second Farm Food Safety Trainings in April. About 20 farmers attended those sessions with Keith Knudson from ECH at Dakota College in Bottineau. These sessions focus on the safety of fruits and vegetables (specialty crops only).
- Received a governor proclamation for Farm to School Week
- Announced farm to school week in NORTH DAKOTA with Governor's proclamation and partnership with ND Dept. of Agriculture.
- Continued work on National Farm to School committee to involve the Tribes in Farm to School programs.
- Continue to work with Neil Doty on aquaponics and school food. The aquaponics provides greens, there is no current fish being sold.
- Toured a specialty crop farm with the Jamestown public school food service staff – 8 staff, 6 farmers, one farm to school coordinator and 1 newspaper reporter.
- Created Harvest of the Month materials. Posters were of specialty crops including honey, cucumbers, tomatoes, peas, beans, squash, summer squash, onions, beets, peppers, cabbage, greens and www.ndfarmtoschool.org.
- Did an interview with Jamestown food service director
- Honored request for information regarding farm to school at Lake Metigoshe.
- Preparing to do student surveys in November.
- Networked a new young farmer with Jamestown schools.
- Working with the national farm to school network to involve more Native Americans in the farm to school conference and thereby supporting local farm to school programs. There were six representatives from three North Dakota agencies at the farm to school conference.
- Began compiling a best practices booklet for Farm to School featuring the student survey results, some USDA Farm to School census information and three North Dakota School Models.
- Continue role as networking for farmers and schools; answer inquiries, keep webpage up to date and collect stories and schools that are interested in or beginning farm to school projects.
- Finished best practices booklet for Farm to School featuring the student survey results, some USDA Farm to School census information and four North Dakota School Models.
- Continue role as networking for farmers and schools; answer inquiries, keep webpage up to date and collect stories and schools that are interested in or beginning farm to school projects.
- Attended the annual meeting for the National Farm to School network and the conference.
- Escorted Bob Gorman, USDA Farm to School rep from the Mountain Region to the School Nutrition Association conference in Bismarck. We shared a booth space. Was also present and introduced when Mr. Gorman gave his presentation to a group of about 300 food service directors.
- Brought copies of the best practices publication to handout.
- Introduced Bob Gorman to one of our farm to school farmers. Did a farm tour.
- Updated the webpage at www.ndfarmtoschool.org.

- Reported to the NFSN and updated the ND webpage on the www.farmtoschool.org website.

Goal 1: Create one North Dakota-specific publication of the three working school models and their stories. This would include student taste preference survey results and information about how to begin farm to school in your school.

- Publication completed with four schools and mailed to 410 schools.
- The publication was also distributed to our U.S. Senators on the ag committee
- The publication was well received and our regional USDA farm to school contact distributed through that office.
- Student survey was completed by 1160 students and results included in publication. Sixty percent of the students indicated they did not like cafeteria food and 75 percent indicated they would try fruits and vegetables grown by local farmers.

Goal 2: Encourage and offer support for every school in the state to implement at least one farm to school activity during the ND Farm to School week in September. Document and collect all press releases and other media boosts for ND Farm to School. Materials will be created online and printed for such activities.

- 15 specialty crop Harvest of the Month posters were created and distributed
- Mailing for farm to school week was included in the distribution of the best practices publication. Twenty schools responded, but many other schools hosted activities around farms including ag in the classroom.
- Photos and press are shared on the website. Videos of news stories have a limited life and are not always available after a period of several months.

Goal 3: Increase the use of specialty crops by 20% over the targeted increase in the *"Increasing fruit and vegetable production to supply North Dakota Farm to School programs"* to meet the USDA's increase in the school meal pattern doubling fruits and vegetable servings with locally grown produce.

According to information from the previous grant, an increase of 15 percent or more was seen in the fresh and frozen offerings in salad bars from 2010 to the 2011-12 school year. The number of sales to schools in the $0-100 range remained the same at about 70 percent of respondents with 10 percent in the more $500 to $1,000 range.

- 7 schools purchased from $500 to $1,000 in specialty crops from farmers and farmers markets
- 15 schools purchased from $100 to $500 in specialty crops from farmers and farmers markets.

Using the high end of the scale that equates to $14,500 in fresh fruit and vegetable purchases. Using USDA farm to school census, updated in May of 2014, of the 45 schools responding to the survey, 15% of those schools have purchased from 15 to 20 percent of their food budgets on local foods for an estimated $48,284 in 2011-12; an increase of 300 percent over the 2010-2011 school year.

A poll of schools after the 2014 farm to school week indicated that 25 schools participated in farm to school activities. Out of 84 responses, there was a16 percent increase in purchases of

specialty crops from local farmers and 50 percent of those respondents purchased more than $100 of fresh fruits and vegetables from producers and farmers markets for that week.

In addition to purchases of specialty crops, 20 percent of schools used more than 2,835 pounds of fresh produce from school gardens. Seventy percent of those schools accepted and served more than 4,113 pounds of donated specialty crops from local growers. Using $1.50 per pound average price for these products that increases the amount of specialty crops used by more than $10,000 for an increased used of nearly 400 percent.

Goal 4: Create a farm to school dedicated web page to fully engage the partners in the process of encouraging their schools and producers in Farm to School activities – production, use and education. Create a one-stop contact for North Dakota Farm to School.

- 53 posts
- 88 Twitter followers
- 9 blog followers
- 607 Facebook followers
- 2,908 views
- 8 pages of information

We are always moving forward with the use of specialty crops and will continue to seek funding to provide assistance for farm to school.

The farm to school coordinator position works to network vegetable and fruit producers with schools. All farm food safety training, workshops, discussions and/or meetings focused solely on specialty crops. Specialty crops are easily incorporated into a school lunch program because of North Dakota's rules and regulations regarding the sale of whole uncut produce to schools as per a letter from Kenan Bullinger, ND State Health Department. This position dealt strictly with specialty crops as to not have to begin reducing the barriers to food products requiring processing licenses, butchering etc.

Beneficiaries

Beneficiaries of this project include:

10 farms with farm food safety certificates
20 farms with exposure to GAP through farm food safety training
18 farms listed in the directory
5,000 plus students participating in farm to school week activities
410 schools receiving information through DPI newsletters, conferences, Facebook, www.farmtoschool.org
10 people that attended the NFSN conference
200+ school food service at the state conference
1,100 students participating in the survey

Awareness about farm to school and specialty crops has increased based on the number of inquiries about farm to school; the number of schools participating in farm to school week and month and the increasing number of specialty crop producers in the state.

Lessons Learned

There is a need for a farm to school coordinator to grow Farm to School and the use of specialty crops in the state. Small producers are struggling to get their vegetables and fruits to market based on perceived and real barriers. It is the coordinator position that educates and encourages the one-on-one networking that makes farm to school successful.

It is difficult to track and entire state's activities, but participation in farm to school has increased with the awareness of the coordinator position – maybe the website or materials created that have helped this along. There is a need for the coordinator to conduct more educational workshops and classes and have the funds available to travel across the state.

Many of the schools are using school garden produce as well as donations from community gardeners. As a coordinator, we have encouraged schools to purchase more produce from farmers citing farm food safety training for our specialty crop producers as the number one reason to select growers produce over donations. The economic activity between farms and schools is hindered by these donations albeit a good thing that the students are receiving the benefits of fresh fruits and vegetables.

While it is important to fund a position, it is critical to have more funds available for trainings, travel and supplies for schools and specialty crop producers. With the number of pounds of donated specialty crops provided to the schools, there is definitely some work that needs to be done to increase purchases from farmers creating economic development opportunities for small and diversified specialty crop growers in the state.

Also, it may benefit the farm to school activity in the state greatly to begin educating the school boards, principals and teachers to the benefits of fresh fruits and vegetables to increase the use of locally grown specialty crops in the future.

Contact

Contact: Sue B. Balcom
701-527-5169
sbalcom@farrms.org

Additional information available

- Please see the website at www.farrms.org for
  - Harvest of the month materials/recipes (download)
  - Resources for farm to school
  - Best practices publication (download)
  - Photos of farm to school activities
  - Links to grant opportunities, etc.

Survey data available upon request.

PROJECT 8: Hastening the Fruit Ripening Process for Germplasm Enhancement in Cold-Hardy Grape Crosses

Final Report

Project Summary

Grower frustration with hardy, but not hardy enough material for North Dakota has led to a grape germplasm enhancement project at NDSU. In the beginning, this project started collecting samples from extremely hardy, old, indigenous *V. riparia* vines for crossing. Most of these selections turned out to be male plants that produce only male flowers, suggesting that fruit production may have a negative effect on winter survival unless female biotypes initiate acclimation (first process towards dormancy) responses to environmental conditions other than air and soil temperature, and soil water content. Thus we started collecting older female *V. riparia* plants that begin to acclimate around Labor Day and appear to just respond to day-length for initiation of acclimation and are using these female plants for some of our crossing.

The use of V. riparia is needed for cold-hardiness attributes. Unfortunately, one of the hardiest grape species in the world also has a large variation in fruit characteristics and generally a tendency toward dark "inky" juice and low tannin content. This is at odds with the desirable traits for red wine, in which moderate color and high tannin content are preferred. Crossing germplasm that has a predetermined minimum phenolic concentration and maximum tannin concentration would help to eliminate progeny with extremely poor fruit characteristics. This would save an enormous amount of development time and resources and allow us to focus our efforts on material with the greatest potential. Thus, the characterization of germplasm for phenolic and tannin content was conducted.

Variety introductions generally take 15 years from the initial cross to the release of a cultivar. To reduce this time limitation, one needs to either have unlimited resources to make a large number of crosses and field test hundreds of thousands of seedlings each year; or one needs a screening method to eliminate crosses with poor potential of producing a commercial cultivar. For grape production in North Dakota to succeed, growers need very cold-hardy grapes that do not respond to favorable fall weather conditions and produce fruit that ripen prior to initiation of acclimation with appropriate fruit characteristics for winemaking. We have utilized the methyl cellulose precipitable tannin assay developed by researchers in Australia to categorize parental material by their tannin levels in fruit. By combining photo-stable and high-tannin parents, we have greatly reduced the number of potential crosses and hopefully reduced the number of years needed before our first introduction. This is extremely important to growers that can't rely on current cultivars to survive a harsh winter as was experienced in 2013 and to an industry in its infancy.

Project Approach

WORK PLAN:

Project Activity	Who	Timeline
Collect potentially superior V. riparia selections.	Collin Auwarter	June with a follow-up on fruit in September.
We received many contacts from people in ND and MT on locations (including GPS coordinates) of superior V. riparia vines. Collin went to all the locations and collected plant material when he deemed the selection as superior.		

NDGGA field day and research results update.	Harlene Hatterman-Valenti, Tom Plocher, John Stenger	September
Approximately 40 people attended and listened to research progress. Obtained additional locations of V. riparia vines. Numerous questions.		
NDSU Horticulture field day and research results update.	Harlene Hatterman-Valenti, John Stenger	September
Excellent attendance of over 100 people. Also talked to State Board for Agriculture Research and Extension (SBARE) about research and need for hardier wine grape cultivars.		
Initiate characterization of parent material.	Harlene Hatterman-Valenti, Tom Plocher, John Stenger	October or as fruit becomes available through the greenhouse breeding process
Determined rankings from high to low of parent material for tannin contents two consecutive years (Table 1). Rankings were similar even though tannin concentrations varied from one year to the next.		
Initiate sex conversion studies on male V. riparia slections.	Harlene Hatterman-Valenti – Tom Plocher – student help	September through December
First trial failed, so we contacted research authors who suggested no correlation between old male vines and high cold-hardiness characteristics. Decided to drop this research and focus on other areas with greater potential benefit.		
Progeny greenhouse evaluation prior to transplanting into first year field nursery	Harlene Hatterman-Valenti, Tom Plocher, John Stenger, Collin Auwarter	October through September
Progeny grew so well in the new greenhouse that we had to prune twice before setting outside to harden off.		
Progeny transplant, field evaluation, and survival data	Harlene Hatterman-Valenti, John Stenger, Collin Auwarter	October and May
Transplanted progeny at the Minot nursery as well as the Fargo nursery. Needed to erect a deer fence at Minot while the Fargo nursery needed a fence to protect from rabbits. Approximately 2,000 seedlings were transplanted each year.		
NDGGA legislative mixer and research program update	Harlene Hatterman-Valenti	February
Answered questions and promoted grape germplasm enhancement project. Received well by most legislative representatives.		
NDGGA annual meeting and research results update.	Harlene Hatterman-Valenti, Tom Plocher, John Stenger	March
Provided update both years. Educating growers on the time requirement between initial cross and subsequent release has been well received even though growers want immediate release of material.		
Progeny field data collection and asexual propagation	Harlene Hatterman-Valenti, John Stenger, Collin Auwarter	October through September
Fruit was collected and quality measured. Two selections have desired values for titratable acidity (Table 2). Anxious to see if results are repeatable in 2014.		

Table 1. Ranking of parent material in 2013 and 2014 according to fruit skin total phenolic and tannin content.

Access	Rank	Estimate	Standard Error	DF	t Value	Pr > |t|
IM#1	1	1.132	0.2057	35	5.50	<.0001
TP2351	2	0.874	0.2055	35	4.25	0.0001
TP2250	3	0.856	0.2693	35	3.18	0.0031
TP1112	4	0.471	0.1775	35	2.65	0.0119
TP1134	5	0.462	0.1609	35	2.87	0.0069
MN1094	6	0.458	0.2048	35	2.24	0.0319
TP2117	7	0.432	0.1781	35	2.42	0.0208
P Pearl	8	0.425	0.2117	35	2.01	0.0524
TP1215	9	0.378	0.3671	35	1.03	0.3105
DM8521	10	0.370	0.1345	35	2.75	0.0093
SK009#15	11	0.351	0.3624	35	0.97	0.3394
ES12618	12	0.314	0.2621	35	1.20	0.2394
Marquette	13	0.251	0.1452	35	1.73	0.0932
MN1220	14	0.229	0.2517	35	0.91	0.3693
SK007#8	15	0.171	0.3624	35	0.47	0.6399
ES101806	16	0.168	0.3671	35	0.46	0.6504
MN1131	17	0.136	0.18	35	0.76	0.455
Frontenac	18	0.109	0.1349	35	0.81	0.4238
SK007#6	19	-0.004	0.3624	35	-0.01	0.9914

Table 2. Fruit quality characteristics from first set of seedlings planted into the field and producing fruit from NDSU germplasm enhancement project.

Cross	TA%	mg/l	Brix	pH	Brix* pH^2	Brix* pH^2/TA^2	Rank in cross	Overall rank	Brix rank	pH rank	TA rank
MHND2009003	2.9	29.3	26.2	2.8	206.9	17.8	1	37	10	37	41
MHND2009003	2.3	22.8	20.0	2.8	154.6	16.6	2	38	38	38	37
MHND2009003	2.6	26.3	23.3	2.7	164.9	14.8	3	40	20	41	40
MHND2009005	2.0	20.0	21.6	3.4	249.7	45.8	2	28	31	5	32
MHND2009005	1.4	13.8	25.1	3.6	321.7	152.9	1	5	13	2	14
MHND2009004	1.4	13.8	23.2	3.1	227.3	86.7	9	17	21	17	16
MHND2009004	1.9	19.0	21.6	3.1	204.9	37.8	16	33	31	22	28
MHND2009004	1.5	15.0	26.9	3.4	305.5	123.1	6	11	7	6	21
MHND2009004	2.2	21.5	22.1	3.1	213.8	31.8	17	34	28	19	36
MHND2009004	2.0	20.3	23.8	3.1	230.2	41.6	13	30	17	19	34
MHND2009004	1.3	13.0	27.4	3.2	282.3	146.9	2	6	4	12	11
MHND2009004	1.8	18.0	26.7	3.3	294.3	80.5	10	19	8	8	26
MHND2009004	1.8	18.3	26.9	3.1	251.9	62.3	12	24	7	24	27
MHND2009004	1.1	10.5	21.8	3.1	210.9	129.7	4	9	29	19	5

MHND2009004	1.3	13.3	27.0	3.2	267.9	129.8	3	8	5	16	12
MHND2009004	1.5	14.8	26.4	3.1	253.7	95.4	8	15	9	21	20
MHND2009004	2.2	21.5	25.5	3.0	229.5	38.0	15	32	12	27	35
MHND2009004	1.2	12.3	23.6	3.0	211.0	99.2	7	13	18	28	8
MHND2009004	1.5	15.3	25.6	2.9	216.8	69.4	11	20	11	35	22
MHND2009004	1.7	16.5	20.4	3.0	178.7	39.6	14	31	37	31	23
MHND2009004	0.7	6.7	22.4	3.4	265.1	448.3	1	1	27	3	1
MHND2009004	0.8	8.5	18.8	2.9	162.5	124.3	5	10	39	33	2
MHND2009008	1.3	12.5	22.8	3.1	212.1	94.4	3	16	24	25	9
MHND2009008	1.4	14.0	21.2	3.0	187.0	60.1	7	25	35	29	17
MHND2009008	1.4	14.0	21.6	3.1	202.3	68.2	4	21	31	24	18
MHND2009008	1.9	19.0	27.8	2.9	230.6	51.1	8	26	3	36	29
MHND2009008	1.1	11.0	23.0	3.2	234.1	141.9	1	7	23	13	6
MHND2009008	1.2	12.0	21.0	3.2	212.4	98.5	2	14	36	14	7
MHND2009008	1.5	14.5	23.0	3.0	201.5	65.3	5	22	23	31	19
MHND2009008	1.8	17.5	24.0	3.3	253.5	64.6	6	23	15	11	25
MHND2009009	1.0	10.3	27.9	3.3	302.0	263.8	1	2	2	10	4
MHND2009009	1.4	13.8	29.7	3.6	380.6	214.1	2	4	1	2	14
MHND2009009	1.4	13.8	23.9	3.3	258.7	107.6	3	12	16	10	14
MHND2009011	2.6	26.3	23.3	2.7	171.1	15.7	1	39	20	40	40
SKND2009007	3.0	30.3	6.1	2.6	40.3	0.7	3	43	43	42	42
SKND2009007	3.9	38.5	15.5	2.5	97.7	2.6	2	42	42	43	43
SKND2009007	1.7	17.3	22.6	3.0	198.0	44.5	1	29	25	31	24
SKND2009009	2.4	24.0	18.7	2.8	143.5	12.9	5	41	40	39	38
SKND2009009	2.0	20.0	22.4	3.4	251.4	47.2	2	27	27	7	32
SKND2009009	2.0	20.0	21.4	3.0	195.2	31.5	3	35	33	26	32
SKND2009009	1.0	10.0	24.5	3.4	284.9	238.0	1	3	14	4	3
SKND2009009	2.0	19.8	17.9	2.9	153.7	20.7	4	36	41	34	30
SKND2009012	1.3	13.0	21.2	3.2	210.4	83.1	1	18	35	16	11

Goals and Outcomes Achieved

By incorporating the methyl cellulose precipitable tannin assay and converting the collection of indigenous male *V. riparia*, the wine potential for the large collection of parent material at NDSU can be ranked and crossing efforts can focus on those selections with greater probability of producing seedlings that will have fruit with phenolic and tannin contents needed to make a palatable wine. Regular updates on the progress of characterizing the germplasm were provided to the North Dakota stakeholders by posting these updates on the NDSU- Grapes listserv, at field days, and at the annual meeting of the North Dakota Grape Growers'. The NDSU-Grapes listserv is part of the NDUS listserv (listserv.nodak.edu) that has 138 lists. I moderate this listserv, which currently has 202 subscribers that can post questions related to growing grapes or wine making. Subscribers are mainly members of the North Dakota Grape and Wine Association, but anyone can send me a request to join the grape listserv. As the moderator, I can also develop a newsletter and send to all subscribers. This has been an excellent way to periodically update the main stakeholders of this project. The past two years the average attendance at the NDGWA fall

field day has been 125. This field day alternates between the eastern and western part of the state and has limited overlap in attendance. In addition, a NDSU Horticulture field day is held each fall with an average attendance of 75 to 100. Membership to NDGWA is approximately 200. The NDGWA website has been completely renovated with a counter to record the number of website hits and a much improved platform to broadly disseminate grape research. The NDGWA continues to develop programs in addition to their annual meeting with NDSU grape research updates as the central focus.
The research project will be of interest to a much wider audience as well. Broader dissemination has been accomplished with the NDSU Plant Sciences Facebook account, the high-value crops website, the NDGWA website, and by presenting data at the NDGWA annual meeting, the ASHS annual meeting, and the International Horticulture Congress.

Crossing continues throughout the year in the greenhouse as well as outdoors during June in response to tannin results from parental material (Table 3).
Table 2. Crosses made to increase the tannin levels in the fruit skins.

Location	Maternal	Paternal	Seeds	Clusters Crossed
Field				
Absaraka, ND	ES 6-16-30	Louise Swenson	.	6
	ES 6-16-30	Solaris	.	6
	ES 6-16-30	Ekre Male #1 (V. riparia)	.	10
	ES 6-16-30	Edelweiss	.	2
	ES 6-16-30	Alpenglow	.	10
	DM 8521-1	Regent	.	4
	DM 8521-1	Cabernet Franc	.	8
	DM 8521-1	Lemberger	.	14
	ES 10-18-75	Louise Swenson	.	2
	ES 4-22-60	Riesling	.	2
	Louise Swenson	Riesling	.	10
	Louise Swenson	Inner Mongolia #1	.	8
	Louise Swenson	ES 6-16-30	.	12
	Louise Swenson	Solaris	.	2
	Stuben	Ekre Male #1 (V. riparia)	.	2
	Campbells Early	ES 6-16-30	.	4
	Campbells Early	ES 10-18-75	.	4
	Edelweiss	Ekre Male #1 (V. riparia)	.	10
Greenhouse				
	ND287 (Valiant x Madeleine Angevine)	SELF	104	.
	ND311 (Valiant x Madeleine Angevine)	SELF	40	.
	ND733 (Valiant x Madeleine Angevine)	SELF	28	.

	Frontenac Blanc	ND253 (Valiant x Madeleine Angevine)	121	.
	ND368 (Valiant x Madeleine Angevine)	Louise Swenson	1	.
	Solaris	Mandan GR 3 (V. riparia)	29	.
	Agria	SD 62-9-39 (V. riparia)	77	.
	ES 5-14	Louise Swenson	.	1
	ES 6-3-33	Louise Swenson	.	2
	Alpenglow	ES 10-18-14	.	1
	Burmunk	Rip 821 (V. riparia)	.	1
	Smuglanka	DM 8521-1	.	10
	Burmunk	NDVRGPS 10 (V. riparia)	.	1
	ND287 (Valiant x Madeleine Angevine)	Louise Swenson	.	1
	(Regent x Ekre Male #1)	DM 8521-1		2
	F2-VAL	SELF		1
Hugo, MN				
	DM 8521-1	Pinot Precose		8
	MN 1094	Dorfelder		7
	MN 1094	Pinot Precose		3
	ES 10-18-06	MN 1094		6
	TP 2-2-50	Montana riparia 62-9-39		2
	TP 2-2-50	Montana riparia 62-7-2		2

Beneficiaries

Many North Dakota homeowners want a hardy grape that they do not have to do special activities in the fall in order to have fruit the following year. They also want something that has lower acid levels than 'Beta' a very old cultivar with moderate to good cold hardiness but rather poor fruit quality. In addition, commercial growers and wineries are requesting this material. Currently there are 11 commercial wineries and 125 vineyards in North Dakota. Two more wineries will be opening in 2015. Growers in surrounding states are also anxious to obtain hardier material. The group that benefited the most from the project's accomplishments are the North Dakota Grape and Wine Association members.
Between field day attendees, annual meeting attendees, listserv members, and website hits, almost 500 beneficiaries were affected by the project's accomplishments and/or the potential economic impact of the project.

Lessons Learned

The most important lesson that was learned is to contact and author that has published a specific procedure as methods described in the publication aren't necessarily as straight

forward as described. Project staff have refined crossing techniques and have really improved the success ratio of crosses and seed germination. This has increased our seedling numbers and hopefully improved our cultivar release potential.
The most unexpected result was the high tannin content from Inner Mongolian #1. As a result, we are now including it in some of our crosses.

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Web site for the high-value crops project: http://www.ag.ndsu.edu/plantsciences/research/high-value-crops.

PROJECT 9: Discovery of Specific Starch Properties of NDSU Potato Germplasm for Nutritional and Industrial Applications

Final Report

Project Summary

Potato (*Solanum tuberosum* L.) is the fourth most widely grown crop worldwide, following wheat, corn and rice (FAO). Potato provides energy, protein, and is an excellent source of vitamin C, potassium, folate, as well as, thiamine and niacin. Its yield potential allows production capabilities of more calories per acre than any other foodstuff, with the exception of sugarcane. Additionally, it is utilized as a feed ingredient for livestock in many areas of the world. While potato is important for food and feed worldwide, consumption in the U.S. has declined in recent years.

The most important vegetable and horticultural crop grown in North Dakota is the potato, *Solanum tuberosum* L. In 2013, potatoes were planted on about 31,780 ha and harvested on approximately 31,566 ha (NASS 2014). Potato hectares in North Dakota (ND) have significantly declined (approximately 17,000 ha) since 2001; thus, potato producers in ND and the northern plains are interested in increasing market share. However, news reports continue to link potatoes with obesity, diabetes, and other diet-related diseases (Halton et al. 2006, Mozaffarian et al, 2011, Soh and Brand-Miller 1999, Foster-Powell et al. 2002). The USDA National Nutrient Database indicates a serving of potatoes (approx. 155.5 g) contains 13 mg vitamin C, 379 mg potassium, 1.44 mg niacin and an average of 1.8 g fiber and 1.87 g protein, while supplying about 20 g carbohydrate, making potato is a carbohydrate nutrient-rich food. Relatively little work has been reported characterizing the carbohydrate composition of commercially and widely grown potato cultivars.

Potatoes are about 80% water and 20% dry matter, of which 60 to 80% is starch. The starch is packed in granules that contain amylase and amylopectin in an approximate ratio of 1:3 (Carmire et al. 2009). Starch content appears to be highly variable, and Jansen et al (2001) report a range from 11-30% for cultivated potato varieties, and from 4-40% in wild potato species. Environment impacts starch quality (Bach et al 2013). In an effort to encourage and escalate the innovative use of potatoes, research was initiated to determine variations in starch properties including identification of genotypes with higher levels of resistant starch, increased levels of micronutrients and higher levels of bioactive functional components.

The North Dakota State University (NDSU) potato improvement team has actively developed improved potato selections since 1930, more than 80 years as part of the North Dakota Agricultural Experiment Station, releasing 26 cultivars, most recently Dakota Russet in 2012 and Dakota Ruby in 2014. Our primary objective is to develop superior, multi-purpose cultivars, that are high yielding, possess improved and multiple resistances to pests and stresses, have excellent processing and consumer qualities, and are adapted to North Dakota, Minnesota, and the Northern Plains. The NDSU potato improvement team focuses breeding, selection, and cultivar development efforts on traits important to our industry, including high yield, durable disease and insect pest resistance, and improved quality attributes, such as cold processing ability (both chip and frozen products) and sugar end resistance. Germplasm enhancement and dedicated crossing

blocks are used in our hybridizing efforts to develop resistance to pests and stresses and in improving quality attributes. While major emphasis is placed on developing genotypes with varying levels of specific gravity, an indirect measure of dry matter content, for different culinary uses, characterization of starch attributes in this diverse collection of germplasm has not been undertaken. Determination of starch properties including total starch, resistant starch, amylyse/amylopectin ratio, gelatination profile, chain-length analysis, the pasting profile, degree of crystallinity, and molecular weight will allow novel approaches to product development, food science and nutritional applications, and industrial utilization.

In order to address the needs of potato producers and the potato industry in North Dakota and the Northern Plains, we established these research objectives: 1) evaluation of parental and advancing selections, capitalizing on genetic diversity, in the NDSU potato breeding program for starch attributes; 2) Identification of appropriate genotypes for fine screening of starch quality traits, based upon initial screening, resulting in identification of clones suited for specific innovative and novel end uses; and 3) Increased production of prospective potato genotypes and work with industry and entrepreneurs to develop products.

Project Approach

Per the work plan, potato genotypes for evaluation were produced and harvested several times. Due to the timing and lack of a MS student to assist with the project, the materials were stored for long periods; some began to break dormancy, sprout, and change in terms of membrane integrity. Materials stored for more than a year have been discarded and some efforts were made to grow some of these selections in the greenhouse in order to not lose them as they may have been dropped from evaluation by the NDSU potato breeding program.

A literature review has been conducted by our graduate student. Additional publications are added as they are published. It is our goal to publish a review paper for the American Journal of Potato Research if accepted by the reviews editor.

Megazyme screening of potato genotypes was conducted. Ten genotypes were evaluated to date. This number falls short of our goals, but we are learning the process and have ideas for streamlining it (please see the Lessons Learned section). Raw potato starch consists of large amounts of resistant starch, which when cooked is converted into digestible starch. Foods high in rapidly digested starch elicit a high insulin demand and have a high glycemic index (GI) (Augustin 2002). Starch is classified by levels of digestibility (Englyst et al 1992), and is broken into three components: rapidly digestible starch (RDS), slowly digestible starch (SDS), and resistant starch (RS). Resistant starches are undigested until they reach the large intestine, while the RDS and SDS are rapidly digested, in the first 20 minutes and 21 to 120 minutes after ingestion, respectively. Amylose has a more resistant structure, thus RS is expected to be primarily composed of amylase, while amylopectin breaks down more rapidly and is more prevalent in RDS and SDS (Bach et al 2013). Total starch is determined by adding RDS + SDS + RS.

The results for the genotypes indicate wide variation for soluble (rapidly digestible and slowly digestible starches) and resistant starch across the 10 selections (Table 1).

Table 1. Mean optical densities (od) for soluble and resistant starch for ten potato genotypes.

Genotype	Soluble Starch	Resistant Starch
ND102600B-1Russ	0.2180bc	0.0810de
ND102604B-1R	0.1270a	0.0340ab
ND102631AB-1	0.2475bc	0.0665cd
ND102638CAB-1	0.3315de	0.1095e
ND102642C-1	0.1350a	0.0665cd
ND102647-1Russ	0.2910cd	0.1090e
ND102647-3Russ	0.3940e	0.1040e
Red Norland	0.2445bc	0.0630bcd
Russet Burbank	0.2690bcd	0.0450bc
Yukon Gold	0.2075ab	0.0295a
Mean	0.2465	0.0703
LSD $\alpha = 0.05$*	0.0817	0.0298

* Letters following numbers indicate significance

Widely grown and consumed cultivars were used as controls. These include Red Norland, Russet Burbank, and Yukon Gold. Based on our results, Yukon Gold tends to have slightly lower soluble (total) starch quantities than Red Norland or Russet Burbank. Russet Burbank is the most widely produced potato cultivar in the US, primarily for processing into frozen French fries, which requires high dry matter content. Typically, the texture of Red Norland and Yukon Gold, both fresh market cultivars, is considered to be more waxy in texture, specific gravity levels are lower than for Russet Burbank, and chip or fry colors tend to be darker due to higher sugar levels, particularly the reducing sugars of glucose and fructose.

The seven selections compared to these controls represent a diverse set of germplasm, in that several wild species are represented in the immediate parent or within the pedigree of the lines. Species represented include *Solanum phureja*, *Solanum etuberosum*, *Solanum berthaultii*, *Solanum bulbocastanum*, *Solanum chacoense*, *Solanum raphanifolium*, and *Solanum infundibuliforme*. The red-skinned selection, ND102604B-1R, had the lowest mean od for soluble starch, although it is not significantly different from ND102642C-1. Low soluble starch levels are desirable as they lead to a lower glycemic index. Yukon Gold and ND102604B-1R had lower levels of resistant starch. Selections developed for processing, ND102638CAB-1 (chip), ND102647-1Russ and ND102647-3Russ (frozen), had higher od values for RS, indicative of higher resistant starch quantities. The latter two clones are the result of the cross Dakota Russet x M7. The female parent has *Solanum raphanifolium* as a grandparent, while a parent of M7 is *Solanum infundibuliforme* (Jansky et al 2012). Other white skinned clones were intermediate for soluble and resistant starch od. Identification of genotypes differing in starch quality attributes are an exciting finding to date.

Fine screening of unique genotypes has not been undertaken to date, because of limited evaluation of genotypes has been conducted for soluble and resistant starch.

Results of this screening and for additional genotypes will be presented at the upcoming NPPGA Research Reporting Conference in February 2015. Potentially, unique genotypes will be increased for further evaluation and subsequent product development in summer 2015.

Goals and Outcomes Achieved

The **first objective** of this project was to evaluate parental genotypes and advancing potato selections from the NDSU potato breeding program for starch attributes, focusing on the genetic diversity contained within this germplasm collection. Assessment will include total starch, resistant starch, and determination of the amylase/amylopectin ratio. Starch content in potato genotypes is highly variable, ranging from 11-30% in potato cultivars, to 4-40% in wild potato species (Jansen et al. 2001). In order to develop durable long-term resistance to diseases, insect pests, and stresses, the NDSU potato improvement team breeding efforts include germplasm enhancement, incorporating resistance and improved quality attributes through the use of wild species, wild species hybrids, and the use of released cultivars and advanced germplasm from breeding programs around the globe.

Just ten selections have been evaluated for soluble and resistant starch components. However, these results indicate significant differences in starch profiles for NDSU potato breeding germplasm. Our breeding program maintains approximately 500 genotypes or more at any given time; much of this material is diverse from a genetic standpoint, representing not just *Solanum tuberosum* germplasm, but also containing progeny from many wild potato species.

The **second objective** of this project was to conduct fine starch chemistry assessments of unique potato genotypes based upon the initial evaluation in objective 1. Because we have not completed the assessment of the diversity of germplasm contained within the potato breeding program, selections have not been identified to conduct the fine starch chemistry screening. Fine screening will include determination of the gelatination profile (by DSC), chain-length analysis (by HPAEC), pasting profile (by RVA), degree of crystallinity (by X-ray diffraction), and molecular weight (by HP-SEC).

In consultation with the NPPGA Potato Innovation Group, **objective 3** was to determine prospective potato genotypes for increased production, based upon the fine screening results in objective 2. Potato clones with unique starch properties could be targeted for research and development of products in the areas of diet and human nutrition, bioplastics and other industrial applications, pharmaceutical uses, and food products. We continue to update the NPPGA on our progress and will work with key seed and commercial growers to increase potential lines of interest in the future.

Information continues to be shared with the Specialty Crop Stakeholders (ie. potato producers, industry representatives, and agricultural researchers) via several venues, including the Potato Innovation Group meetings (held approximately monthly from harvest to planting and some via conference call, on average about 15 members attend regularly, though some sessions are double and triple that), at the Northern Plains Potato Growers Association (NPPGA) Annual Field Day

(usually third Thursday of August), the Northern Plains Potato Growers Research Reporting Conference (held in conjunction with the International Crops Expo in Grand Forks each February), and via articles in the Valley Potato Grower magazine (with a circulation of just over 9,200) and Potato Bytes (on-line weekly electronic newsletter). There are approximately 250 members of the NPPGA and many more readers around the nation of the Valley Potato Grower magazine and Potato Bytes. During the August 21, 2014, NPPGA Field Day, approximately 160, 200, and 100 people attended sessions at Larimore, Inkster and Hoople, ND, respectively.

A literature review was initiated and continues as a work in progress. Our hopes are to submit a review article for the American Journal of Potato Research.

Our progress to date has been meager, but we will be investigating ways to speed up the analysis of our materials. Based on further evaluation, we will determine unique genotypes for fine screening per the work plan and will work with the potato innovation team to determine distinct profiles and to increase these genotypes for further evaluation and potential product development.

Beneficiaries

Potato production in North Dakota has declined by approximately 16,000 ha or 32%, since 2001. Additionally, the number of producers has declined with time. The Northern Plains Potato Growers Association website indicates that they have approximately 250 grower members in ND and MN. All could be impacted by results of this project, whether they produce seed potatoes, or potatoes for the different market sectors (chip processing, fresh, frozen processing), or perhaps a new industrial category may arise in our area based on this research and future findings.

Consumers of potatoes, snackfoods, plastics, and pharmaceuticals may also be impacted through product development or improved potato cultivars with enhanced nutritional attributes. Potato genotypes with unique starch quality attributes (higher levels of resistant starch, increased levels of micronutrients and higher levels of bioactive functional components) potentially may lead to novel product development (diet and nutritional goods, original foodstuffs, industrial applications such as bioplastics, and pharmaceutical uses including as coatings which slow or speed medication absorption). Ultimately, unique potato cultivars with distinctive starch properties (and possessing multiple resistances to pests and environmental stresses an objective of the NDSU potato improvement team) may reduce input costs for producers, provide high quality raw material for processing, and provide superior choices for consumers, thus providing a sustainable, cost-effective, healthy, and environmentally friendly food and industrial source.

Lessons Learned

Sample preparation is quite time intensive. A positive lesson that we learned is that we can probably use microwavable steam bags rather than boiling and baking the tubers prior to starch extraction. A sample can be prepared in the microwave in 3.5 to 7 minutes, compared to an hour for baking, and nearly as long for boiling. A negative is that our current setup allows just one sample to be read in the spectrophotometer at a time.

Our goals were not attained, despite having a no-cost extension granted. This had to do with our inability to secure a graduate student until late into the process, due to timing of the initial funds being available and then a student coming on board and resigning unexpectedly a month into the semester. New graduate students may not start mid-term. Because of this, germplasm was stored for two years with no evaluation, some of which has been grown in the greenhouse so that we can access as we drop many selections annually, which may impact the diversity of germplasm and the starch content these clones may have, as well as the fine starch profiles for traits such as gelatination profiles, chain-length analysis, pasting profiles, crystallinity, and molecular weight. While we know that storage and cooking can influence starch attributes, we do not know how production location (ie. irrigated versus non-irrigated conditions, field versus greenhouse, etc.) influence starch chemistry. We are really just getting started evaluating the NDSU potato breeding program genotypes and comparing them to the popular cultivars Red Norland, Russet Burbank, and Yukon Gold. These initial findings (for soluble and resistant starch), for a tiny number of clones (just 10 reported here. Our program contains approximately 500 genotypes maintained in the field per growing season), are very interesting and demonstrates a wide range in total and resistant starch amounts across genotypes. While I am very disappointed that we are not farther along in the starch content analysis and have done no fine screening, it is still exciting to see the range within this limited data set.

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Additional information available

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