Specialty Crop Block Grant Program—Farm Bill

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Minnesota Department of Agriculture,
Agricultural Marketing and Development Division (MDA-AMDD)

Project Coordinator:
Julianne LaClair, Grants Specialist, 651-201-6135, julianne.laclair@state.mn.us

2014-15 Final Report

1/29/15
Revised 3/12/15
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Project A

MN Specialty Crop Block Grant
FINAL PERFORMANCE REPORT

This form is used to make a final report to MDA. It is due no later than 60 days following the end of your project.

Please submit electronically in MS Word format to Brian Erickson at brian.j.erickson@state.mn.us, or if accompanied by an invoice, to **mda.accounts-payable@state.mn.us**

Submitted by: Meg Moynihan

e-mail: meg.moynihan@state.mn.us

Date: 1/21/2014

PROJECT TITLE

Specialty Crop Farm Business Management FY 11

PROJECT SUMMARY

1. **Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.**

Minnesota agriculture is dominated by commodity cash crop and livestock production. However, increasing consumer interest in purchasing local food – especially fruits and vegetables – has opened up tremendous market opportunities for Minnesota specialty crop growers. Prospective growers need reliable cost of production and profitability data in order to make informed decisions about whether to undertake these enterprises. For example, when lots of growers rush into producing "x" after hearing rumors that they can make a lot of money doing it, they hurt themselves and the industry as a whole if their expectations turn out to be unfounded and their land, labor, and capital investments fail.

2. **Establish the motivation for this project by presenting the importance and timeliness of the project.**

Commodity crop performance data is readily available from tools like the University of Minnesota Center for Farm Financial Management's (CFFM) FINBIN financial benchmarking database, but specialty crops are still significantly underrepresented. This project aimed to improve the financial and business management literacy of specialty crop farmers in order to increase the competitiveness of existing or potential farmers who grow six target fresh market specialty crops: **apples, berries, grapes, fresh market mixed vegetables, pumpkins, and sweet corn** in Minnesota.

3. **If the project built on a previously funded project with the SCBGP or SCBGP-FB describe how this project complimented and enhanced previously completed work.**

When we proposed this project, previous work funded by the SCBG program had already begun to have an impact, but actual cost of production information for specialty crops was still inferior. This project enrolled more

growers, published production and profitability data for 2011 and 2012, and provided additional educational opportunities about business management to specialty crop growers. Although the project has ended, CFFM will post and MDA intends to publish data for 2013 as well.

PROJECT APPROACH

4. **Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.**

   This project delivered 1:1 Farm Business Management education to 73 individual specialty crop growers, exposed more than 150 existing and potential specialty growers crop growers to financial management concepts at workshps and seminars, collected and published two data reports on the profitability and performance of specialty crop operations in Minnesota, and contributed profitability and production data to a public benchmarking database.

5. **Present the significant contributions and role of project partners in the project.**
   MDA – managed award, developed program materials, conducted publicity, outreach, and advertising, reviewed and approved scholarship applications, disbursed scholarship funds, convened project partner meetings, managed report writing and production, disseminated print and electronic copies of report.

   MnSCU – recruited and enrolled specialty crop growers, delivered educational instruction, prepared and submitted annual financial analyses.

   CFFM – modified farm management and reporting software as necessary to include specialty crop data, provided technical support to instructors, monitored consistency and quality of specialty crop analyses, posted data on FINBIN database, contributed summary analysis for two "Profitability and Performance" publications.

   MFVGA and SFA – participated on steering team, reviewed instructor mini gran applications, conducted outreach to stakeholder groups, created opportunities for educational offerings at meetings and conferences. In addition, MFVGA coordinated a webinar for members and other specialty crop growers.

GOALS AND OUTCOMES ACHIEVED

6. **Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.**

   The MDA and partner organizations recruited specialty crop producers to participate in this program using direct mailings, paid advertising, web blasts, press releases, and personal contacts to publicize the program, encouraging existing participants to re-enroll and new participants to sign up.

   Minnesota State Colleges and Universities Farm Business Management instructors enrolled the producers in for-credit FBM courses, with enrollments as follows:

	# instructors	# students
Spring 2012	22	45
Summer 2012	8	15
Fall 2012	14	32
Spring 2013	27	63
Summer 2013	8	10
Fall 2013	16	25

MDA staff reviewed applicant eligibility to determine that they were growing one or more of the target specialty crops (apples, berries, grapes, pumpkins, sweet corn, and assorted vegetables) and determined scholarship level. Students qualified for 80% scholarships first two semesters of enrollment, 70% for semesters three and four, etc. MDA disbursed the scholarship funds directly to the eight colleges at which the producers were enrolled, and the payments were applied as credits on their accounts.

Instructors met 1:1 with each student (or in small groups) throughout the year, delivering educational materials tailored to the producer's type of operation, as well as his/her level of previous knowledge and business goals.

In the meantime, the project steering team discussed and finalized goals, eligible activities, and an application form for instructor mini grants and promoted the opportunity to instructors. The intention was to encourage five sets of instructors to develop and deliver innovative or collaborative specialty crop outreach/education sessions or workshops.

To our surprise, instructors showed very little interest in the mini-grants; we received and funded only two applications. The steering team considered other ways to support professional development for instructors and settled on webinars as the best delivery strategy.

In December 2012, the Center for Farm Financial management (CFFM) hosted two informational webinars open to all instructors and deans in the program. Webinar I was presented by Craig Chase of Iowa State University. Chase has extensive experience working with specialty crop, organic, and value added producers. Chase related his experiences of working with specialty crop producers in Iowa on finance, budgeting, labor management, marketing, and all things related to improving profitability and shared some of his experiences working with producers as they try to enter the specialty crop markets. Webinar II included presentations by two FBM instructors. Gene Kuntz described his experiences working with a peer group approach to FBM education with specialty crop producers. Keith Olander identified a lot of issues that he has worked through in his work with CSA's, high tunnels, and other specialty crop producers. Dale Nordquist of the CFFM also facilitated a discussion about analysis procedure and standardizing data reporting for these types of operations. The categories and charts of accounts for specialty crops have not been available for very long and, because of this Specialty Crop Block Grant, are improving every year, so instructors are still learning about how to most consistently enter the operations' data.

In September, 2013, offered another webinar with Chase called "Fearless Farm Finances," which was organized by MFVGA and promoted to enrolled students, their instructors, and other

interested growers. About 20 people participated in that webinar, and the interaction prompted partner MFVGA to offer an in-person workshop now scheduled for March, 2014.

The project provided funds to help sponsor sessions and trade show exhibits about recordkeeping and business management at conferences including, Midwest Value Added Conference, Minnesota Fruit and Vegetable Growers Assn, Sustainable Farming Association of Minnesota, Minnesota Grape Growers Cold Climate Conference. At trade shows, the *Minnesota Specialty Crops – An Analysis of Performance 2008-2011* and 2009-2012 reports drew a great deal of interest (and some envy from producers in other states.)

Project partners planned and executed this project's educational sessions. We required partners to collect, summarize, and report on evaluation data from session participants, but did not prescribe a survey instrument or questions to include. In retrospect, we should have been more specific and prescriptive in our expectations of how we expected the partners to evaluate the sessions. This is something we should consider for the future and would advise others to do. The effort partners put into evaluating and reporting on the sessions – particularly when they were part of a larger event – and the methods they used varied.

The Sustainable Farming Association reported that attendees rated the session 4.5/5 and that it received comments including "very helpful," "would attend again," and "Nicely Done." The SFA indicated that they plan include similar sessions because they recognize that the subject matter is desired by their conference attendees.

The MFVGA was unable to execute a grower workshop in the time allotted, so requested and received permission to hold an educational webinar instead. The 9/4/13 webinar was promoted to at least 2,000 people and attended by 20. In making the change from in-person workshop to webinar, the MFVGA and the MDA we forgot about the evaluation component.

The Value Added Conference evaluated all five sessions in the business track that this project helped to underwrite, although not using a before/after test. Nearly 100 people attended the sessions (the same person likely attended more than one breakout). Cumulative ratings for the five sessions were 68% "excellent" and 31% "good" (5 pt scale). Attendee comments about what they liked most included, "very practical, useful info," "specific info to help farmers make money," "clear, abundant information," "good coverage of topic," "tailored to audience interests and needs," and "dealt with issues of business structure, contracts, leases, and interns."

7. **If outcome measures were long term, summarize the progress that has been made towards achievement.**
   N/A

8. **Provide a comparison of actual accomplishments with the goals established for the reporting period.**

- **Benchmarking information on performance of target specialty crop enterprises is available:** data from the 2012 and 2013 growing seasons were collected by participants and instructors throughout the year. The 2012 was analyzed, summarized and published in 2013 as Minnesota Specialty Crops Profit & Performance 2009-2012. Although this SCBG has ended, we plan to disseminate the 2013 data after analyses are completed in 2014.

- **70 existing growers of the target specialty crops improve understanding of financial management**– We enrolled 73 individuals as direct participants between Fall 2011 and Fall

2013. Each worked with an FBM instructor during the semesters enrolled to identify and use farm records and, when possible, to complete a financial analysis.

- **Five mini grants to instructors result in new workshop program development and delivery** – We received and funded only two applications from instructors. One mini grant funded a tour of specialty crop operations for enrolled students. A dozen participants said they found the following helpful: seeing business structures and enterprises first hand; discussion with other producers, and sharing ideas about business practices with their peers. Another mini grant funded a business planning workshop, attended by 25 people. They rated the value of the session high, scoring it a 4.5 out of 5.

  Due to low instructor interest, the steering team revised this goal to support three webinars, as described elsewhere in this report. Two webinars focused on professional development for instructors and were peer-led by two instructors experienced of in working with this clientele. These webinars reached about a quarter of the instructors involved in delivering FBM education to specialty crop growers in the state. The third webinar was targeted toward producers. It educated about 20 participating and non-participating farmers, recordkeeping and how record analysis can lead to improved profitability.

9. **Educational sessions increase the financial management literacy of at least 150 specialty crop growers** – According to project partner estimates we delivered educational sessions to at least 157 growers. In addition to the mini grants and farmer-oriented webinar detailed above, we supported educational offerings at the 2012 Value Added Conference (~40 attendees), 2013 Sustainable Farming Association of Minnesota Annual Conference (35) and 2013 Minnesota Grape Growers Conference (26). We also visited 1:1 and distributed project materials in the trade shows at all of these events.

10. **Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.**

    Data is shown below. In some cases and some years, operations reporting increased. In others, it decreased. We suspect that an individual farm's performance the year before had a bearing on whether growers enrolled, as did the fact that scholarships decreased by 10% for each year of enrollment.

Enterprise	Farms reporting enterprise Data to FINBIN			
	2009	2010	2011	2012
Apples	<5	6	13	11
Grapes	1	5	7	7
Berries	15	14	22	12

Mixed Veg/ Garden Produce	(not coded)	5	6	9
Pumpkins	11	10	8	6
Sweet Corn	<5	7	8	11

BENEFICIARIES

11. **Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.**

Participating (enrolled in FBM) farmers – learned to use farm records, improved farm business management understanding and skills through work 1:1 with a FBM instructor.

Non-enrolled farmers – learned concepts including business planning, cost of production, enterprise profitability, business structure, farm management on tours, in workshops, and in webinars.

FBM instructors – enhanced their knowledge of specialty crop growing and their ability to serve these types.

MnSCU - increased their enrollment due to scholarships offered.

UMN – enhanced the diversity of data available on in its public farm management database, FINBIN and the versatility of its FINPACK software for use with and for specialty crop enterprises.

MDA – enhanced its offerings to specialty crop growers and its repuration as an organization responsive to the needs of specialty crop agriculture. Partly inspired by this project and the partnerships it fostered, the MDA also spun off a FBM program focused on business planning for minority and immigrant farmers.

MFVGA and SFA – were able to offer special programs of interst to their members

12. **Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.**

The project produced reports on specialty crop profitability in both 2012 and 2013. Each year, the reports included a summary analysis and reportable data for all the individual enterprises. In both reports, we divided specialty crop performance into three categories: high gross returns (above $8,000 per acre); medium gross returns ($4,000-$6,000 per acre); and low gross returns (below $2,000 an acre). High gross return crops included strawberries and mixed vegetables. Crops with medium gross returns include blueberries, apples, cantaloupes, and raspberries. Crops grossing under $2,000 per acre were sweet corn, pumpkins and grapes.

The reports also discussed considerations like high labor costs, high establishment costs, and the importance of having a good handle on the true cost of production, which includes both direct and overhead expenses and is quite high for most specialty crops included in this project.

In addition, we solicited direct participant feedback on the program from enrolled growers in both 2012 and 2013.

	2012	2013	Scale
Survey response rate	42%	52%	
Ave Years in FBM	3+	3+	
Satisfaction w/ profitability of specialty crop enterprise	2.4	3.2	1 (not at all) 4 (exceeding expectations)
How program has impacted farming operation	3.4	3.2	1 (not helpful) 4 (extremely helpful)
Magnitude of change in understanding before/after FBM)	Business planning (1.2) Cash flow (1.3) Recordkeeping/Acctg (1.3) Taxes (1.3) Whole farm profitability (1.3) Marketing (1.1) Labor issues (1.1)	Business planning (1.2) Recordkeeping/Acctg (1.1) Whole farm profitability (1.1) Enterprise profitability (1.1) Tax preparation (1.1)	1 (little to none) 5 (like an expert)
How they have used learning	Assess profitability (85%) Pricing/marketing (74%) Prepare taxes (59%) Planting decisions (59%)	Assess profitability (67%) Create/monitor cash flow (61%) Pricing/marketing (61%) Prepare taxes (52%)	
Have used benchmarking data to compare to peers	48%	46%	

LESSONS LEARNED

13. Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.

- The steering team's idea of offering instructor mini grants planned for the program were not received well by the intended audience, so the steering team developed another professional development strategy.
- Instructors reported anecdotally that at $1,500 to $1,600 per year, the program is very expensive for growers, even with a scholarship. While most reported in surveys that they found value in the project, we saw attrition as the size of the scholarship decreased with each year in the project and believe it is likely that many growers will discontinue participation the absence of financial support.
- Summary data collected through this project indicates many specialty crops are not profitable for Minnesota growers.

14. Provide unexpected outcomes or results that were an effect of implementing this project.

- Some project part pants and members of the have been surprised to see how few specialty crops are profitable – at least those generating data published by this project.

- Several instructors have built on the exposure to specialty crop FBM concepts and growers provided by this project, and they have continued and broadened their program delivery and reach. Instructors Steve Zenk and Mike Mastey, for example, have worked with the MDA and several other partners to launch a farm business management training course designed for immigrant farmer. The course hase proved course is especially helpful for immigrant and minority farmers seeking Federal, State or private loans assistance. IN another case, instructor Thaddeus McCamant has incorporate the project experience and data into presentations he delivers at conferences and seminars he delivers at grower conferences and seminars throughout the Midwest.

  "There have been a number of interesting things happen with the project, commented McCamant. "In many cases, people shrugged their shoulders when I said that we needed to do a balance sheet, but a few months to a year later, they called me and said, 'Could you send me a copy? I need it for ___.'"

15. If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.
    - The goals and outcome measures were achieved, although was sometimes difficult to make instructors and grower/students understand that submitting analysis data was required.

ADDITIONAL INFORMATION

16. **Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.**

Minnesota Specialty Crops: An analysis of Profitability & Performance 2008-2011
http://www.mda.state.mn.us/~/media/Files/food/organicgrowing/specialtycrop2012.ashx

Minnesota Specialty Crops: An analysis of Profitability & Performance 2009-2012
http://www.mda.state.mn.us/~/media/Files/food/organicgrowing/specialtycrop2009-12.ashx

The Specialty Crop FBM program pamphlet is no longer available on the Web, so we are including it below.

Effective financial and business management are important keys to farm prosperity. Farm Business Management (FBM) education helps farm owners and operators learn new skills that will help them meet their business and personal goals. Growers in the program learn to maintain and, most importantly, **use** their own farm records to make sound business decisions.

In Minnesota, the FBM program is offered by the Minnesota State Colleges and Universities (MnSCU) system and the Southwest Farm Business Management Association. There are more than 70 instructors located throughout Minnesota.

This scholarship program, offered by the Minnesota Department of Agriculture (MDA), pays a portion of the cost for specialty crop producers to enroll in FBM education.

Who is eligible to receive a scholarship?

Specialty crop growers (fresh market only - eligible crops in 2012 are apples, berries, grapes, pumpkins, sweet corn, and vegetables.)

All recipients must be enrolled in a Minnesota FBM program. Only a limited number of scholarships are available.

If I am already an FBM student, am I still eligible?

Yes!

How does it work?

You will meet one-on-one with an FBM instructor. Together, you will design a program that fits your needs, customized to **your** farming operation. At the end of the year, you will receive an analysis with details about the financial performance of your farm, and your instructor will submit your data to be combined with information from other specialty crop growers. **Strict privacy measures protect the confidentiality of your information.**

How much are the scholarships? How much do I have to pay?

While funds are available, the scholarship will pay:

- 80% of your tuition for the first two semesters of enrollment,
- 70% for semesters 3 and 4,
- 60% for semesters 5 and 6, etc.

Tuition ranges from $155 to $180 per credit, depending on your location. A scholarship can reduce your out-of-pocket cost significantly.

More →

Is it worth the investment?

More than 3,000 other Minnesota farmers think so! They use the program to help them manage their records and get a clearer picture of what is really happening on their farms from year to year. Which enterprises are making money? Which enterprises are unprofitable? Where could I reduce costs? Enhance profits? You will receive an end of year financial and business analysis and can use an anonymous benchmarking database called FINBIN to compare your operation with others at www.finbin.umn.edu.

Participants report that being in the program helps them assess their profitability, make pricing and marketing decisions, monitor cash flow, and prepare their taxes.

When can I start?

You can start the program at any time.

How long will this scholarship last?

The Minnesota Department of Agriculture will offer these scholarships as long as funds are available.

How do I sign up?

Contact the farm business management program in your area (see map) and ask for an instructor. The instructor will do the rest.

1. Northwest	**4. Southwest**
Ron Dvergsten Northland Community and Technical College (218) 683-8747	Al Bruedlie Minnesota West Community and Technical College (507) 847-7928 Jim Kurtz Southwest Farm Business Management Association (507) 372-3904
2. Northeast/East Central	**5. South Central**
DelRay Lecy Central Lakes College (218) 894-5164	Al Brudelie South Central College (507) 389-7264
3. West Central	**6. Southeast**
Jim Molenaar Ridgewater Community and Technical College (320) 222-5211	Eric Deters Riverland Community College (507) 259-6262

Where do the scholarship funds come from?

Funds come from MDA and the USDA Specialty Crop Block Grant Program.

What if I have questions this brochure does not answer?

Contact Meg Moynihan at the MDA (651) 201-6616 or meg.moynihan@state.mn.us

What participating farmers are saying:

It is a good tool to help in all management decisions made on the farm.

In a multi-enterprise operation, I have to know my costs of production in order to determine if I am marketing my products for a profit or loss. I highly recommend this program.

Our instructor prepares us very well to go to our lenders with our ideas and plans. It has given us courage to expand and improve our farm through (using) credit wisely.

My instructor is an awesome numbers guy. I am definitely a better manager because of this much needed program. My lender loves the information.

USDA MINNESOTA DEPARTMENT OF AGRICULTURE

Project partners and supporters

Minnesota State Colleges and Universities · University of Minnesota Center for Farm Financial Management
Minnesota Fruit and Vegetable Growers Association · Minnesota Grape Growers Assoc. · Minnesota Apple Growers Assoc.

REVISED 12/9/11
File Name: FBMS version B 2010.indd

Project B

MN Specialty Crop Block Grant
FINAL PERFORMANCE REPORT

This form is used to make a final report to MDA, for incorporation into a State report to USDA-AMS.

Please submit electronically in MS Word format to Brian Erickson at brian.j.erickson@state.mn.us, or if accompanied by an invoice, to **mda.accounts-payable@state.mn.us**

Submitted by: **Minnesota Fruit & Vegetable Growers Association (MFVGA)**
15125 W. Vermillion Cir. NE
Ham Lake, MN 55304

e-mail: **mfvga@msn.com**

Date: **July 31, 2013**

PROJECT TITLE

Increasing the Adoption of Good Agricultural Practices (GAPs) through Regional Grower Workshops to Develop Food Safety Plans, GAP Demonstration Audits and Risk-Based Practices Food Safety Fact Sheets

PROJECT SUMMARY

Food safety is becoming increasingly important to ensure the safety of children and other consumers and to protect the reputations of local growers. Demand for locally grown produce by consumers and at schools, hospitals, restaurants, grocery stores and other wholesale locations continues to increase, but federal legislation and proposed FDA rulings regarding food safety and food safety audits caused confusion and concern among local specialty crop growers selling to institutions or through wholesale distributors. Many grocery stores require an audit certificate and beginning in 2012, many produce distributors also started requiring third-party food safety audits. According to a survey by the Institute for Agriculture and Trade Policy, the number of schools participating in the Farm to School program increased from 10 districts in 2006 to 123 districts in 2010. School food service directors began requesting that growers have written food safety plans. Growers who did not comply were likely to lose those markets. It was anticipated that the new "harmonized" audit would be adopted by all auditing entities, public and private, which would likely require more paperwork and preparation for growers.

The purpose of this project was to increase the awareness of the importance of food safety, provide growers with the skills and knowledge necessary to implement on-farm food safety practices and to help Minnesota's specialty crop growers prepare for future food safety audits. In turn, this helps growers supply the increasing demand for local fruits and vegetables to schools and other wholesale markets.

This project builds on previous work funded by the USDA Specialty Crops Program and uses materials developed under partnership agreements with the USDA Risk Management Agency. This project and previously developed materials give growers resources to help them develop individual food safety plans and prepare for food safety audits. The demonstration audit gave growers a 'pre-view' of the audit process and gave them an opportunity to discuss food safety issues with the auditor before going through it themselves. Ideas and innovations developed by growers were incorporated into factsheets to help other growers.

PROJECT APPROACH

Project goals were to conduct five workshops encouraging specialty crop growers to develop GAPs oriented Food Safety Plans, hold two demonstration audits and develop a set of food safety resource documents. The target number of growers participating in the workshops and demonstration audits was 100 to 150.

Seven food safety workshops and one demonstration audit were held. Ninety-two producers attended the food safety workshops along with six other people involved in reaching the target audience. Thirty producers plus seven others (University Extension, public school representatives, etc.) attended the GAPs demonstration audit. Five fact sheets were developed.

Comments from the workshops were very positive. Those attending had very limited knowledge of Good Agricultural Practices, did not have written food safety plans and were not food safety certified. They came for information on current regulations and how those regulations applied to small farming operations, recordkeeping requirements, how to prepare for a food safety audit and how to protect their customers by preventing microbial contamination in fresh produce. Attendees indicated the information received during the workshops was very useful and they appreciated the interaction between the speaker and other growers. Most of the producers who attended the workshops are not required to have a written food safety plan or to complete a food safety audit.

Project partners were the Minnesota Fruit and Vegetable Growers Association (MFVGA) and the University of Minnesota On Farm Food Safety Team (Michele Schermann and Annalisa Hultberg). MFVGA was responsible for grant administration and primarily handled the coordination, promotion, registration and follow up for the workshops and demonstration audit. Workshops were conducted by Michele Schermann. Factsheets were developed by Michele Schermann and Annalisa Hultberg.

GOALS AND OUTCOMES ACHIEVED

Seven food safety workshops and one demonstration audit were held. Ninety-two producers attended the food safety workshops along with six other people involved in reaching the target audience. Thirty producers plus seven others (University Extension, public school representatives, etc.) attended the GAPs demonstration audit. Five fact sheets were developed.

A long-term goal was to increase the number of small to mid-size growers who were GAP or other food safety certified from 5 to 15 by the beginning of 2015. The Minnesota Department of Agriculture recently funded 22 applications for a GAPs cost-share program. According to USDA information, 28 audits were done in 2012; 20 were potato growers, 2 were tomato repacker-distributors and one was a mushroom GAP. Only five mixed produce farms had an audit in 2012; four had a GAP audit and one had a harmonized audit. None of the farms that had an audit in 2012 would be considered small- to mid-sized farms. Currently the GAP audit is voluntary and buyers have either not been requiring GAP audits or small- to mid-sized farms may be opting out of that market. However, there had been anecdotal evidence that other institutional buyers are requesting to see written food safety plans. Over the course of this grant, the number of people starting to write food safety plans has increased and project staff has spent many hours fielding questions and reviewing food safety plans for small- to mid-sized growers. At least two have sent finished plans to project staff.

Project Goals:	**Accomplishments:**
Conduct 5 workshops	Conducted 7 workshops
Reach 100 – 150 Producers	122 producers reached plus 13 others
Develop food safety resources	Five Food Safety Fact sheets were developed
	The ‘safety.cfans.umn.edu’ website was

“remodeled” for easier

access to materials and videos.

Ninety-five percent of the producers who attended the workshops were not food safety audited and had little knowledge of recommended on-farm food safety Good Agricultural Practices (GAPs). Thirty-seven percent planned to become food safety audited while thirty-two percent said they would not seek an audit. Thirty-one percent came to the workshops to get more information before deciding whether to pursue a GAP audit.

Ninety-one percent of those who attended the workshops did not have a written food safety plan. Sixty-three percent did not include worker hygiene and safety in their employee training. Sixty percent were not testing water on an annual basis.

People came to the workshop to learn more about Good Agricultural Practices and on-farm food safety and to start their own food safety plans. The majority of those who attended the workshops thought the information presented was useful (36%) or very useful (60%) and they indicated that they would implement Good Agricultural Practices on their farms.

When asked if they were more likely to get a GAP audit, ten percent said 'yes, definitely', eighteen percent said 'most likely' and thirty-eight percent said 'maybe likely.' Thirty-one percent indicated they were not likely to have a GAP audit. When asked if they were more likely to adopt a food safety plan following the workshops, forty-nine percent said 'yes, definitely', thirty-nine percent said 'most likely' and twelve percent said 'maybe likely'.

Of those who returned the follow-up surveys, sixty percent had adopted some of the Good Agricultural Practices covered in the workshops, mainly related to worker hygiene and safety and post-harvest handling. Fourteen percent of respondents indicated they had completed a food safety plan or were working on their plans. Eighty-six percent had not completed a food safety plan, but the majority of those indicated they would develop a food safety plan in the future. None of the respondents had completed a food safety audit.

Information on the 'mock' audits was included in the final report, but we referred to them as demonstration audits instead of 'mock' audits.

An important part of preparing for a food safety audit is the completion of a written food safety plan. In the fall of 2011 we asked MFVGA members if they had completed a written food safety plan and 15 growers indicated they had a written plan. In the fall of 2013 we again asked MFVGA members if they had completed a written food safety plan. Of those who responded to the 2013 question, 24 growers indicated they have now adopted written food safety plans, including at least 5 growers who did not have a written food safety plan in 2011.

Although we have not seen a substantial increase in the number of food safety audits for small to medium sized farms, there is an increase in awareness of good agricultural practices and an increase in the number of growers completing written food safety plans. Having a written plan better prepares them for an audit when or if it is requested or required by a customer.

BENEFICIARIES

Receiving direct benefit were those who attended the workshops and demonstration audit as well as those who have access to the fact sheets via a variety of educational opportunities and websites. Also receiving direct benefit are the individual growers who have called and emailed project staff for individualized GAP assistance and help with and review of their food safety plans. Project staff estimates they spend at least four hours per week giving individualized assistance. An increased awareness among growers and implementation of good agricultural practices provides examples for neighboring growers to follow. One of the vendors at the 2013 Upper Midwest Regional Fruit and Vegetable Growers Conference and Trade Show prominently displayed a handwashing station in his booth which also increases awareness.

Direct benefit comes from establishing contacts with other growers who are also working on implementing GAPs or writing a food safety plan. The demonstration audit gave growers the opportunity to see a working operation and discuss appropriate measures and potential problems.

Although an indirect benefit of this project, school children and consumers who eat locally grown food, grown and distributed by producers who recognize the need to implement practices to minimize the risk of food-borne illness, also receive the direct benefit of safe and healthy local food.

LESSONS LEARNED

This project increased awareness of the importance of minimizing microbial contamination and the sources of microbial contamination. With the increased awareness many growers are implementing food safety practices, primarily in the areas of worker health and hygiene and post-harvest handling. Because of the time and expense involved in developing a written food safety plan, even with available templates, and completing a food safety audit; growers are reluctant to complete an audit unless required by institutional buyers.

Growers like to visit other farms, but growers are reluctant to invite other growers to their farms. This became an issue when trying to find growers to agree to host a demonstration audit. Lots of people wanted to attend, but not host. Several growers who originally agreed to host audits backed out. We were only able to offer one demonstration audit instead of two. In discussions with other GAP trainers, finding farm sites for demonstration audits has been a challenge in other states as well.

ADDITIONAL INFORMATION

Additional information and fact sheets have been posted to the University of Minnesota On-Farm GAPs Education website at www.safety.cfans.umn.edu. A GAPs Education Program Facebook page was created to further communicate with growers who use Facebook. Relevant information and updates are posted on the Facebook site.

Information about GAPs and the Proposed Rule on Standards for Produce Safety are disseminated via email to MFVGA, ED, SUSTAG email list, SFA lists, and to farmer-leaders throughout the region and updated on the website and Facebook to keep growers informed about upcoming legislation, as well as new science-based information from other Universities and federal agencies.

A few brief “mini-workshops” on GAPs were given to other groups who work with growers so they would have some background about on-farm food safety. These groups include Minnesota Crop Improvement Association (April 16, 2013, n=15; they certify organic farms.)

Project C

MN Specialty Crop Block Grant
FINAL PERFORMANCE REPORT

Submitted by: Mark Abrahamson, 651-201-6505

E-mail: mark.abrahamson@state.mn.us

Date: January 23, 2015 (Revised March 6, 2015)

PROJECT TITLE

Preparing Minnesota fruit and vegetable growers for the management of a new pest, the brown marmorated stink bug (BMSB).

PROJECT SUMMARY

The purpose of this project was to prepare Minnesota specialty crop growers to manage a new invasive pest called the brown marmorated stink bug (BMSB), which threatens the yields and marketability of the state's fruit and vegetable crops. This purpose was to be realized through research focused on the protection of apples, grapes, sweet corn, green peas and snap beans from the damage caused by this pest, thereby increasing the competitiveness of these crops. An additional component of the project was statewide monitoring for BMSB so as to identify areas with increasing populations before crop damage occurred.

The BMSB is originally from Asia and was first identified in the U.S. in 2001 and in Minnesota in 2010. When this project began, BMSB had been detected in Ramsey, Washington, Anoka and Winona counties in Minnesota. However, recent survey work specific to this pest had not been conducted so there may have been other undocumented infestations in other parts of the state.

The BMSB attacks the leaves, stems, fruits and seeds of a wide variety of plant species, including vegetable, fruit and field crops. In New England and the Mid-Atlantic, the pest has caused 50-90% crop loss to apples. In the same regions, severe damage was also documented on other fruit and vegetable crops. Beyond being a plant pest, this insect is also a home invader, much like the Asian lady beetle and boxelder bug.

Experience from eastern states, where this pest has been established longer suggests that BMSB will become a significant problem for fruit and vegetable production in Minnesota in the near future. However, at the time this project was initiated very little was known about its biology, impacts and control in Minnesota. Since pest management recommendations from one region (e.g., Eastern US) are not necessarily applicable to other regions (e.g., Midwestern US), there was a need for data specific to the Midwest. Waiting until the pest began to cause damage in Minnesota to begin research would have put our growers at significant risk. Therefore, this project was needed to proactively prepare Minnesota growers for impacts from BMSB.

PROJECT APPROACH / GOALS AND OUTCOMES ACHIEVED

Objective 1 - Determine when and where this pest is active in Minnesota.

Soybean fields were sampled by Minnesota Department of Agriculture (MDA) staff during 2011, 2012 and 2013 (Figure 1). Soybean is a preferred host of BMSB and its presence in a soybean field would indicate that fruit and vegetable production in the area could be at risk. Fields were sampled by making a total of 200 sweeps (50 sweeps in each of 4 different areas) in each field. About 385 fields were sampled in 2013, 604 fields were sampled in 2012 and 300 fields were sampled in 2011. No BMSB were found in a soybean field in any of the three years.

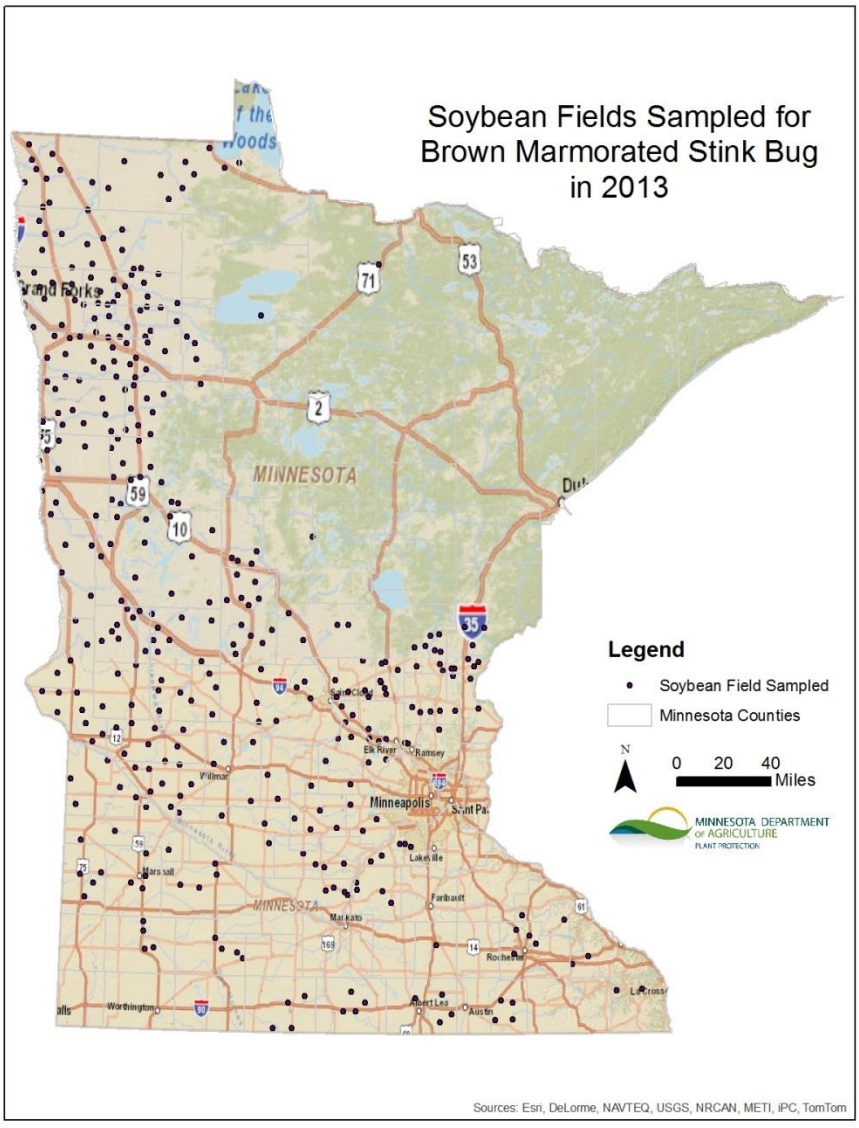


Figure 1. Soybean fields sampled for BMSB in 2013, sampling distribution was similar in 2011 and 2012

Objective 2 – Evaluate potential impacts to common varieties of fruit and vegetable specialty crops grown in MN:

Field cage trials were conducted on apples in 2012 and 2013 and on sweet corn in 2012, 2013, and 2014. Adults and/or nymphs were caged in mesh drawstring cylindrical cages (35cm x 25cm) at different densities, for different lengths of time, and at different points in the growing season. BMSB injury on these crops was quantified and described throughout the experiment. Data from the summer of 2012 and 2013 are in the process of being analyzed for publication.

Objective 3 – Determine efficacy of potential conventional and organic pesticide treatment options:

As integrated pest management (IPM) programs are developed for BMSB, both conventional and organic-certified insecticides will play a critical role in management of this pest. Currently, many insecticides recommended for BMSB do not directly kill adults even at the highest labeled rate, resulting in sublethal exposures. In addition, adult BMSB may avoid lethal doses of pesticides due to their high mobility. However, sub-lethal doses of insecticides have been shown to affect BMSB behavior and movement in laboratory studies as well as feeding injury in apple orchards.

When BMSB and other phytophagous pentatomidae feed, they leave behind a dried salivary sheath indicating a feeding site (Figure 2), which can then be used to quantify feeding on a given crop. In this study we used the number of feeding sites per adult insect to evaluate the sub-lethal effects of exposure to various insecticides. Such sub-lethal feeding effects should be considered when creating an IPM plan to allow for a more accurate picture of how an insecticide can minimize subsequent economic damage.

Figure 2. BMSB feeding site (unstained stylet sheath) on a dry soybean

The sub-lethal feeding effects we found would not be apparent using the traditional methods of evaluating insecticide efficacy through mortality estimates (Figure 3). Future considerations into the development of economic thresholds based on number of BMSB feeding sites may be warranted. This additional level of detail could allow the effectiveness of an insecticide to be determined based on reductions in feeding injury rather than solely on mortality as seen with results for organic spinosad, sulfoxaflor, and bifenthrin in Fig. 2. Measuring sub-lethal insecticide effects on BMSB feeding is critical for future management plans to maximize the efficiency and efficacy of IPM programs.

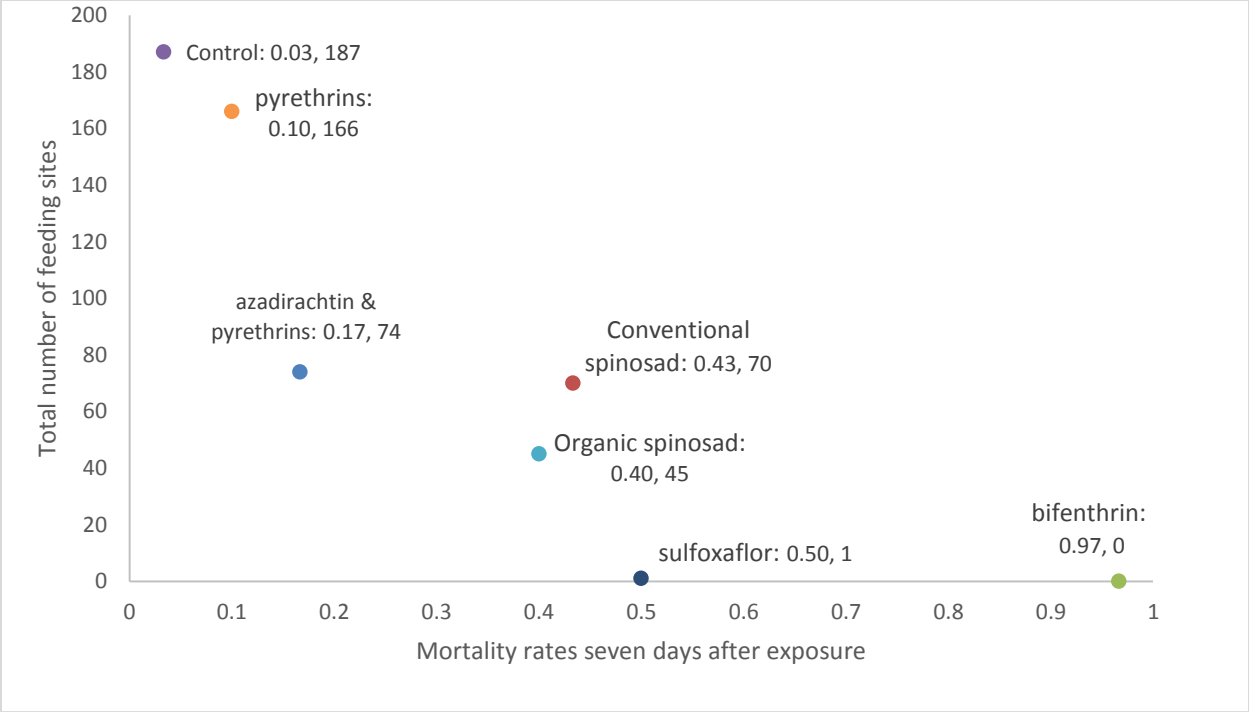


Figure 3. A comparison of direct mortality and total number of feeding sites for all living BMSB in each treatment over one week

In conjunction with this study on topical sprays targeted against adult BMSB, a second study was also conducted on the impact of insecticides on all BMSB life stages (Figure 4). We found that all insecticides performed poorly on eggs, while mortality was high for most insecticides on nymphs. Since mortality was high on younger life stages, no sub-lethal effects were quantified.

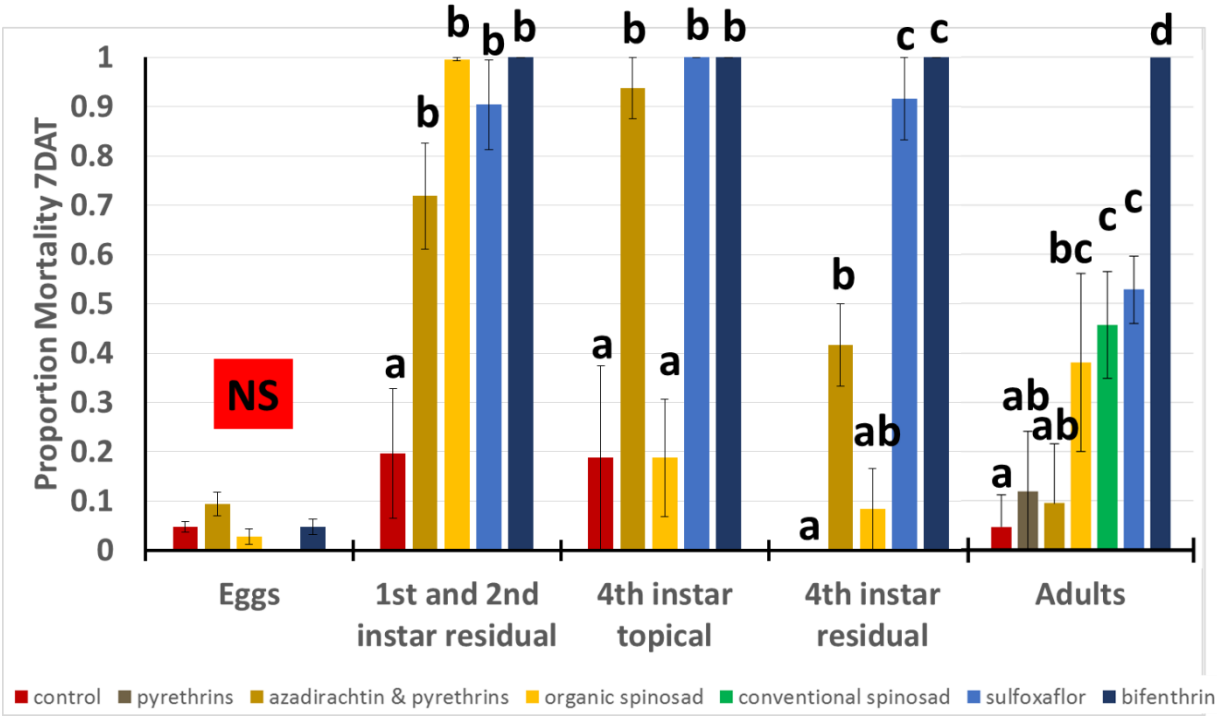


Figure 4. Proportion mortality of egg, nymph, and adult *H. halys* seven days after exposure to one of five insecticidal treatemnts**.** Letters indicate significant differences between treatments within an age and exposure method through an analysis of variance (ANOVA) and Tukey's HSD $P < 0.05$ after an Abbott's correction was performed on arcsine square root transformed data.

Objective 4 – Distribute information on pest biology, impacts, and management to fruit and vegetable growers, including translation of printed materials into Spanish and Hmong to benefit the socially disadvantaged groups speaking these languages in MN

Theresa Cira presented information on BMSB at the Minnesota Fruit and Vegetable Growers Association meeting in January 2013 (~25 participants) and January 2014 (~30 participants) and also a Minnesota First Detector training workshop in July 2013 (~45 participants). A fact sheet was also prepared for the general public and is posted on the University of Minnesota VegEdge website (see factsheet below under Additional Information).

The factsheet is posted on the website as a pdf (http://www.vegedge.umn.edu/vegpest/BMSB%20Factsheet.pdf) and therefore the exact number of page views cannot be calculated. However, a standard web page for BMSB was also developed which had 268 views between November 1, 2014 and March 5, 2015 (http://www.extension.umn.edu/garden/insects/find/brown-marmorated-stink-bug/).

This factsheet has now been translated into Spanish, Hmong, and Somali. These factsheets will be posted to the University of Minnesota website in early March, 2015. The factsheets were distributed at the Immigrant and Minority Farmer Conference in St Paul, February 7-8, 2015.

Additionally, Theresa Cira has presented her research on BMSB at the 2012, 2013 and 2014 national Entomological Society of America (ESA) annual meetings during poster sessions, and in a presentation at the 2014 North Central Branch ESA meeting to ~65 participants.

Goals and Outcomes Achieved:

Project Goals
- Provide Minnesota and other Midwestern growers with new research-based knowledge about the biology, impacts and management of BMSB in fruit and vegetable crops
- Produce data of high scientific quality
- Contribute to the development of human resources

Baselines
- Data specific to fruit and vegetable production relative to BMSB biology, impact and management in the Midwest
- Graduate student trained in Minnesota to contend with BMSB

Targets
- Information disseminated to growers via a website, a printed fact sheet and grower meetings
- Data published in at least one article, in a peer-reviewed scientific journal and presented at one national meeting.

These goals, baselines and targets have been realized in this project: research based data of high scientific quality has been summarized in this report under Objectives 2 and 3 and has been distributed to growers and other audiences as described under Objective 4. One graduate student, Theresa Cira, has conducted this research and outreach work in the course of completing her graduate work at the University of Minnesota.

The cooperator roles and work occurred as planned during this project with MDA leading monitoring efforts and U of M leading research efforts. Significant communication and collaboration regarding both components occurred between the partners throughout the project.

BENEFICIARIES

Minnesota fruit and vegetable growers have benefited directly from this project and have had information gained from this project disseminated directly to them. Fruit and vegetable growers benefiting from this information include those speaking Spanish, Hmong and Somali as the factsheet provided below has been translated into those languages. Since this information is also available on the web there is an opportunity for others in the Midwest or elsewhere to also benefit. Measurable outcomes include at least 268 views of web content and 100 growers reached directly at meetings.

Other researchers have also had an opportunity to benefit from this project as results from this work have been presented at the last three national entomology meetings. In addition, this work will eventually be published in a peer-reviewed journal. Measurable outcomes are difficult to estimate for the three poster presentations, but about 65 researchers were reached directly through an oral presentation.

The primary research data of value to both growers and other researchers is the impact of BMSB feeding on an important fruit (apple) and an important vegetable (sweet corn) as well as how feeding damage can be reduced through sub-lethal effects of pesticides.

LESSONS LEARNED

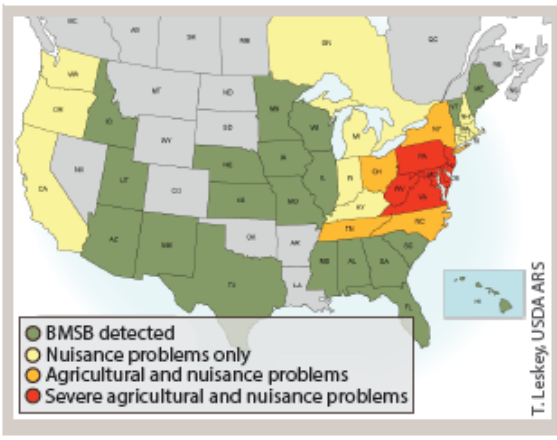
The primary challenge in this project was that BMSB has not yet become widely abundant in Minnesota. This restricted the amount of field work that could be accomplished and as a result there was a greater reliance on lab experiments and maintaining a lab colony of BMSB for those experiments.

ADDITIONAL INFORMATION

Factsheet Page 1

BMSB

THE BROWN MARMORATED STINK BUG (BMSB) IS
NOT NATIVE TO THE UNITED STATES
IN THE MID-1990's IT ARRIVED UNDETECTED IN A SHIPMENT FROM ASIA



CURRENT U.S. RANGE 2013

In comparison to NATIVE STINK BUGS,
BMSB have these features:

STRIPED ANTENNAE

ROUNDED SHOULDERS

DARK AND LIGHT BANDING ON THE ABDOMEN

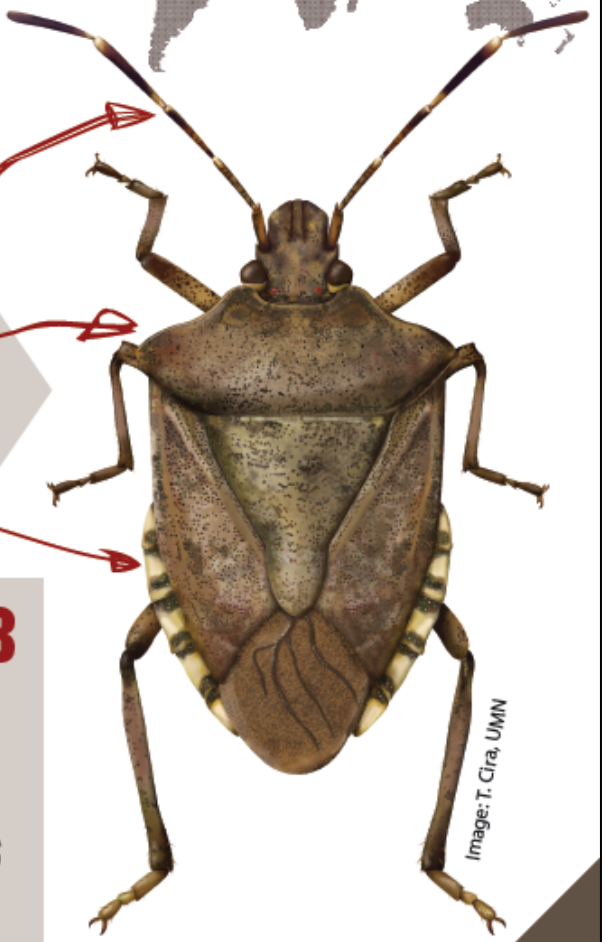


Image: T. Cira, UMN

KEY FACTS FOR BMSB

- ~ INVASIVE
- ~ ATTACKS MANY CROPS
- ~ OVERWINTERS IN HOUSES
- ~ RANGE EXPANDING ACROSS THE US
- ~ YOU CAN HELP MONITOR FOR BMSB

Brown Marmorated Stink Bug

Halyomorpha halys

Factsheet Page 2

Adults are present late-summer through the winter and emerge in spring to lay eggs.

Eggs are laid on the underside of leaves in late spring and early summer.

Photo: W. Hershberger

♂ ♀

Five immature stages feed through the summer.

WHAT'S ALL THE STINK ABOUT?

This species will feed on over **300 different species of plants**, including many fruits, vegetables, and row crops.
The injury from their piercing-sucking mouthparts can lead to **significant crop damage and severe economic losses**.

To survive the winter, this insect must find shelter, often taking cover in houses, garages, or barns.
They can become a nuisance in fall when **many bugs can invade a home**.

True to their name, **stink bugs can stink**.
The smell of BMSB is slightly earthy, some say it resembles cilantro. This defensive liquid is secreted from the underside of their thorax when the stink bugs feel threatened.

BMSB are spread with help from humans.
By hitchhiking on cars, trucks, campers, suitcases, and even mailed packages, this bug can move from an **infested area to an uninfested area very quickly**.

HELP MN!

If you think you have found a brown marmorated stink bug contact the Minnesota Department of Agriculture's **Arrest the Pest program**
arrest.the.pest@state.mn.us

For more information on this species visit: www.stopBMSB.org

Authors: Theresa Cira: cirax002@umn.edu
& William D. Hutchison: hutch002@umn.edu
Department of Entomology, University of Minnesota

Project D

MN Specialty Crop Block Grant
FINAL PERFORMANCE REPORT

Submitted by: Stephanie Heim, 507-319-0263
e-mail: heim0106@umn.edu
Date: 12/30/14

PROJECT TITLE
From Apples to Zucchini: Building Demand for Farm to School

PROJECT SUMMARY
From Apples to Zucchini: Building Demand for Farm to School aimed 1) To connect MN specialty crop producers to school nutrition programs and assist both entities in working together to reduce barriers and increase the use of MN specialty crops in schools; and, 2) To increase the number of schools that participate in Farm to School (F2S) educational opportunities.

Key informant interviews of MN producers, suppliers, and foodservice directors involved in a previous Specialty Crop Block Grant, *Making the Connections for Minnesota-Grown Fresh Fruits and Vegetables pilot project*, identified common themes regarding barriers to greater sales/purchase of specialty crops. These included: 1) the need for advance planning; 2) knowledge of each other's needs and ways of operating; 3) and the ability to find/grow fresh fruits and vegetables in large quantities to meet the needs of a school district. The second project was designed to overcome these barriers.

From Apples to Zucchini: Building Demand for Farm to School was a timely project as it built on the synergy created at the federal level to reduce childhood obesity. A few notable examples of this progress include the adoption of new nutrition standards for school meals programs that required more servings of fruits and vegetables daily, the expansion of federal funding for the Fresh Fruit and Vegetable Program (FFVP) and the creation of a Farm to School team and grant program within USDA. This project represented one way that schools could more effectively meet new nutrition standards, participate in the FFVP, and benefit from Farm to School.

PROJECT APPROACH
Using surveys and evaluations conducted during the previously funded grant project, the current project aimed to increase demand for MN specialty crops using a three-pronged approach focused on: 1) **reducing barriers**; 2) **educating consumers** (staff, community members, students and families); and 3) **creating incentives**. In addition to targeting MN specialty crop producers, this project targeted our work with schools who received USDA Fresh Fruit and Vegetable Program (FFVP) funding, as these schools have greater flexibility to address two barriers identified by MN producers and school foodservice directors – cost and preparation time. Furthermore, schools funded by FFVP were already operating and establishing the working patterns for the new nutrition standards to serve more fruits and vegetables on a daily basis.

Ample **time for planning** is a perennial issue of both school foodservice directors and producers. This project reduced this barrier by organizing **eight** regional Farm to Cafeteria workshops. Workshops were designed to meet the needs of each region, cultivate strong partnerships

between producers and buyers, and offer educational opportunities to increase capacity for local food purchases. The workshops took place from February through April 2013, and engaged **570** Minnesotans. The participants in the workshops included stakeholders such as producers (23%), food service professionals (31%), and local public health and university staff (46%).

With leadership from UM Extension, Minnesota has now successfully planned and executed regional Farm to Cafeteria workshops in 2010 and 2013. Regional interest in continuing these workshops has been expressed over this project period. As a result of this community interest, Minnesota's Farm to School Leadership Team submitted a LOI , a part of USDA's Farm to School grant program to host another round of regional Farm to Cafeteria workshops in Spring 2015. Although the proposal was not funded, partners continue to discuss creative ways to meet regional needs to expand farm to school.

To **educate consumers**, UM Extension worked systemically within its health and nutrition programs to incorporate Farm to Fork activities, with particular emphasis on the SNAP-Ed and EFNEP programs. This included internal training and revised work plans that were targeted to increase the number of MN schools engaged in Farm to School programming. UM Extension Health and Nutrition staff tailored educational opportunities to each school's capacity and interests. In some schools, this tailored education was focused on trainings for school food service, in others the education focused on taste testings in the classroom and in others education focused on strengthening the connections between local schools and producers. The data collected to document the change in F2S educational opportunities offered to schools focused on UM Extension's SNAP-Ed and EFNEP programs. In May 2013, staff were trained about Farm to Fork activities, with a special emphasis on local food taste tests and schools gardens. Additionally, the staff training provided an overview of the Fresh Fruit and Vegetable Program and details of the Eat Smart Food Competition . As a result of the staff training, **92%** of staff indicated they would take action to support Farm to Fork. Extension staff indicated they would: 1) find out if a school in their region receives Fresh Fruit and Vegetable Program Funding and learn how they can partner to provide nutrition education, 2) plan to promote the Eat Smart Food Competition if school(s) in their community received Fresh Fruit and Vegetable Program funding for the 2013-14 school year, 3) use one of the resources presented to get additional information on Farm to Fork, and/or 4) talk with their supervisor about Farm to Fork activities.

Although Health and Nutrition Programs in UM Extension experienced great financial uncertainty in 2013, that ultimately resulted in a significant restructure with a 40% staff reduction (Refer to Lessons Learned below for additional detail), our farm to fork programming in school classrooms across Minnesota actually increased **2.5%** and the number of students impacted by our farm to fork direct education increased **6.4%**. Overall, the number of FFVP funded schools SNAP-Ed and EFNEP educators worked with from the 2012/13 to 2013/14 school years decreased from 18 to 14 schools. Although the farm to fork programming remained unchanged in both school years.

At the outset, UM Extension recognized that different approaches are needed to engage the wide variety of school nutrition programs and decision makers that exist across MN. As a result, this project **created an incentive**, the Eat Smart Food Competition, for schools receiving FFVP funding and provided three winning school/producer partnerships with promotional incentives. The competition was held during Farm to School month, September 2013. To promote the

competition and Farm to School in general, **six** Eat Smart Food videos were developed. One promoted the competition to schools and five promoted the benefits of eating Minnesota specialty crops to Minnesota school children.

Eat Smart Food Competition award celebrations were conducted at the **three winning schools**: Brewster School, Fond du Lac Ojibwe School, and Laporte School. Each school enjoyed hosting Olympic runner and Minnesota Grown spokesperson Carrie Tollefson, who dazzled students, staff, local producers, and other community members with her motivational presentations about her running career and her focus on eating well to perform at her best in everything she does. **Over 100 hundred people participated at each school site** and participants were overwhelmingly positive about their experience. The schools were able to serve extra special meals on the days of the celebrations with produce they had in storage from the 2013 growing season or extra produce purchased just prior to the celebration. Students were pleased with the bright colors and wide variety of foods served. **One thousand-dollar awards** were disbursed to the winning schools and their producer partners, who purchased food service equipment like knives, fruit slicers, cutting boards, and food storage items. Some of the money also helped support producers, who purchased produce storage bins and labels to smooth the logistics of delivering and storing produce. In one case, part of the award was used to support student field trips to the farm and for the producer to do educational activities at the school. Schools asked whether the competition would be an annual event and producers were especially grateful for UM Extension's concrete role in supporting Farm to School.

Numerous partners made significant contributions to this project. Two state agencies served in key roles. The Minnesota Department of Education (MDE) revised the standard FFVP claim form to ensure MN schools had a place to document MN Grown produce procured within the FFVP. In addition, MDE provided leadership to the development and promotion of the Eat Smart Food Competition. The Minnesota Department of Agriculture (MDA), specifically the MN Grown program, provided critical support in the development of the Eat Smart Food videos and Eat Smart Food celebrations at schools. Furthermore, local and state partners worked together to organize and execute each regional Farm to Cafeteria workshop. This level of engagement from local partners was critical in the successful development and execution of the workshops. These partners include, but are not limited to:

- Regional Sustainable Development Partnerships: Provided significant leadership, often as lead planners, in the region
- Renewing the Countryside: Led producer-buyer networking
- Minnesota Department of Health: Promotion of regional workshops to Statewide Health Improvement Program (SHIP) coordinators and local public health staff. Local public health also served on regional planning committees.
- Minnesota Institute for Sustainable Agriculture: Promotion of workshops via regional and statewide channels.
- Minnesota School Nutrition Association: Participation on regional planning committees and promotion of regional workshops.

The focus of this project was to promote the use of locally grown fruits and vegetables within the USDA Fresh Fruit and Vegetable Program. The USDA Fresh Fruit and Vegetable Program funds only specialty crops. The core elements of the Farm to Cafeteria workshops focused on meeting the needs of each region, cultivating strong partnerships between producers and buyers, and offering educational opportunities to increase capacity for local food purchases, with emphasis

on fruits and vegetables. The increased capacity and skills gained by attendees may have had ripple effects which benefited Farm to School initiatives at a larger scale.

GOALS AND OUTCOMES ACHIEVED

At a Glance - Summary of activities and accomplishments

Activities completed to achieve goal and outcome	**Summary of accomplishments**	**Goal #1**	**Goal #2**
Farm to Cafeteria workshops	-Formed 8 local planning committees to ensure regional assets and needs leveraged -570 Minnesotans participated in eight regional workshops -90% of participants surveyed indicated their understanding of farm to cafeteria efforts in their region increased as a result of the workshop. -92% of producers and 94% of food service staff were confident in building relationships with one another	X	X
Development of MN Grown tracking system for the FFVP	-Claim form adapted to include two additional metrics, 1) identification of producer/supplier, 2) MN Grown (Yes or No) -*Favorable unexpected organizational change*: Tracking of MN producers/suppliers and MN Grown fruits and vegetables has been institutionalized within the Minnesota Departments of Education's new online data system for schools participating in the FFVP	X	
Eat Smart Food Competition	-Developed Eat Smart Food competition rules and guidelines -Designed and created six Eat Smart Food videos, leveraging expertise of consultant -3 celebrations with MN Grown Spokesperson, Carrie Tollefson at the winning schools	X	X
Farm to School Education	-92% of Health and Nutrition staff indicated they would take action to support Farm to Fork after training and technical assistance -*Favorable unexpected organizational change:* The 2015 SNAP-Ed Plan has incorporated the following objective for all programming, "*By the end of a course, 90% of participants in direct education in youth settings will try at least one locally grown fruit or vegetable.*"		X

This project had two focused goals, each with its own performance measure, benchmark and target as follows:

1. Increase the amount of MN produce (in dollars) purchased in the Fresh Fruit and Vegetable Program (FFVP) by 10% from Sept 2012 to Sept 2013.
2. Increase the number of FFVP funded schools that participate in F2S educational activities by 10% from Sept-Dec 2012 to Sept - Dec 2013.

To accomplish both goals, lines of communication were immediately established with key partners to initiate project work. Partnerships at the local, regional and state levels proved to be

vital to the success of this project. What follows is a summary of goals and outcomes achieved, organized by the following core activities:

- Farm to Cafeteria workshops
- Development of MN Grown tracking system for the FFVP
- Eat Smart Food Competition
- Farm to School Education

In addition, this report includes a data table for each goal. Discussion of the results can be found in the Lessons Learned section.

Eight **Farm to Cafeteria workshops** were designed to meet the needs of each region, cultivate strong partnerships between producers and buyers, and offer educational opportunities to increase capacity for local food purchases by institutions. Each workshop included breakout sessions, producer to buyer networking, and a meal. Local food meals were provided at each site to highlight and support regional producers. The content of the breakout sessions varied by region and were led by regional experts and statewide staff. For example, breakout session topics included the following in the West Metro:

- Post-harvest handling and on-farm food safety
- Navigating Farm to School contracts between producers and school food service
- How to generate and maintain school and community support for Farm to School
- Overview of the new National School Lunch Program regulations and the Fresh Fruit and Vegetable Program
- Tips for empowering parents and community members to advocate for Farm to School and other school wellness initiatives
- Minnesota Food Charter Input Session

Evaluations indicated **80%** of participants felt the workshops were well organized and the materials and activities aided in their learning. Ninety percent of participants surveyed responded that their understanding of farm to cafeteria efforts in their region increased as a result of the workshop. The majority of the participants (**over 90%**) said they will use the information from the event and 65% planned to use resources within the next 3 months. As a result of the workshops, **92%** of producers and **94%** of food service staff were confident in building relationships with one another. One producer wrote, "It seems like schools will pay [an] equivalent amount as co-op or wholesale" for local food. At the conclusion of the workshops, several producers commented that they had a better understanding of the concerns and desires of cafeterias, which will allow them to better prepare for these markets. Participants also felt the workshops were valuable as they met new people (majority met more than 5 people) and the workshops provided practical examples. One participant noted, "Panel of people are great! They are people from the area that we can relate to. They practice what they preach." The workshops were also appreciated for factors such as "quick paced and did not get boring." Ninety-seven percent of food service staff stated they were confident in buying local foods as a result of the workshop. One food service staff stated, "I have been practicing F2S for a few years and it just keeps getting better and better." Another added, "We were already doing it prior to the workshop, but meeting the growers made me even more confident." Part of the confidence in buying local foods may be explained in the increased trust with producers and new or strengthened connections to their farms.

To continue to build the network, participants requested more time to network and a contact list of participants. One participant recommended providing "an asset map of projects, producers, cafeteria...of all of those who attended." Future learning needs were identified by workshop participants. In general, producers indicated they want more information about distribution models and food safety considerations while food service professionals would like more resources to identify producers and integrate food into the cafeteria. In summary, the regional Farm to Cafeteria workshops increased knowledge, built confidence, and inspired participants.

Initially, the **development of a MN Grown tracking system for the FFVP** within the Minnesota Department of Education (MDE) was focused on the needs of this current project. The coordinator during this project period, Stephanie Heim, researched other tracking systems to support MDE in editing their former system. Focused conversations with the FFVP Coordinator at MDE and MDE leadership began early in 2012. There was agreement that the FFVP claim form would be adapted to capture the "producer/supplier" where the food was procured and whether a fruit or vegetable purchased was grown in Minnesota. During the project period, claim forms were submitted electronically via email using an excel spreadsheet. Beginning in the 2014-15 school year, all schools receiving FFVP funds submit their claim reimbursement via an online data system. This new system has institutionalized the changes originally made in school year 2012-13. This outcome surpassed the original expectations for this project.

The **Eat Smart Food Competition** was held in September 2013, winners were chosen at the end of the year, and school celebrations were conducted for the winners and awards distributed in early 2014. Because the school celebrations brought together students, food service staff, and specialty crop producers over community accomplishments, the Eat Smart Food Competition benefited the dual grant objectives of connecting Minnesota specialty crop producers to schools and increasing the number of schools participating in Farm to School educational opportunities. The celebrations provided a positive experience for all involved and promoted a sense of community pride by portraying the schools in a positive light. The financial awards were also disbursed and allowed the schools and producers to purchase supplies that enable them to continue Farm to School partnerships in the future. The winners completed award report forms detailing how the award money was spent and reflecting on how they anticipated the awards would benefit the school communities and what further steps can be taken to ensure continued collaboration between schools and specialty crop producers.

Farm to School Education within Minnesota schools increased over the project period through multiple channels. According to the USDA Farm to School Census, 208 school districts in Minnesota participate in Farm to School. This is up from 18 school districts in 2006 and 145 school districts in 2011. For this project, we aimed to increase the number of FFVP funded schools that participate in Farm to School educational activities by 10% from September-December 2012 to 2013. Quantitative analysis of the data indicates this did not happen (see below). In fact, the number of FFVP funded schools where UM Extension's Health and Nutrition Programs provided direct education to students fell from 18 schools in 2012/13 to 14 schools in 2013/14. It is interesting to note however that farm to fork focused direct education stayed the same at 10 schools each school year and the number of students we reached in these schools actually increased 6.4%.

Table 1

Goal 1:	To increase the amount of MN produce (in dollars) purchased in the FFVP			
Performance Measure	Amount of MN produce purchased by schools with FFVP grant funding in Sept. 2013 compared to previous year			
Benchmark	Dollars of MN FFV purchases by schools in Sept. 2012. Target: Average purchase of MN FFV by schools in Sept. 2013 increases by 10%			
Denominator	# of schools who participated in the FFVP in both September 2012 **AND** September 2013 (n=64)			
	.	**2012**	**2013**	**% change**
	# FFVP schools serving MN grown produce in Sept.	44	14	-68.00%
	Total dollar amount of MN grown produce in Sept.	11,741.38	3,432.72	-70.00%
	# Variety of MN fruits served	19	19	0%
	# Variety of MN vegetables served	17	16	-5.88%
	# of suppliers/distributors providing MN Grown produce	16	11	-31.25%
	Total dollar amount of non-MN grown produce in Sept.	88,271.41	121,846.97	38.00%
	Total dollar amount of Sept. claims	100,012.79	125,279.69	25.00%

Additional comments to support interpretation of data:

- In 2012 Minneapolis Public Schools purchased $5,071.38 of MN grown produce. In 2013 they did not start FFVP until October so this impacted the overall amount of money spent in the month of September.
- In 2012 St. Paul Public Schools purchased $4,808.10 of MN grown produce. In 2013 they indicated $0 was spent on MN grown produce.
- Overall the reliability of the data reported date is somewhat questionable. For example, some schools noted gold kiwi and red seedless grapes were MN Grown. As a result, there is an opportunity to provide further education to food service staff, distributors and others involved in submitting the monthly FFVP claims to improve accuracy of reporting MN grown items.

Table 2

Goal 2:	To increase the number of FFVP funded schools that participate in F2S educational activities			
Performance Measure	Number of FFVP funded schools using F2S educational materials			
Benchmark	Number of FFVP schools utilizing UM Extension's CNEs that participate in F2S in Sept-Dec 2012. Target: Increase number of schools by 10% in Sept-Dec 2013			
Denominator*	# of schools with FFVP funding in 2012/13 **AND** 2013/14 (n=88)			
		2012/13	**2013/14**	**% change**
	# of schools with SNAP-Ed or EFNEP	18	14	-12.50%

	# of schools with SNAP-Ed or EFNEP AND Farm to Fork strategies**	10	10	0.00%
	# of sessions within schools with SNAP-Ed or EFNEP	460	345	-14.29%
	# of sessions within schools with SNAP-Ed or EFNEP AND Farm to Fork strategies	305	279	-4.45%
	# of individual classrooms within schools with SNAP-Ed or EFNEP	88	80	-4.76%
	# of individual classrooms within schools with SNAP-Ed or EFNEP AND Farm to Fork strategies	56	59	2.61%
	# of students within schools with SNAP-Ed or EFNEP	1707	1623	-2.52%
	# of students within schools with SNAP-Ed or EFNEP AND Farm to Fork strategies	1127	1281	6.40%

* Data analysis was conducted for the full school year and not the targeted timeframe of September-December. See lessons learned below for additional explanation.
**Internally, Farm to Fork strategies are defined as: teaching about where food comes from, taste testing with local food, gardening, cooking with local food, educating about where to buy local food and encouraging use of SNAP to purchase seeds/food plants.

BENEFICIARIES

The primary beneficiaries of this project were MN specialty crop producers and MN school children. Secondary beneficiaries included school foodservice, families of school children, and members of communities where the local economy was improved due to increased sales of MN grown produce. Additional beneficiaries included the Minnesota Department of Education and University of Minnesota Extension Health and Nutrition Programs.

Minnesota specialty crop producers experienced enhanced competitiveness in the marketplace for their products as school food services developed or expanded their relationships with producers and/or distributors to purchase more MN grown produce. Improved relationships with schools resulted from the regional Farm to Cafeteria workshops as indicated in the evaluations (see Goals and Outcomes section above). In total, 44 FFVP funded schools served MN Grown fruits and vegetables in September 2012 while 14 FFVP funded schools served MN Grown fruits and vegetables in September 2013. This amounted to total purchases of $15,173 of MN specialty crops. Furthermore, Minnesota specialty crop producers received positive attention associated with the Eat Smart Food Competition school celebrations, such as being a focal point during the celebrations as well as being portrayed positively in media coverage of the events. They were empowered by recognition for the work they have done in supporting healthy foods in schools and appreciate the small monetary award for containers to improve the process of delivering produce to the schools. The producers will continue to benefit going forward as their partnering schools make use of the kitchen equipment purchased with the Eat Smart Food Competition funds and continue to source locally grown fruits and vegetables.

Minnesota school children benefitted from farm to school educational opportunities delivered by SNAP-Ed Educators within UM Extension's Health and Nutrition Program. It is important to note that this project did not evaluate knowledge or behavior change of Minnesota school children and instead examined the exposure of educational opportunities. Data in table 2 (above) indicates the number of students reached from the 2012-13 school year to the 2013-14 school year increased by 6.4% to 1,281 students.

Furthermore, as evidenced above, the regional Farm to Cafeteria workshops improved the skills and connections food service staff had with MN producers. The three winning schools of the Eat Smart Food Competition and their communities also benefitted from the learning opportunities around the celebrations as well as from the award funds. The schools experienced a sense of pride in their communities for being recognized and staff noted the value of the celebrations in

promoting a school-wide focus on healthy living. Entire school communities and other community members benefitted from participating in the motivational presentation by Olympic athlete Carrie Tollefson. The food service staff are benefiting from the purchase of supplies to help process and prepare Minnesota grown fruits and vegetables in the future. The new supplies increase ease and efficiency, making it more feasible for school kitchens to continue working with fresh, local products. The students benefit from the fresh, local produce included in their snacks and meals and the schools anticipate increased opportunities for educational interactions between students and producers in the future. Lastly, the awards have motivated the schools to expand their Farm to School programming by increasing the engagement of students in school gardening activities, a positive educational gain for students, staff, and the broader communities. Communities of the three winning schools benefited from the one thousand-dollar awards to support continued Farm to School programming. Three specialty crop producers also benefited from receipt of partial award funds to purchase equipment to allow them to continue participating in Farm to School activities and to support educational engagement with students. The communities also benefited from the award celebrations, including the extra fresh fruits and vegetables purchased with the allocated $200.

The Minnesota Department of Education (MDE) and UM Extension's Health and Nutrition Programs also benefitted greatly from this project. Involvement in this project, including the execution of the grant deliverables built internal staff capacity to work on farm to school. This resulted in MDE institutionalizing the documentation of MN Grown fruits and vegetables within the FFVP. In addition, it resulted in the development of a 2015 Health and Nutrition objective (specifically for our SNAP-Ed Program), that 90% of youth participants will taste a locally grown fruit or vegetable. These two changes in organizational practices are just two of the documented ripple effects of this project.

LESSONS LEARNED

Funding provided from the MDA Specialty Crop Block Grant in 2010 and again in 2012 has significantly increased UM Extension's capacity to provide leadership to Farm to School in Minnesota. Today, for example, UM Extension serves as the state lead for the National Farm to School Network and provides critical coordination to Minnesota's Farm to School Leadership Team. Over the past five years, UM Extension has learned many important lessons. First, Farm to School programs are place-based and uniquely built from the assets and needs of a particular community. Second, the landscape of Farm to School in Minnesota is continually changing. Needs and priorities constantly evolve as partners, resources and expertise enter and leave a community. Third, Farm to School is at its best when diverse stakeholders are at the table to communicate, cooperate, coordinate and partner.

Several unexpected outcomes resulted throughout this project that emphasize the three important lessons noted above. Although some of these were documented in our 2013 annual report, below is a summary to help future grantees:

- Successful Farm to School initiatives take time - and a lot of it! The strongest Farm to School initiatives start small and at the heart are focused on relationships. Multiple partners with multiple perspectives give Farm to School initiatives great strength. This is true at the community, regional, state and national levels. This project was resilient in the face of significant change because diverse stakeholders worked together to achieve the goals of this project. Without this deep level of engagement from a broad set of partners, this project may have failed. Specifically, two significant staff changes within UM Extension's Health and Nutrition Programs are worth noting:
    - In November 2013, Extension announced a restructuring of our Health & Nutrition Programs due to loss of federal funding. In January 2013, federal funding for

SNAP-Ed (Supplemental Nutrition Education Program Education) was significantly reduced. After sustaining the program for a year, Extension made the decision to restructure the program, with 40 percent fewer nutrition staff, to match the decreased funding levels. While Extension has remained committed to providing educational programs to low-income individuals and the agencies that serve them, including Farm to School, the significance of this news impacted the delivery of programming and ultimately impacted one of the expected measurable outcomes of this project, to increase the number of FFVP funded schools that participate in Farm to School educational activities by 10% in Sept-Dec 2013.

    - Related to the significant program restructure described above, significant project coordinator changes occurred from January 2012-March 2014. This resulted in program and communication gaps with internal staff, including external partners (i.e. MN schools and MDE). Specifically, the planning and promotion efforts for the Eat Smart Food Competition in September 2013 were not well executed as we experienced our second staff transition with the departure of Sarah Eichberger in July 2013. Additionally, the originally named project coordinator, Stephanie Heim, was still away on maternity leave during this time. As a result, another Extension Educator, Susan DeBlieck, who was new to UM Extension and the project was asked to take the lead. The summer 2013 was a critical time to educate FFVP funded schools about buying MN Grown produce during the month of September, in conjunction with the Eat Smart Food Competition. It was also a critical time for training and technical assistance with SNAP-Ed Educators who were responsible for delivering farm to school educational opportunities. This staff transition impacted both expected measurable outcomes for this project.

- The Eat Smart Food Competition was planned to support Farm to School month which Minnesota celebrated during September from 2009-2013. Planning farm to school month celebrations during September can prove difficult however. With the start of the new school year, the month of September proves to be very busy for school foodservice departments. Most schools are focused on incorporating new menus, training staff, and establishing routines for breakfast and lunch. As an example from this project, of the 118 schools participating in Fresh Fruit and Vegetable Program (FFVP) in the 2013-2014 school year, only 89 school choose to participate during September 2013. Of these 89 schools, 30 purchased MN Grown fruits and vegetables. Some schools delayed the start of their participation in the FFVP to October and as result these schools missed the opportunity to participate in the Eat Smart Food Competition and their claim forms to track MN Grown fruits and vegetables were not included in our data analysis. Specifically, the Minneapolis school district, with a total of 21 schools participating in the 2013-14 school year, waited to start the FFVP program in October 2013. As a result of what we learned in this project, MN's Farm to School Leadership team, following the lead of members of the Minnesota School Nutrition Association, decided to permanently move the Farm to School Month celebration from September to October to align with the National celebration.
- Sometimes the measures you choose to evaluate at the outset of a project are not the best way to document impact. It is critical to pay attention to the the unexpected

outcomes as often they may be the most powerful examples of change. With gratitude to the Minnesota Department of Agriculture, the approved extension of the original project timeline, has provided us an opportunity to document the unintended positive outcomes of this project. MDE and UM Extension Health and Nutrition Program made significant organizational changes in support of farm to school (as described above) that will have lasting impact on MN specialty crop producers and MN school children.

ADDITIONAL INFORMATION

1. Fresh Fruit and Vegetable Program website: http://www.extension.umn.edu/food/farm-to-school/fresh-fruit-and-vegetable-program/
2. Eat Smart Food video: http://www.extension.umn.edu/food/farm-to-school/fresh-fruit-and-vegetable-program/videos/
3. Eat Smart Food Competition media coverage:
    a. http://lptv.org/laporte-wins-eat-smart-food-contest-golden-apple/
    b. http://www.walkermn.com/news/article_f2f01872-a471-11e3-9e8d-001a4bcf887a.html
4. ~~Eat Smart Food Competition photos~~ (Removed Link-Pictures in Google Drive)

Project E

PROJECT 6: Development of Nitrogen Management Practices in Minnesota and North Dakota to Reduce Acrylamide Levels in Processed Potato Products

Submitted by: Carl Rosen, 612-625-1244, crosen@umn.edu

Final Report – 2014

Project Summary

The recent discovery of the neurotoxin, acrylamide, in processed potato products (Tareke et al, 2002) has made health concerns a topic of interest to potato processors, producers and consumers. This issue is particularly important in North Dakota and Minnesota because French fries from this region appear to have higher acrylamide levels than those from other regions (Vernon, 2010).

Acrylamide levels are affected by potato cultivar, processing method, and gene expression. Altering cultural management practices, such as nitrogen fertilization rates, influences the levels of reducing sugars and asparagine, precursors to acrylamide (Mottram et al, 2002; Stadler et al, 2002 and Becalski et al, 2004), and may reduce acrylamide levels immediately. The purpose of this trial was to determine if acrylamide concentrations of processed potato products can be controlled by nitrogen application rate and cultivar selection.

Our research efforts are focused on establishing baseline acrylamide levels in French fries and potato chips made from Russet Burbank and Snowden, compared to the newer processing

cultivar releases Alpine Russet, Dakota Trailblazer, and Ivory Crisp, which initial research indicates have lower reducing sugar levels and, in some cases, lower asparagine levels. The effect of nitrogen fertilization rate and tuber storage time on whole-tuber sucrose, glucose, and nitrogen concentrations and French-fry or chip acrylamide concentration for these cultivars were determined. Results for petiole nitrate-nitrogen (nitrate-N) concentrations and tuber yield are also presented.

Project Approach

In 2011 and 2012, five genotypes (Alpine Russet, Dakota Trailblazer, Russet Burbank, Ivory Crisp, and Snowden) were grown at two study sites each year at varying rates of nitrogen application (30, 120, 180, 240, and 300 lbs./ac) to determine the effects of nitrogen management on acrylamide levels and processing quality. In 2011, trials were planted in Becker, MN, and Inkster, ND. In 2012, a field at Park Rapids, MN, was used in place of the Inkster site. Study plots consisted of four rows (the center two being harvested and sampled), 20 feet long. Tubers were spaced one foot apart within each row, with three feet between rows. Prior to planting, all plots were fertilized with a blend of nutrients that included 30 lbs. N/ac as monnoammonium phosphate and ammonium sulfate. ESN, a polymer coated urea (44-0-0), was sidedressed at the time of shoot emergence at rates of 0, 90, 150, 210, and 270 lbs. N/ac and then hilled in. Petioles were sampled at Becker, four times in 2011 and five times in 2012. Petiole samples were dried and analyzed to determine nitrate-N concentrations.

Tubers from Becker were sorted and graded on-site within a week of harvest. Grading data and quality attribute assessment include total yield and grade, specific gravity, and internal quality assessment for disorders impacting processing quality. Samples were taken for French-frying and chipping soon after grading, and additional samples were taken after three, six and nine months' storage at 46 ˚F. Harvest samples were analyzed for whole-tuber sucrose and glucose concentrations and processed into French fries and chips (depending on the cultivar) at the USDA-ARS Potato Worksite (East Grand Forks, MN). The acrylamide levels (parts per billion of fresh weight) of finished French fries and chips were determined at the University of Minnesota Mass Spectrometry Laboratory.

Goals and Outcomes Achieved

Yield and petiole nitrate-N data are presented for the Becker, MN, site (see appendix). Sugar and acrylamide concentrations have been determined for all sites and all storage times for both 2011 and 2012. We calculated baseline sugar and acrylamide concentrations for all four site-year combinations for each cultivar, averaged (± 1 S.D.) across all nitrogen application rates (Table 1). In addition, for each nitrogen application rate used, we calculated the average baseline values (± 1 S.D.) across both chipping cultivars (Table 2) and all three French-frying cultivars (Table 3).

Nitrogen application rate effects on petiole and tuber N and tuber yield and size

Nitrogen treatment had significant effects on petiole nitrate-N concentration and tuber nitrogen concentration (Tables A1 – A 10), as well as tuber yield and size distribution (Tables A11 – A 20). Petiole nitrate-N concentration increased significantly with nitrogen application rate at all

sampling times for all five cultivars in both years. Whole tuber nitrogen concentration increased approximately linearly with nitrogen application rate at Becker in 2011 and 2012.

Marketable yield peaked at a total nitrogen application rate of 180 or 240 lbs./ac (the third- and second-highest rates) for all cultivars in 2011. Different cultivars showed different yield responses to nitrogen application rate in that year (i.e. the treatment-by-cultivar interaction was significant for marketable yield). Alpine Russet, Dakota Trailblazer, and Ivory Crisp each showed a clear peak in marketable yield (at 180 lbs. total N/ac for Alpine Russet and Dakota Trailblazer and at 240 lbs. total N/ac for Ivory Crisp), while Russet Burbank and Snowden yields plateaued above a certain application rate (180 lbs. N/ac for Russet Burbank; 120 lbs. N/ac for Snowden). In 2012, marketable yield either increased with nitrogen application rate across the range of application rates used (Alpine Russet, Russet Burbank, and Ivory Crisp) or plateaued at the second-highest rate, 240 lbs. total N/ac (Dakota Trailblazer and Snowden). These responses were not significantly different from each other.

In 2011, the percentage of tubers over six or ten ounces increased with increasing nitrogen application rate across the range of application rates evaluated. In contrast, these percentages often peaked at application rates of 180 or 240 lbs. N/ac in 2012.

Cultivar effects on petiole and tuber N and tuber yield and size

Petiole nitrate-N concentration and tuber yield and size distribution also differed significantly among the cultivars. In both years and at all storage times, petiole nitrate-N concentration for Alpine Russet was high early in the season (June) but low late in the season (July and August), compared to other cultivars. The opposite was true for Russet Burbank. Ivory Crisp maintained relatively low petiole nitrate-N concentrations throughout the season, while Dakota Trailblazer and Snowden maintained relatively high concentrations.

In terms of whole tuber nitrogen concentration for tubers grown at Becker in 2011, the cultivars ranked as follows: Alpine Russet > Ivory Crisp > Snowden = Russet Burbank > Dakota Trailblazer. The ranking was similar in 2012: Alpine Russet > Ivory Crisp = Russet Burbank > Snowden > Dakota Trailblazer.

In 2011 at Becker, the marketable yields of the cultivars ranked as follows: Dakota Trailblazer > Snowden = Ivory Crisp > Russet Burbank > Alpine Russet. The three newer cultivars had significantly higher percentages of their yield represented by tubers over six or ten ounces than Russet Burbank or Snowden did.

In 2012 at Becker, the marketable yields of the cultivars ranked differently than in 2011: Alpine Russet ≥ Ivory Crisp = Dakota Trailblazer = Snowden ≥ Russet Burbank (with Alpine Russet > Russet Burbank). Again, the new cultivars had significantly greater percentages of their yield in tubers over six ounces than Russet Burbank or Snowden did. The same was true for yield in tubers over ten ounces, except that the percentage for Ivory Crisp was not significantly greater than the percentage for Russet Burbank.

In both years, Alpine Russet and Russet Burbank produced far higher yields of U.S. No. 2 tubers than the other cultivars did. Yield of U.S. No. 2 tubers increased with nitrogen application rate for Russet Burbank, but not for Alpine Russet. Nearly all tubers produced by Dakota Trailblazer, Ivory Crisp, and Snowden were U.S. No. 1 tubers.

Nitrogen application rate effects on tuber sugars and French-fry and chip acrylamide

The relationship between nitrogen application rate and whole-tuber sucrose concentration was inconsistent among years, sites, and storage times, for both the chipping cultivars and the French-frying cultivars.

In contrast to the inconsistent results for whole-tuber sucrose, whole-tuber glucose concentration was usually significantly related to nitrogen application rate, such that higher application rates yielded lower glucose concentrations. At Becker, this relationship was seen at all storage times for both French-frying and frying cultivars in 2011 and for the chipping cultivars in 2012. It was also observed in the frying cultivars in Park Rapids in 2012. However, there was no directional relationship between nitrogen application rate and whole-tuber glucose concentration for the chipping cultivars at either site in 2012, and the relationship between application rate and whole-tuber glucose concentration tended to be positive at Inkster in 2011.

The relationship between the fresh-weight acrylamide concentration of fried products and nitrogen application rate was variable, depending on site, year, cultivar, and storage time. Because of these interactions, we conclude that, while N management can affect acrylamide in fried potato products, the direction of the response will depend upon each specific situation, precluding the ability to predict the effect of N rate on acrylamide concentrations

Cultivar, preparation, and storage effects on tuber sugars and French-fry and chip acrylamide

Among the French-frying cultivars, Russet Burbank consistently had a lower mean whole-tuber sucrose concentration than Alpine Russet, and it had a lower sucrose concentration than Dakota Trailblazer in all cases except at Inkster after three to nine months in storage. Between the chipping cultivars, Ivory Crisp usually had the lower whole-tuber sucrose concentration, especially at three and six months' storage. For both groups, tuber sucrose concentration generally increased greatly between six and nine months in storage, except that the French-frying cultivars had their highest tuber sucrose concentrations at harvest and three months' storage in 2011.

Dakota Trailblazer had a lower mean whole-tuber glucose concentration than the other two French-frying cultivars at three of the four site-year combinations, the exception being Inkster, where Alpine Russet had the lowest mean glucose concentration. At Becker, the tuber glucose concentrations of the French-frying cultivars tended to increase with storage time. The reverse was seen for Park Rapids tubers, and the glucose concentrations of Inkster tubers fluctuated over time. The two chipping cultivars did not differ consistently in their tuber glucose concentrations until nine months in storage in 2011 and six months in storage in 2012, at which time Snowden began to have far higher glucose concentrations than Ivory Crisp.

Acrylamide concentration was generally significantly higher for the chipping cultivars than for the French-frying cultivars. Only at Park Rapids after three and six months in storage did a French-frying cultivar (Russet Burbank) have significantly higher French-fry acrylamide concentrations than one (Ivory Crisp at six months) or both (at three months) chipping cultivars. This difference in acrylamide concentration between the two preparation methods presumably occurred because the fresh weight of potato chips includes much less water than that of French fries.

Among the French-frying cultivars, Dakota Trailblazer produced the lowest concentrations of acrylamide for most combinations of site, year, and time in storage. The exception was Inkster in 2011, where French fries made from Alpine Russet had significantly lower acrylamide concentrations than those made from Dakota Trailblazer at three and nine months' storage. Overall, Alpine Russet and Dakota Trailblazer in North Dakota and Dakota Trailblazer at Becker consistently produced French fries with lower average acrylamide concentrations than Russet Burbank.

There was no general pattern for how French-fry acrylamide concentrations varied with time in storage. Rather, variation in concentration over storage time depended on cultivar, site, year, and, in some cases, nitrogen fertilizer rate.

The two chipping cultivars produced chips with similar (though often statistically significantly different) acrylamide concentrations through six months' storage at Becker in 2011, at harvest and at six months' storage at Inkster in 2011, and through three months' storage at both Becker and Park Rapids in 2012. After longer periods of storage, Snowden chips had acrylamide concentrations three to five times as high as Ivory Crisp chips, which showed little tendency for acrylamide concentration to increase with storage time. Both chipping cultivars generally produced their lowest acrylamide concentrations after three or six months storage.

Relationships between acrylamide, tuber nitrogen and sugars, and chip color

Acrylamide concentration was generally positively correlated with whole-tuber glucose concentration for both the French-frying cultivars and the chipping cultivars.

For French-frying cultivars grown in 2012, acrylamide concentration was significantly negatively correlated with the sucrose concentration of tubers from both sites and all four storage times. In contrast, acrylamide concentration was not significantly related to sucrose concentration for either site or any storage time for the chipping cultivars. In 2011, the relationship between sucrose concentration and acrylamide concentration was either insignificant or significantly negative for the French-frying cultivars and significantly positive for the chipping cultivars.

The relationship of whole-tuber nitrogen concentration at harvest to the acrylamide concentration of French fries was significantly positive for French fries made after nine months in storage in 2011. This positive relationship was also significant for French fries made at all storage times except six months (when there was still a trend) in 2012. In contrast, the relationship between chip acrylamide concentration and at-harvest tuber nitrogen tended to become negative with

increasing storage time, probably because Snowden had lower tuber nitrogen than Ivory Crisp, but its chip acrylamide levels increased dramatically in the later storage times.

For the chipping cultivars in all sites, both years, and most storage times, acrylamide concentration was positively related to subjective chip color scores (higher scores indicate darker chips) and negatively related to Agtron readings (lower readings indicate darker chips). These relationships were weaker for Inkster in 2011 than for the other site-year combinations, except at nine months' storage, because chip color was less variable at this site.

Objectives achieved

The first objective of this study was to develop baseline values for sugar content, French-fry color, chip color, and acrylamide levels following 0, 3, 6, and 9 months' storage at 46˚F. This objective has been achieved completely.

The second objective was to develop nitrogen management guidelines that improve upon the baseline acrylamide levels determined in the first objective. Because the relationship between nitrogen application rate and acrylamide concentration was inconsistent between sites, between years, and among cultivars, we cannot develop nitrogen management guidelines to reduce acrylamide levels based on the results of this study. However, our data do permit us to make cultivar and storage recommendations to reduce acrylamide levels (see "Lessons Learned"), as well as cultivar, nitrogen fertilization, and petiole-N recommendations to optimize marketable yield.

Lessons Learned

Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.

The acrylamide concentrations of fried potato products can be controlled, to some extent, through cultivar selection. Tuber glucose concentration is a determinant of final acrylamide concentration. The low glucose concentrations of Dakota Trailblazer tubers, which also yielded low acrylamide levels, suggest that cultivar selection for low tuber glucose concentration may help to reduce acrylamide levels in fried products.

Nitrogen application rate had inconsistent effects on acrylamide concentration. Even when application rate was significantly related to whole-tuber glucose concentration, the relationship between nitrogen application rate and acrylamide concentration was highly variable.

The results of this study indicate good potential to reduce (but not eliminate) acrylamide in fried potato products through cultivar selection, particularly through selection for low-glucose cultivars. However, our results do not suggest that acrylamide concentrations can be controlled in a consistent way by manipulating nitrogen application rate.

Other insights:

- Marketable yield at Becker usually peaked at a nitrogen application rate below the highest rate used in this study (300 lbs. N/ac), especially in 2011.
- Alpine Russet and Russet Burbank had high yields of U.S. No. 2 tubers. The other cultivars produced U.S. No. 1 tubers almost exclusively.
- For Russet Burbank, but not for other cultivars, U.S. No. 2 tubers became increasingly prevalent as nitrogen application rate increased.
- Petiole nitrate-N was strongly positively related to nitrogen application rate.
- Nitrogen application rate in the field had inconsistent effects on the acrylamide concentrations of French fries or potato chips.
- Potato cultivar significantly influenced the acrylamide concentrations of French fries and potato chips.
- The newer cultivars (Alpine Russet and Dakota Trailblazer for the French-frying cultivars, Ivory Crisp for the chipping cultivars) yielded lower acrylamide concentrations than the older ones did (Russet Burbank and Snowden).
- For the chipping cultivars, chip acrylamide concentrations were lowest when tubers stored for three or six months were used. For Ivory Crisp, acrylamide concentrations remained low after longer times in storage, but Snowden consistently produced very high acrylamide concentrations by nine months in storage.
- Acrylamide concentration in both French fries and chips was usually positively correlated with whole-tuber glucose concentration.
- Whole-tuber sucrose and nitrogen concentrations were inconsistently correlated with French-fry and chip acrylamide concentration.
- Darker potato chips (as measured subjectively or using an Agtron machine) had higher acrylamide concentrations.

In conclusion, the relationship of acrylamide concentration to nitrogen fertilization rate was found to be highly inconsistent, depending on site, year, cultivar, and storage time. In contrast, there were consistent differences among the cultivars for all site-year combinations. Overall, the new cultivars (Alpine Russet and Dakota Trailblazer for French-frying, Ivory Crisp for chipping) had lower acrylamide concentrations than the older cultivars (Russet Burbank for French-frying, Snowden for chipping). Based on the results of this study, cultivar identity has more clear and consistent effects on the acrylamide concentrations of French fries and chips than does the nitrogen application rate in the field.

Provide unexpected outcomes or results that were an effect of implementing this project.

Nitrogen application rate was expected to be a significant determinant of the acrylamide contents of fried potato products, but this did not prove to be the case. Acrylamide formation can potentially be limited by the concentrations of reducing sugars and asparagine during the Maillard reaction. Because the concentration of asparagine in potato tubers has been shown to be strongly positively related to total tuber nitrogen concentration, and because tuber nitrogen

increased with nitrogen application rate at Becker, it was expected that asparagine concentration would be less likely to limit acrylamide formation at higher application rates. As a consequence, acrylamide formation was expected to increase with nitrogen application rate.

The fact that this did not occur may be explained by the potential for the concentrations of reducing sugars to limit acrylamide formation. Where the tuber glucose concentration responded systematically to nitrogen application rate, it decreased as application rate increased. The contradictory trends shown by tuber nitrogen and glucose may have prevented acrylamide formation from showing a consistent directional response to nitrogen treatment.

If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

All goals and outcome measures were achieved in this study.

Additional Information

This research has been published in the 2012 and 2013 Minnesota Area II Potato Research and Promotion Council and Northern Plains Potato Growers Association (NPPGA) Research Reports. It was also presented to 100 producers and potato agronomists at the NPPGA Research Reporting Conference held in conjunction with the International Crop Expo (Grand Forks, ND) in February 2013, 40 scientists that work on potatoes at the Potato Association of America Annual Meeting (Quebec City, QC) in July 2013, and 45 potato producers and agronomists at the Minnesota Area II Educational Conference in November 2013. For these events, a half hour PowerPoint presentation was given followed by questions and answers.

Field day events were held in Inkster in August 2012 and in Becker in August 2012 and July 2013. Approximately 200 people attended the Inkster field day, primarily producers and those in the industry. The trial was briefly described in a field day handout, and a brief verbal update was given as to status of the FY11 trials. Approximately 25 growers attended the 2012 field day in Becker. Acrylamide analyses were not complete at the time; only yield and quality results were discussed. Approximately 35 growers attended the 2013 field day, in which 2011 acrylamide results were discussed along with yield and quality results. No formal feedback was received from the attendees at any event, but the potato processors and growers are very interested in the project and the results.

Beneficiaries

Potato producers growing for the chip and frozen processing markets are potential beneficiaries. Approximately 320 potato producers growing for the chip and frozen processing markets from Minnesota and North Dakota are potential beneficiaries. There are at least 100 more growers in nearby upper Midwest states that would also benefit. Additionally, based on yield and petiole information, not only will their product have potentially less acrylamide formation, but they may find that new cultivars are more sustainable from a production standpoint using less nitrogen to produce a high yield of a high quality crop. This may also positively impact the environment and consumers concerned about leaching. A second group of beneficiaries would include the potato processors. In North Dakota and Minnesota potatoes grown by ND and MN growers are

made into French fries and other frozen products at Simplot (Grand Forks, ND), Cavendish Farms (Jamestown, ND), and Lamb-Weston/ConAgra (Park Rapids, MN). Potatoes grown by MN and ND producers for chipping are processed at Barrel of Fun (Perham, MN), Old Dutch (in Cities area, MN), and also by Frito-Lay plants outside our states. These manufacturing sites benefit if the raw product has low levels of reducing sugars and asparagine, resulting in a finished product with reduced levels of acrylamide. Finally, consumers of frozen processed products including French fries, and snack foods containing potato, such as chips, benefit when acrylamide levels are reduced.

Contact

Carl Rosen
crosen@umn.edu
Department of Soil, Water, and Climate
University of Minnesota

Asunta Thompson
asunta.thompson@ndsu.edu
Department of Plant Sciences
North Dakota State University

Table 1. Whole-tuber sucrose and glucose concentrations and post-processing acrylamide concentrations of potatoes from each cultivar, averaging (± 1 S.D.) across all nitrogen treatments, from each study site in each year, at harvest and after three, six, and nine months in storage at 46 ˚F.

Site	Year	Cultivar	Sucrose				Glucose				Acrylamide			
			Harvest	3 months	6 months	9 months	Harvest	3 months	6 months	9 months	Harvest	3 months	6 months	9 months
Becker	2011	Alpine Russet	1.46 ± 0.37	1.29 ± 0.36	0.99 ± 0.26	0.62 ± 0.53	1.54 ± 0.70	2.29 ± 0.78	2.65 ± 1.08	2.88 ± 1.31	434 ± 170	643 ± 390	686 ± 235	1077 ± 524
		Dakota Trailblazer	1.41 ± 0.28	1.18 ± 0.81	0.79 ± 0.63	1.00 ± 0.77	0.41 ± 0.23	0.53 ± 0.25	0.79 ± 0.85	0.88 ± 0.48	120 ± 63	412 ± 370	207 ± 109	333 ± 214
		Russet Burbank	0.95 ± 0.27	1.05 ± 0.38	0.51 ± .018	0.28 ± 0.21	1.71 ± 0.62	2.15 ± 0.75	2.00 ± 1.02	1.96 ± 0.76	576 ± 219	749 ± 363	832 ± 324	874 ± 272
		Ivory Crisp	0.71 ± 0.22	0.64 ± 0.45	0.81 ± 0.77	1.05 ± 1.15	0.22 ± 0.12	0.28 ± 0.20	0.66 ± 0.71	0.93 ± 0.70	3046 ± 1043	2602 ± 1145	1571 ± 975	2285 ± 1208
		Snowden	1.05 ± 0.26	0.83 ± 0.21	1.35 ± 0.68	2.09 ± 1.06	0.22 ± 0.13	0.28 ± 0.23	0.61 ± 0.45	2.84 ± 0.94	3079 ± 1058	1890 ± 829	2353 ± 1042	9549 ± 3104
	2012	Alpine Russet	1.62 ± 0.54	1.64 ± 0.62	1.91 ± 0.57	2.18 ± 1.05	2.70 ± 1.01	2.88 ± 0.89	2.90 ± 0.87	3.00 ± 0.63	1091 ± 298	1326 ± 426	721 ± 518	835 ± 357
		Dakota Trailblazer	1.71 ± 0.43	1.84 ± 0.71	4.64 ± 1.45	15.65 ± 7.09	1.15 ± 0.52	0.60 ± 0.22	0.79 ± 0.35	1.13 ± 0.52	478 ± 201	375 ± 244	135 ± 105	326 ± 161
		Russet Burbank	1.12 ± 0.60	0.93 ± 0.25	1.11 ± 0.34	1.52 ± 0.90	3.27 ± 0.86	2.87 ± 0.81	2.87 ± 0.81	3.91 ± 0.97	1130 ± 385	1351 ± 693	903 ± 684	881 ± 497
		Ivory Crisp	1.01 ± 0.29	0.66 ± 0.40	2.57 ± 0.89	8.04 ± 6.01	0.64 ± 0.27	0.35 ± 0.20	0.45 ± 0.25	0.99 ± 0.46	5503 ± 1596	2055 ± 1003	2705 ± 1010	3586 ± 1502
		Snowden	1.27 ± 0.25	0.87 ± 0.24	2.93 ± 0.47	5.83 ± 1.94	0.61 ± 0.21	0.16 ± 0.07	0.90 ± 0.39	2.21 ± 0.59	5885 ± 1350	1223 ± 468	6167 ± 2303	11080 ± 2714
Inkster	2011	Alpine Russet	1.90 ± 0.44	1.77 ± 0.43	0.99 ± 0.25	0.88 ± 0.31	0.27 ± 0.16	0.36 ± 0.19	0.28 ± 0.46	0.47 ± 0.42	205 ± 141	304 ± 156	304 ± 112	218 ± 109
		Dakota Trailblazer	1.34 ± 0.35	0.77 ± 0.24	0.33 ± 0.17	0.34 ± 0.24	0.48 ± 0.25	0.96 ± 0.54	0.40 ± 0.28	0.71 ± 0.69	212 ± 127	604 ± 348	297 ± 143	325 ± 145
		Russet Burbank	1.03 ± 0.14	0.90 ± 0.22	0.68 ± 0.19	0.59 ± 0.23	0.54 ± 0.20	0.92 ± 0.32	0.55 ± 0.20	0.72 ± 0.28	424 ± 142	737 ± 291	666 ± 185	404 ± 144
		Ivory Crisp	1.50 ± 0.26	0.72 ± 0.27	0.78 ± 0.25	0.95 ± 0.83	0.20 ± 0.14	0.17 ± 0.21	0.06 ± 0.07	0.27 ± 0.45	2682 ± 961	821 ± 182	981 ± 113	812 ± 331
		Snowden	1.38 ± 0.27	0.91 ± 0.17	0.98 ± 0.22	1.78 ± 0.39	0.07 ± 0.04	0.06 ± 0.06	0.04 ± 0.02	0.98 ± 0.38	2131 ± 356	2946 ± 1164	1357 ± 241	3717 ± 1257
Park Rapids	2012	Alpine Russet	2.00 ± 0.54	1.95 ± 0.44	1.98 ± 0.60	2.01 ± 0.80	1.04 ± 0.53	1.11 ± 0.63	0.81 ± 0.62	0.71 ± 0.53	1657 ± 571	933 ± 388	1924 ± 867	656 ± 225
		Dakota Trailblazer	2.16 ± 0.50	2.56 ± 1.07	2.75 ± 0.68	4.77 ± 1.98	0.30 ± 0.20	0.07 ± 0.05	0.08 ± 0.06	0.06 ± 0.04	441 ± 113	308 ± 256	693 ± 455	206 ± 118
		Russet Burbank	0.94 ± 0.32	1.26 ± 0.30	0.76 ± 0.20	0.75 ± 0.16	2.67 ± 0.63	2.86 ± 0.57	2.24 ± 0.30	1.81 ± 0.49	2590 ± 586	2083 ± 835	3826 ± 900	874 ± 237
		Ivory Crisp	1.70 ± 0.49	2.25 ± 0.97	2.70 ± 0.94	7.36 ± 5.21	0.32 ± 0.17	0.08 ± 0.05	0.06 ± 0.04	0.14 ± 0.12	5373 ± 1633	841 ± 248	569 ± 130	1354 ± 537
		Snowden	1.39 ± 0.23	1.81 ± 0.53	3.07 ± 0.68	5.19 ± 1.81	0.57 ± 0.28	0.07 ± 0.04	0.58 ± 0.26	1.09 ± 0.38	5363 ± 1840	707 ± 226	2285 ± 840	4020 ± 860

Table 2. Whole-tuber sucrose and glucose concentrations and post-processing acrylamide concentrations of chipping-variety (Ivory Crisp and Snowden) potatoes from each nitrogen treatment, averaging (± 1 S.D.) across both cultivars, from each study site in each year, at harvest and after three, six, and nine months in storage at 46 ˚F.

Site	Year	Treatment	Sucrose				Glucose				Acrylamide			
			Harvest	3 months	6 months	9 months	Harvest	3 months	6 months	9 months	Harvest	3 months	6 months	9 months
Becker	2011	30 lbs N/ac (0 as ESN)	0.88 ± 0.45	0.68 ± 0.31	1.05 ± 0.73	1.49 ± 1.11	0.35 ± 0.14	0.50 ± 0.22	1.28 ± 0.93	2.87 ± 1.14	3200 ± 1152	2129 ± 727	3013 ± 1249	7469 ± 3992
		120 lbs N/ac (90 as ESN)	0.87 ± 0.36	0.70 ± 0.21	0.79 ± 0.56	1.14 ± 0.89	0.26 ± 0.13	0.36 ± 0.31	0.56 ± 0.42	1.79 ± 0.86	3197 ± 779	2944 ± 674	1949 ± 799	6857 ± 4486
		180 lbs N/ac (150 as ESN)	0.86 ± 0.24	0.81 ± 0.31	1.41 ± 0.96	1.64 ± 1.38	0.16 ± 0.06	0.26 ± 0.06	0.71 ± 0.42	1.64 ± 1.38	3206 ± 1174	2604 ± 1364	2031 ± 1279	6913 ± 5236
		240 lbs N/ac (210 as ESN)	0.93 ± 0.24	0.65 ± 0.25	1.09 ± 0.50	1.80 ± 1.51	0.18 ± 0.09	0.22 ± 0.08	0.48 ± 0.44	1.57 ± 1.48	2878 ± 667	1565 ± 522	1678 ± 895	4493 ± 3253
		300 lbs N/ac (270 as ESN)	0.82 ± 0.23	0.83 ± 0.63	1.11 ± 1.05	1.81 ± 1.34	0.15 ± 0.09	0.11 ± 0.06	0.28 ± 0.15	1.65 ± 1.39	3222 ± 1009	2224 ± 1131	1498 ± 256	4744 ± 4567
	2012	30 lbs N/ac (0 as ESN)	1.04 ± 0.32	0.83 ± 0.29	2.55 ± 0.86	6.30 ± 2.63	0.61 ± 0.15	0.30 ± 0.18	0.59 ± 0.16	1.50 ± 0.63	4349 ± 882	1592 ± 582	3687 ± 1756	6676 ± 3848
		120 lbs N/ac (90 as ESN)	1.11 ± 0.19	0.81 ± 0.54	3.11 ± 0.81	9.30 ± 8.24	0.73 ± 0.24	0.24 ± 0.14	0.83 ± 0.40	2.01 ± 0.80	5974 ± 1163	1888 ± 1243	4855 ± 2422	7780 ± 4866
		180 lbs N/ac (150 as ESN)	1.19 ± 0.28	0.73 ± 0.30	2.84 ± 0.69	7.31 ± 3.31	0.73 ± 0.16	0.36 ± 0.25	0.88 ± 0.58	1.79 ± 0.74	6881 ± 1352	2118 ± 1070	5232 ± 3789	8563 ± 4915
		240 lbs N/ac (210 as ESN)	1.19 ± 0.38	0.75 ± 0.29	2.65 ± 0.64	6.97 ± 2.71	0.52 ± 0.23	0.20 ± 0.11	0.62 ± 0.34	1.70 ± 0.97	5251 ± 1191	1383 ± 398	5139 ± 2233	7290 ± 4578
		300 lbs N/ac (270 as ESN)	1.17 ± 0.34	0.72 ± 0.30	2.61 ± 0.62	4.65 ± 2.24	0.51 ± 0.32	0.13 ± 0.04	0.47 ± 0.31	1.08 ± 0.79	5985 ± 1569	1131 ± 536	3570 ± 1792	6816 ± 4546
Inkster	2011	30 lbs N/ac (0 as ESN)	1.26 ± 0.08	0.64 ± 0.12	0.83 ± 0.31	1.04 ± 0.61	0.12 ± 0.12	0.06 ± 0.06	0.04 ± 0.03	0.44 ± 0.33	2493 ± 876	1323 ± 738	1159 ± 211	2201 ± 1905
		120 lbs N/ac (90 as ESN)	1.44 ± 0.30	0.95 ± 0.24	0.79 ± 0.20	1.45 ± 0.66	0.08 ± 0.06	0.06 ± 0.04	0.03 ± 0.01	0.43 ± 0.41	1991 ± 460	1561 ± 1094	1050 ± 187	2172 ± 1734
		180 lbs N/ac (150 as ESN)	1.44 ± 0.22	0.81 ± 0.20	0.90 ± 0.29	1.34 ± 0.53	0.12 ± 0.09	0.11 ± 0.12	0.04 ± 0.03	0.75 ± 0.64	2350 ± 591	2011 ± 1350	1226 ± 310	2100 ± 1549
		240 lbs N/ac (210 as ESN)	1.40 ± 0.16	0.80 ± 0.20	0.85 ± 0.22	1.19 ± 0.51	0.19 ± 0.21	0.10 ± 0.09	0.05 ± 0.06	0.41 ± 0.29	2703 ± 710	1886 ± 1506	1169 ± 175	2535 ± 1927
		300 lbs N/ac (270 as ESN)	1.66 ± 0.35	0.87 ± 0.33	1.04 ± 0.21	1.78 ± 1.25	0.17 ± 0.09	0.24 ± 0.31	0.08 ± 0.08	1.09 ± 0.69	2497 ± 1063	2637 ± 1801	1241 ± 404	2315 ± 1940
Park Rapids	2012	30 lbs N/ac (0 as ESN)	1.56 ± 0.26	2.00 ± 1.04	2.58 ± 0.71	7.73 ± 6.42	0.64 ± 0.24	0.09 ± 0.07	0.42 ± 0.41	0.71 ± 0.67	6442 ± 1924	652 ± 181	1545 ± 909	2819 ± 959
		120 lbs N/ac (90 as ESN)	1.50 ± 0.37	2.59 ± 0.83	2.75 ± 0.57	6.93 ± 3.73	0.43 ± 0.15	0.08 ± 0.03	0.25 ± 0.28	0.62 ± 0.51	5424 ± 1797	827 ± 296	1537 ± 1104	2868 ± 1868
		180 lbs N/ac (150 as ESN)	1.47 ± 0.17	1.76 ± 0.68	3.54 ± 1.30	5.65 ± 2.18	0.28 ± 0.19	0.05 ± 0.04	0.33 ± 0.40	0.68 ± 0.71	5870 ± 1824	758 ± 195	1646 ± 1353	2965 ± 1658
		240 lbs N/ac (210 as ESN)	1.67 ± 0.74	1.92 ± 0.62	2.96 ± 0.52	5.39 ± 2.74	0.49 ± 0.35	0.09 ± 0.05	0.32 ± 0.29	0.50 ± 0.49	4345 ± 1824	808 ± 246	908 ± 450	2820 ± 1668
		300 lbs N/ac (270 as ESN)	1.50 ± 0.34	1.89 ± 0.69	2.62 ± 0.59	5.69 ± 4.14	0.38 ± 0.25	0.05 ± 0.03	0.30 ± 0.25	0.57 ± 0.50	4764 ± 1467	793 ± 299	1663 ± 1307	2331 ± 1539

Table 3. Whole-tuber sucrose and glucose concentrations and post-processing acrylamide concentrations of French-frying-variety (Alpine Russet, Dakota Trailblazer, and Russet Burbank) potatoes from each nitrogen treatment, averaging (± 1 S.D.) across all three cultivars, from each study site in each year, at harvest and after three, six, and nine months in storage at 46 ˚F.

Site	Year	Treatment	Sucrose				Glucose				Acrylamide			
			Harvest	3 months	6 months	9 months	Harvest	3 months	6 months	9 months	Harvest	3 months	6 months	9 months
Becker	2011	30 lbs N/ac (0 as ESN)	1.30 ± 0.51	1.16 ± 0.51	0.86 ± 0.54	0.71 ± 0.74	1.69 ± 1.14	2.30 ± 1.28	2.58 ± 1.36	2.33 ± 1.51	321 ± 167	604 ± 381	421 ± 318	578 ± 353
		120 lbs N/ac (90 as ESN)	1.21 ± 0.44	1.29 ± 0.33	0.79 ± 0.44	0.67 ± 0.79	1.32 ± 0.67	1.71 ± 0.33	1.84 ± 1.41	2.33 ± 1.49	338 ± 178	582 ± 397	618 ± 336	753 ± 444
		180 lbs N/ac (150 as ESN)	1.23 ± 0.34	1.24 ± 1.01	0.87 ± 0.62	0.71 ± 0.65	1.09 ± 0.61	1.65 ± 1.01	1.86 ± 1.11	2.05 ± 1.28	461 ± 299	641 ± 496	712 ± 422	937 ± 706
		240 lbs N/ac (210 as ESN)	1.26 ± 0.40	0.94 ± 0.28	0.64 ± 0.27	0.54 ± 0.49	1.08 ± 0.76	1.37 ± 0.90	1.60 ± 1.22	1.52 ± 0.68	339 ± 237	528 ± 352	655 ± 407	847 ± 409
		300 lbs N/ac (270 as ESN)	1.37 ± 0.23	1.21 ± 0.35	0.65 ± 0.26	0.53 ± 0.44	0.92 ± 0.58	1.27 ± 0.66	1.19 ± 0.78	1.31 ± 0.67	426 ± 340	675 ± 382	470 ± 242	693 ± 386
	2012	30 lbs N/ac (0 as ESN)	1.87 ± 0.85	1.95 ± 0.84	2.74 ± 1.84	7.96 ± 9.56	2.88 ± 1.50	2.61 ± 1.68	2.22 ± 1.40	2.49 ± 1.67	727 ± 337	1116 ± 897	417 ± 471	657 ± 696
		120 lbs N/ac (90 as ESN)	1.46 ± 0.57	1.51 ± 0.76	2.56 ± 1.46	7.83 ± 8.27	2.56 ± 1.29	2.36 ± 1.56	2.52 ± 1.51	3.02 ± 1.87	819 ± 393	869 ± 709	722 ± 858	568 ± 251
		180 lbs N/ac (150 as ESN)	1.36 ± 0.45	1.33 ± 0.54	2.36 ± 1.77	5.78 ± 7.66	2.45 ± 1.17	2.07 ± 1.08	2.36 ± 1.16	2.77 ± 1.19	871 ± 499	932 ± 626	506 ± 440	632 ± 368
		240 lbs N/ac (210 as ESN)	1.35 ± 0.43	1.27 ± 0.48	3.01 ± 2.41	5.99 ± 6.74	2.18 ± 1.10	1.79 ± 0.99	1.99 ± 1.09	2.58 ± 0.97	974 ± 433	941 ± 518	737 ± 738	682 ± 341
		300 lbs N/ac (270 as ESN)	1.41 ± 0.40	1.33 ± 0.57	2.22 ± 1.37	5.21 ± 7.38	1.72 ± 0.77	1.71 ± 0.96	1.80 ± 0.98	2.47 ± 1.17	927 ± 394	1110 ± 595	536 ± 336	836 ± 418
Inkster	2011	30 lbs N/ac (0 as ESN)	1.47 ± 0.52	1.24 ± 0.65	0.70 ± 0.32	0.68 ± 0.41	0.32 ± 0.15	0.67 ± 0.54	0.30 ± 0.31	0.72 ± 0.83	189 ± 202	395 ± 298	380 ± 217	269 ± 195
		120 lbs N/ac (90 as ESN)	1.45 ± 0.44	1.25 ± 0.63	0.60 ± 0.23	0.60 ± 0.28	0.39 ± 0.20	0.62 ± 0.33	0.36 ± 0.27	0.63 ± 0.43	306 ± 211	708 ± 411	447 ± 340	383 ± 186
		180 lbs N/ac (150 as ESN)	1.44 ± 0.40	1.24 ± 0.46	0.68 ± 0.26	0.55 ± 0.25	0.53 ± 0.31	0.85 ± 0.50	0.35 ± 0.20	0.53 ± 0.25	298 ± 151	542 ± 245	437 ± 205	302 ± 137
		240 lbs N/ac (210 as ESN)	1.46 ± 0.66	1.01 ± 0.51	0.61 ± 0.34	0.55 ± 0.34	0.49 ± 0.19	0.67 ± 0.46	0.50 ± 0.32	0.58 ± 0.35	289 ± 136	521 ± 256	369 ± 105	333 ± 128
		300 lbs N/ac (270 as ESN)	1.30 ± 0.44	1.00 ± 0.45	0.75 ± 0.51	0.63 ± 0.43	0.42 ± 0.25	0.93 ± 0.46	0.54 ± 0.52	0.70 ± 0.48	299 ± 128	575 ± 371	491 ± 228	293 ± 87
Park Rapids	2012	30 lbs N/ac (0 as ESN)	1.95 ± 0.87	2.27 ± 0.99	1.91 ± 1.17	2.36 ± 1.66	1.65 ± 1.03	1.67 ± 1.38	1.22 ± 0.96	1.08 ± 0.99	1518 ± 964	1393 ± 1070	2524 ± 1414	682 ± 396
		120 lbs N/ac (90 as ESN)	1.75 ± 0.72	1.80 ± 0.98	1.87 ± 1.10	2.79 ± 2.33	1.42 ± 1.16	1.45 ± 1.29	1.11 ± 1.07	1.05 ± 0.95	1480 ± 908	1048 ± 1037	1751 ± 1607	513 ± 269
		180 lbs N/ac (150 as ESN)	1.61 ± 0.69	2.07 ± 0.92	1.75 ± 1.07	3.16 ± 3.11	1.17 ± 1.21	1.14 ± 1.27	0.99 ± 1.04	0.69 ± 0.86	1411 ± 1095	1176 ± 1037	2297 ± 1629	609 ± 342
		240 lbs N/ac (210 as ESN)	1.52 ± 0.47	1.83 ± 0.93	1.85 ± 0.84	2.42 ± 1.67	1.31 ± 1.11	1.45 ± 1.40	0.99 ± 0.96	0.82 ± 0.71	1819 ± 1081	804 ± 538	2055 ± 1187	537 ± 395
		300 lbs N/ac (270 as ESN)	1.69 ± 0.79	1.66 ± 0.32	1.79 ± 0.84	1.91 ± 1.24	1.13 ± 1.13	1.04 ± 1.05	0.92 ± 1.04	0.66 ± 0.65	1587 ± 1083	1074 ± 959	2111 ± 1764	552 ± 329

Appendix

Table A1. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration and harvest tuber N concentration of Alpine Russet potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Petiole NO_3-N Concentration (ppm)				Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]					
		lbs N/ac	P, E	June 20	June 28	July 11	July 26	
1	MAP + AMS	30	30, 0	10197 b	1423 c	181 d	206 c	1.16 c
2	MAP + AMS, ESN	120	30, 90	20449 a	10819 b	2417 c	781 c	1.29 bc
3	MAP + AMS, ESN	180	30, 150	21559 a	12151 b	3032 c	1329 c	1.18 c
4	MAP + AMS, ESN	240	30, 210	21206 a	19265 a	9571 b	3834 b	1.43 b
5	MAP + AMS, ESN	300	30, 270	22655 a	19594 a	14510 a	9299 a	1.62 a
			Significance[3]	*	**	**	**	**
			LSD (0.10)	5769	5653	1369	1199	0.16

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A2. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration and harvest tuber N concentration of Dakota Trailblazer potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Petiole NO_3-N Concentration (ppm)				Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]					
		lbs N/ac	P, E	June 20	June 28	July 11	July 26	
1	MAP + AMS	30	30, 0	8011 c	981 d	379 e	194 d	0.82 c
2	MAP + AMS, ESN	120	30, 90	17102 b	7813 c	3301 d	1092 cd	0.86 c
3	MAP + AMS, ESN	180	30, 150	18381 ab	10133 c	7121 c	2682 c	0.98 b
4	MAP + AMS, ESN	240	30, 210	20606 a	16080 b	9954 b	5071 b	1.07 b
5	MAP + AMS, ESN	300	30, 270	21556 a	20186 a	12828 a	7515 a	1.19 a
			Significance[3]	**	**	**	**	**
			LSD (0.10)	3181	3594	1081	1652	0.12

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A3. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration and harvest tuber N concentration of Russet Burbank potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Petiole NO_3-N Concentration (ppm)				Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]					
		lbs N/ac	P, E	June 20	June 28	July 11	July 26	
1	MAP + AMS	30	30, 0	4415 c	689 e	333 e	112 e	0.79 c
2	MAP + AMS, ESN	120	30, 90	14864 b	5353 d	2919 d	1600 d	1.06 b
3	MAP + AMS, ESN	180	30, 150	17714 a	10181 c	7442 c	4367 c	1.12 ab
4	MAP + AMS, ESN	240	30, 210	19549 a	14070 b	12438 b	6683 b	1.14 ab
5	MAP + AMS, ESN	300	30, 270	19893 a	17249 a	15501 a	9377 a	1.23 a
			Significance[3]	**	**	**	**	**
			LSD (0.10)	2638	2177	1776	1313	0.18

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A4. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration and harvest tuber N concentration of Ivory Crisp potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Petiole NO_3-N Concentration (ppm)				Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]					
		lbs N/ac	P, E	June 20	June 28	July 11	July 26	
1	MAP + AMS	30	30, 0	4032 c	346 d	160 d	100 c	0.98 d
2	MAP + AMS, ESN	120	30, 90	16220 b	5157 c	937 d	275 c	1.09 c
3	MAP + AMS, ESN	180	30, 150	19321 ab	9918 b	4265 c	1721 bc	1.19 b
4	MAP + AMS, ESN	240	30, 210	21115 a	16604 a	8705 b	3536 b	1.20 b
5	MAP + AMS, ESN	300	30, 270	22467 a	16943 a	14872 a	7478 a	1.48 a
			Significance[3]	**	**	**	**	**
			LSD (0.10)	3467	3370	2654	2134	0.07

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A5. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration and harvest tuber N concentration of Snowden potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Petiole NO_3-N Concentration (ppm)				Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]					
		lbs N/ac	P, E	June 20	June 28	July 11	July 26	
1	MAP + AMS	30	30, 0	3556 c	573 d	260 e	306 d	1.11
2	MAP + AMS, ESN	120	30, 90	15618 b	6535 c	2766 d	1490 c	1.21
3	MAP + AMS, ESN	180	30, 150	20797 a	11989 b	6237 c	2561 b	1.03
4	MAP + AMS, ESN	240	30, 210	22039 a	16424 a	10604 b	6679 a	1.14
5	MAP + AMS, ESN	300	30, 270	20957 a	18960 a	14041 a	7535 a	1.16
			Significance[3]	**	**	**	**	NS
			LSD (0.10)	3843	2691	1907	1003	--

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A6. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration of Alpine Russet potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Petiole NO3-N Concentration (ppm)					Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]						
		lbs N/ac	P, E	June 11	June 28	July 10	July 24	August 9	
1	MAP + AMS	30	30, 0	2997 c	505 d	140 c	267 b	44 b	1.35 b
2	MAP + AMS, ESN	120	30, 90	14956 b	5566 c	658 bc	312 b	125 b	1.39 b
3	MAP + AMS, ESN	180	30, 150	17786 b	8065 bc	1593 b	1257 ab	493 ab	1.41 b
4	MAP + AMS, ESN	240	30, 210	17560 b	9308 b	1392 bc	582 b	160 b	1.46 b
5	MAP + AMS, ESN	300	30, 270	22296 a	13045 a	3032 a	2761 a	1180 a	1.60 a
			Significance[3]	**	**	*	++	++	*
			LSD (0.10)	3224	3562	1405	1639	845	0.13
			Linear contrast	**	**	**	*	*	**
			Quadratic contrast	NS	NS	NS	NS	NS	NS

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A7. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration of Dakota Trailblazer potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Petiole NO3-N Concentration (ppm)					Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]						
		lbs N/ac	P, E	June 11	June 28	July 10	July 24	August 9	
1	MAP + AMS	30	30, 0	4653 c	780 e	264 d	490 c	28 b	0.99 c
2	MAP + AMS, ESN	120	30, 90	16726 b	7196 d	611 cd	428 c	155 b	0.99 c
3	MAP + AMS, ESN	180	30, 150	17874 b	10307 c	1795 c	897 c	268 b	1.12 bc
4	MAP + AMS, ESN	240	30, 210	21451 a	15100 b	5498 b	3017 b	536 b	1.25 ab
5	MAP + AMS, ESN	300	30, 270	19420 ab	19332 a	8677 a	5967 a	2487 a	1.30 a
			Significance[3]	**	**	**	**	*	*
			LSD (0.10)	3479	2991	1370	1864	1381	0.16
			Linear contrast	**	**	**	**	**	**
			Quadratic contrast	**	NS	**	**	++	NS

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A8. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration of Russet Burbank potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Petiole NO3-N Concentration (ppm)					Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]						
		lbs N/ac	P, E	June 11	June 28	July 10	July 24	August 9	
1	MAP + AMS	30	30, 0	2833 c	454 d	75 c	307 a	57 b	1.14 b
2	MAP + AMS, ESN	120	30, 90	12164 b	5325 c	1060 c	1052 d	519 b	1.31 a
3	MAP + AMS, ESN	180	30, 150	15457 a	9585 b	2334 bc	2904 c	898 b	1.39 a
4	MAP + AMS, ESN	240	30, 210	16359 a	12244 ab	3699 b	5711 b	1117 b	1.38 a
5	MAP + AMS, ESN	300	30, 270	16711 a	14740 a	7358 a	10723 a	3074 a	1.34 a
			Significance[3]	**	**	**	**	*	*
			LSD (0.10)	3237	2926	2299	1430	1454	0.13
			Linear contrast	**	**	**	**	**	**
			Quadratic contrast	**	NS	++	**	NS	++

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A9. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration of Ivory Crisp potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Petiole NO3-N Concentration (ppm)					Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]						
		lbs N/ac	P, E	June 11	June 28	July 10	July 24	August 9	
1	MAP + AMS	30	30, 0	871 d	1294 d	68 b	298 b	29	1.20 cd
2	MAP + AMS, ESN	120	30, 90	12142 c	2962 d	226 b	558 b	26	1.18 d
3	MAP + AMS, ESN	180	30, 150	16665 b	6745 c	647 b	232 b	49	1.34 bc
4	MAP + AMS, ESN	240	30, 210	15331 b	11160 b	2292 b	1111 b	67	1.39 b
5	MAP + AMS, ESN	300	30, 270	21878 a	15671 a	6005 a	6599 a	837	1.61 a
			Significance[3]	**	**	**	**	NS	**
			LSD (0.10)	2939	3617	2579	2575	--	0.16
			Linear contrast	**	**	**	**	++	**
			Quadratic contrast	*	++	*	**	NS	++

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A10. Effect of nitrogen rate from ESN fertilizer on petiole nitrate-N concentration of Snowden potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Petiole NO3-N Concentration (ppm)					Tuber Nitrogen (%)
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	June 11	June 28	July 10	July 24	August 9	
		lbs N/ac	P, E						
1	MAP + AMS	30	30, 0	2949 c	1128 d	554 c	466 c	54 b	1.09
2	MAP + AMS, ESN	120	30, 90	13087 b	4441 c	373 c	257 c	87 b	1.18
3	MAP + AMS, ESN	180	30, 150	17482 a	9609 b	1904 bc	1012 c	173 b	1.31
4	MAP + AMS, ESN	240	30, 210	18233 a	10671 b	3298 b	5284 b	795 b	1.36
5	MAP + AMS, ESN	300	30, 270	19916 a	17810 a	7907 a	13843 a	3771 a	1.19
			Significance[3]	**	**	**	**	**	NS
			LSD (0.10)	2692	2739	2006	2191	872	--
			Linear contrast	**	**	**	**	**	NS
			Quadratic contrast	**	NS	**	**	**	++

[1]MAP = monoammonium phosphate; AMS = ammonium sulfate; ESN = Environmentally Smart Nitrogen.

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A11. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Alpine Russet potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0-3 oz	3-6 oz	6-10 oz	10-14 oz	> 14 oz	Total	# 1 > 3 oz	# 2 > 3 oz	Total marketable	> 6 oz	> 10 oz
		lb N/ac	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	51.3	168.4 a	82.7 c	34.1 b	1.6 c	338.1 c	154.3 c	132.5 a	286.8 c	37.1 b	11.5 c
2	MAP + AMS, ESN	120	30, 90	42.5	150.5 a	140.1 ab	66.5 a	30.3 b	429.8 ab	293.6 ab	93.7 ab	387.3 ab	55.8 a	23.4 b
3	MAP + AMS, ESN	180	30, 150	50.7	150.3 a	154.1 a	75.7 a	42.5 b	473.3 a	339.7 a	82.9 b	422.5 a	57.8 a	25.2 b
4	MAP + AMS, ESN	240	30, 210	53.8	123.4 ab	128.8 ab	79.7 a	41.9 b	427.6 ab	286.4 b	87.4 b	373.8 ab	59.9 a	29.6 ab
5	MAP + AMS, ESN	300	30, 270	40.6	96.6 b	113.9 bc	56.5 ab	76.7 a	384.3 bc	266.7 b	77.0 b	343.7 b	64.7 a	35.1 a
			Significance[3]	NS	++	*	*	**	*	**	++	**	**	**
			LSD (0.10)	--	46.5	32.1	23.2	24.4	59.9	51.8	39.2	50.3	10.6	9.6

[1]MAP = monoammonium phosphate (11-46-0); AMS = ammonium sulfate (21-0-0-22); ESN = Environmentally Smart Nitrogen (44-0-0).

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A12. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Dakota Trailblazer potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0-3 oz	3-6 oz	6-10 oz	10-14 oz	> 14 oz	Total	# 1 > 3 oz	# 2 > 3 oz	Total marketable	> 6 oz	> 10 oz
		lb N/ac	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	20.6 bc	162.7 a	213.6 bc	26.1 b	0.9 c	424.0 c	399.8 c	3.6	403.3 c	56.2 c	6.1 c
2	MAP + AMS, ESN	120	30, 90	19.5 c	121.9 bc	260.3 ab	88.8 a	21.7 b	512.1 ab	491.2 ab	1.4	492.6 ab	72.4 a	21.5 b
3	MAP + AMS, ESN	180	30, 150	29.1 a	135.4 ab	272.9 a	97.3 a	12.4 bc	547.0 a	516.4 a	1.4	517.8 a	69.8 ab	19.9 b
4	MAP + AMS, ESN	240	30, 210	27.8 ab	159.6 ab	196.1 c	115.9 a	24.4 ab	523.8 ab	496.0 ab	0.0	496.0 ab	64.1 b	26.2 ab
5	MAP + AMS, ESN	300	30, 270	32.1 a	94.1 c	213.4 bc	114.7 a	44.3 a	498.7 b	465.7 b	1.0	466.6 b	74.7 a	32.0 a
			Significance[3]	*	*	++	**	*	**	**	NS	**	**	**
			LSD (0.10)	7.7	38.6	57.2	27.8	20.1	41.9	46.0	--	46.2	7.1	6.6

[1]MAP = monoammonium phosphate (11-46-0); AMS = ammonium sulfate (21-0-0-22); ESN = Environmentally Smart Nitrogen (44-0-0).

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A13. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Russet Burbank potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0-3 oz	3-6 oz	6-10 oz	10-14 oz	> 14 oz	Total	# 1 > 3 oz	# 2 > 3 oz	Total marketable	> 6 oz	> 10 oz
		lb N/ac	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	141.0 a	231.1	56.6	1.1 c	0.0 c	429.8 b	232.2	56.6	288.8 b	12.9 c	0.3 c
2	MAP + AMS, ESN	120	30, 90	112.2 b	234.3	135.5	7.6 c	5.0 bc	494.6 ab	320.2	62.1	382.4 a	30.2 b	2.6 c
3	MAP + AMS, ESN	180	30, 150	107.2 b	243.7	143.7	38.4 b	10.0 bc	543.0 a	363.2	72.6	435.8 a	35.4 ab	8.9 b
4	MAP + AMS, ESN	240	30, 210	102.4 bc	208.3	139.4	50.5 ab	14.4 ab	515.0 a	315.9	96.7	412.6 a	39.6 ab	12.6 b
5	MAP + AMS, ESN	300	30, 270	82.0 c	177.3	148.2	68.7 a	25.3 a	501.5 ab	304.0	115.5	419.5 a	48.1 a	19.3 a
			Significance[3]	*	NS	NS	**	*	++	NS	NS	*	**	**
			LSD (0.10)	24.8	--	--	20.7	12.7	77.2	--	--	79.1	14.3	6.3

[1]MAP = monoammonium phosphate (11-46-0); AMS = ammonium sulfate (21-0-0-22); ESN = Environmentally Smart Nitrogen (44-0-0).

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A14. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Ivory Crisp potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0 - 3 oz (0 - 2.25")	3 - 6 oz (2.25 - 2.75")	6 - 10 oz (2.75 - 3.25")	10 - 14 oz (3.25 - 3.75")	> 14 oz (> 3.75")	Total	# 1 > 3 oz	# 2 > 3 oz	Total marketable	> 6 oz	> 10 oz
		lb N/ac	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	41.6	147.1 a	135.6 d	36.2 c	7.6 c	368.1 c	326.4 c	0.0	326.4 c	47.8 b	11.4 c
2	MAP + AMS, ESN	120	30, 90	30.4	125.7 ab	215.4 b	80.2 bc	18.4 bc	470.1 b	438.9 b	0.8	439.7 b	66.1 a	20.0 bc
3	MAP + AMS, ESN	180	30, 150	33.6	137.2 ab	185.2 bc	108.7 ab	40.1 ab	504.8 ab	470.7 ab	0.5	471.2 ab	65.9 a	28.9 b
4	MAP + AMS, ESN	240	30, 210	26.4	118.4 bc	254.8 a	104.9 ab	41.5 ab	546.1 a	516.7 a	2.9	519.6 a	73.5 a	26.6 b
5	MAP + AMS, ESN	300	30, 270	25.5	89.9 c	176.9 c	128.6 a	67.0 a	487.9 b	461.6 ab	0.8	462.4 ab	76.3 a	40.2 a
			Significance[3]	NS	*	**	*	*	**	**	NS	**	**	**
			LSD (0.10)	--	28.7	35.3	47.4	30.6	53.3	59.6	--	59.7	11.0	10.6

[1]MAP = monoammonium phosphate (11-46-0); AMS = ammonium sulfate (21-0-0-22); ESN = Environmentally Smart Nitrogen (44-0-0).

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A15. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Snowden potato plants grown at Becker, MN, in 2011.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0 - 3 oz (0 - 2.25")	3 - 6 oz (2.25 - 2.75")	6 - 10 oz (2.75 - 3.25")	10 - 14 oz (3.25 - 3.75")	> 14 oz (> 3.75")	Total	# 1 > 3 oz	# 2 > 3 oz	Total marketable	> 6 oz	> 10 oz
		lb N/ac	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	76.1 bc	240.7	81.2 b	12.1 d	1.8 c	411.9 b	335.7 b	0.0	335.7 b	23.0 c	3.3 d
2	MAP + AMS, ESN	120	30, 90	72.8 c	275.8	164.8 a	25.2 cd	1.6 c	540.3 a	467.5 a	0.0	467.5 a	35.2 b	4.9 cd
3	MAP + AMS, ESN	180	30, 150	75.3 bc	243.8	203.2 a	32.5 c	5.1 bc	559.9 a	484.6 a	0.0	484.6 a	43.1 ab	6.7 c
4	MAP + AMS, ESN	240	30, 210	90.3 ab	231.5	181.2 a	48.3 b	13.3 ab	564.6 a	474.3 a	0.0	474.3 a	43.2 a	10.9 b
5	MAP + AMS, ESN	300	30, 270	96.4 a	210.7	173.1 a	64.9 a	16.9 a	562.0 a	464.0 a	1.6	465.6 a	44.9 a	14.5 a
			Significance[3]	*	NS	**	**	*	**	**	NS	**	**	**
			LSD (0.10)	16.0	--	47.5	14.8	8.9	53.1	53.2	--	53.5	8.0	2.6

[1]MAP = monoammonium phosphate (11-46-0); AMS = ammonium sulfate (21-0-0-22); ESN = Environmentally Smart Nitrogen (44-0-0).

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A16. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Alpine Russet potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0-3 oz	3-6 oz	6-10 oz	10-14 oz	> 14 oz	Total	# 1 > 3 oz	# 2 > 3 oz	Total marketable	> 6 oz	> 10 oz
		lb N/ac	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	43.2 a	126.6 a	103.6 b	53.3 c	11.7 d	338.4 d	92.0 c	203.3 b	295.2 d	49.7 c	19.2 c
2	MAP + AMS, ESN	120	30, 90	25.4 b	112.2 a	158.2 a	153.7 b	112.1 c	561.6 c	215.3 b	320.9 a	536.2 c	75.5 b	47.3 b
3	MAP + AMS, ESN	180	30, 150	20.4 b	66.6 b	159.1 a	182.5 a	156.5 b	585.0 bc	251.6 ab	313.1 a	564.7 bc	85.1 a	57.8 a
4	MAP + AMS, ESN	240	30, 210	15.3 b	73.5 b	153.3 a	179.5 ab	190.5 ab	612.1 ab	295.8 a	301.0 a	596.8 ab	85.5 a	60.4 a
5	MAP + AMS, ESN	300	30, 270	24.8 b	82.6 b	141.5 a	187.6 a	202.7 a	639.2 a	291.9 a	322.6 a	614.4 a	82.9 a	60.6 a
			Significance[3]	**	**	*	**	**	**	**	*	**	**	**
			LSD (0.10)	11.1	25.9	32.9	26.5	41.1	33.9	61.5	58.0	38.7	4.7	7.9
			Linear contrast	**	**	*	**	**	**	**	*	**	**	**
			Quadratic contrast	*	NS	NS	**	**	**	**	*	**	**	**

[1]MAP = monoammonium phosphate (11-46-0); AMS = ammonium sulfate (21-0-0-22); ESN = Environmentally Smart Nitrogen (44-0-0).

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A17. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Dakota Trailblazer potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0-3 oz	3-6 oz	6-10 oz	10-14 oz	> 14 oz	Total	# 1 > 3 oz	# 2 > 3 oz	Total marketable	> 6 oz	> 10 oz
		lb N/A	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	17.2	110.2 b	157.6 c	37.2 b	16.1 b	338.3 c	319.2 c	1.9	321.1 b	61.8 b	15.6 b
2	MAP + AMS, ESN	120	30, 90	7.8	119.6 b	218.4 ab	143.8 a	42.9 b	532.5 b	504.5 b	20.2	524.7 a	76.1 a	34.9 a
3	MAP + AMS, ESN	180	30, 150	11.3	107.4 b	245.2 a	145.9 a	42.7 b	552.5 ab	540.3 a	0.9	541.2 a	78.4 a	34.0 a
4	MAP + AMS, ESN	240	30, 210	17.2	200.3 a	184.4 bc	143.2 a	25.5 b	570.6 a	550.0 a	3.5	553.4 a	61.6 b	29.4 a
5	MAP + AMS, ESN	300	30, 270	15.0	112.1 b	208.3 abc	133.7 a	92.1 a	561.1 ab	545.3 a	0.9	546.1 a	77.1 a	40.1 a
			Significance[3]	NS	*	++	**	**	**	**	NS	**	*	*
			LSD (0.10)	--	58.9	55.4	46.3	31.8	29.8	34.0	--	31.6	11.1	13.1
			Linear contrast	NS	NS	*	**	NS	**	**	NS	**	NS	++
			Quadratic contrast	NS	++	NS	*	*	**	**	NS	**	NS	*

[1]MAP = monoammonium phosphate (11-46-0); AMS = ammonium sulfate (21-0-0-22); ESN = Environmentally Smart Nitrogen (44-0-0).

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A18. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Russet Burbank potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0-3 oz	3-6 oz	6-10 oz	10-14 oz	> 14 oz	Total	#1 > 3 oz	#2 > 3 oz	Total Marketable	> 6 oz	> 10 oz
		lb N/A	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	97.8 a	199.8	69.8 c	15.0 c	1.0 c	383.4 c	101.9 c	183.6	285.6 c	21.8 c	3.9 c
2	MAP + AMS, ESN	120	30, 90	68.0 ab	239.2	131.8 b	72.6 b	21.4 bc	533.0 b	221.5 b	243.5	465.0 b	41.9 b	17.1 b
3	MAP + AMS, ESN	180	30, 150	47.5 b	169.1	149.7 b	105.5 ab	81.9 a	553.7 ab	221.3 b	284.9	506.2 ab	61.7 a	35.1 a
4	MAP + AMS, ESN	240	30, 210	62.2 b	191.1	212.6 a	110.0 ab	42.5 b	618.3 ab	260.2 ab	295.9	556.1 ab	59.0 a	24.6 ab
5	MAP + AMS, ESN	300	30, 270	57.8 b	182.1	176.1 ab	131.5 a	86.1 a	633.6 a	298.7 a	277.1	575.8 a	61.6 a	33.8 a
			Significance[3]	*	NS	**	**	**	**	**	NS	**	**	**
			LSD (0.10)	30.1	--	47.9	46.5	34.4	97.0	40.2	--	91.8	14.1	12.3
			Linear contrast	**	NS	**	**	**	**	**	*	**	**	**
			Quadratic contrast	NS	NS	**	**	NS	**	**	NS	**	**	++

[1]ESN (Environmentally Smart Nitrogen, Agrium, Inc.) = 44-0-0; MAP (monoammonium phosphate) = 11-50-0; AMS (ammonium sulfate) = 21-0-0-22

[2]P=planting, E=emergence/hilling.

[3]NS = Non significant; ++, *, ** = Significant at 10%, 5%, and 1%, respectively.

Treatments that have the same letter within a column are not significantly different from each other.

Table A19. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Ivory Crisp potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0 - 3 oz (0 - 2.25")	3 - 6 oz (2.25 - 2.75")	6 - 10 oz (2.75 - 3.25")	10 - 14 oz (3.25 - 3.75")	> 14 oz (> 3.75")	Total	# 1 > 3 oz	# 2 > 3 oz	Total marketable	> 6 oz	> 10 oz
		lb N/A	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	47.9 a	170.6	108.9 b	24.4 c	1.7 c	353.4 d	305.5 d	0.0	305.5 c	38.6 b	7.6 c
2	MAP + AMS, ESN	120	30, 90	31.8 b	175.2	187.9 a	102.5 b	36.0 b	533.4 c	499.4 c	2.3	501.6 b	59.3 a	24.6 b
3	MAP + AMS, ESN	180	30, 150	33.5 b	153.5	191.6 a	142.6 ab	36.0 b	557.2 bc	522.9 bc	0.8	523.7 b	66.5 a	31.6 ab
4	MAP + AMS, ESN	240	30, 210	37.0 b	169.0	237.2 a	124.6 ab	47.1 b	614.9 ab	576.4 ab	1.4	577.8 ab	66.4 a	27.6 ab
5	MAP + AMS, ESN	300	30, 270	39.9 ab	155.3	229.7 a	154.4 a	75.6 a	654.9 a	615.0 a	0.0	615.0 a	70.2 a	35.1 a
			Significance[3]	*	NS	*	**	**	**	**	NS	**	**	**
			LSD (0.10)	8.5	--	63.7	48.0	22.3	72.3	76.2	--	76.3	11.1	8.9
			Linear contrast	*	NS	*	**	*	**	**	NS	**	**	**
			Quadratic contrast	NS	NS	**	*	**	**	**	NS	**	**	**

[1]MAP = monoammonium phosphate (11-46-0); AMS = ammonium sulfate (21-0-0-22); ESN = Environmentally Smart Nitrogen (44-0-0).

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Table A20. Effect of nitrogen rate from ESN fertilizer on tuber yield and size distribution for Snowden potato plants grown at Becker, MN, in 2012.

Nitrogen Treatments				Tuber Yield										
Treatment #	Nitrogen Source[1]	Nitrogen Rate	Nitrogen Timing[2]	0 - 3 oz (0 - 2.25")	3 - 6 oz (2.25 - 2.75")	6 - 10 oz (2.75 - 3.25")	10 - 14 oz (3.25 - 3.75")	> 14 oz (> 3.75")	Total	# 1 > 3 oz	# 2 > 3 oz	Total marketable	> 6 oz	> 10 oz
		lb N/ac	P, E	cwt / A						cwt / A			%	
1	MAP + AMS	30	30, 0	73.0	188.0 b	85.3 c	12.0 b	1.0	359.2 d	286.2 d	0.0 b	286.2 d	26.9 c	3.6 b
2	MAP + AMS, ESN	120	30, 90	79.1	290.7 a	152.3 b	15.4 b	0.7	538.1 c	459.0 c	0.0 b	459.0 c	31.0 bc	3.0 b
3	MAP + AMS, ESN	180	30, 150	72.8	278.8 a	179.1 ab	52.1 ab	2.2	585.0 b	511.5 b	0.7 a	512.2 b	39.9 ab	9.3 ab
4	MAP + AMS, ESN	240	30, 210	61.7	298.3 a	213.5 a	87.2 a	8.0	668.7 a	607.0 a	0.0 b	607.0 a	46.2 a	14.2 a
5	MAP + AMS, ESN	300	30, 270	79.4	318.3 a	219.7 a	54.5 ab	6.9	678.8 a	599.4 a	0.0 b	599.4 a	41.4 ab	9.1 ab
			Significance[3]	NS	**	**	*	NS	**	**	++	**	*	++
			LSD (0.10)	--	39.8	46.2	48.3	--	31.1	50.0	0.5	49.9	10.5	8.1
			Linear contrast	NS	**	**	*	NS	**	**	*	**	**	*
			Quadratic contrast	NS	**	**	NS	NS	**	**	++	**	*	NS

[1]MAP = monoammonium phosphate (11-46-0); AMS = ammonium sulfate (21-0-0-22); ESN = Environmentally Smart Nitrogen (44-0-0).

[2]P = planting; E = emergence/hilling.

[3]NS = non-significant; ++ = significant at 10%; * = significant at 5%; ** = significant at 1%.

Treatments that have the same letter within a column are not significantly different from each other.

Project F

FINAL PERFORMANCE REPORT: Minnesota Farmers' Market Association

SUBMITTED BY: Kathy Zeman, 320-250-5087, kzeman@mfma.org

PROJECT TITLE
MFMA Farmers' Market Manager Certification Program (Contract #36334)

PROJECT SUMMARY

- Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
- Establish the motivation for this project by presenting the importance and timeliness of the project.

The original purpose of this project (2011) was to develop a comprehensive training program for farmers' market managers so they would be knowledgeable about the many legal requirements and good business practices needed to successfully operate a farmers' market. These successful farmers' markets, would in turn, increase the sales of specialty crops, since MFMA's historical data shows that approximately 67% of our member vendors sell solely specialty crops.

Minnesota incurred a significant increase in the number of new farmers' markets, from 80 in 2008; to 125 in 2011; to over 200 in 2013. These new market managers (and vendors) created the need for an efficient and effective training program to help them understand the laws that impact farmers' markets and vendors; and sound business principles applicable to the markets themselves and to the vendors direct marketing their products to consumers. Additionally, this project sought to fill the knowledge gap between market management and vendors – and what was required by statute and rule from the Minnesota Department of Agriculture and the Minnesota Department of Health regarding food licensing and food safety.

- If the project built on a previously funded project with the SCBGP or SCBGP-FB describe how this project complimented and enhanced previously completed work.

This project did not build on a previously funded grant.

PROJECT APPROACH

0. Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.
1. Present the significant contributions and role of project partners in the project.

Two main components of this project were completed successfully:

a. MFMA staff learned how to build and manage the certification course on Moodle, a software program designed to offer educational courses online.
b. MFMA's "Farmers' Market Manual," the knowledge base for the certification course, was completely rewritten and researched; and went through professional and peer reviews.

The last component of the project, having market managers enroll in and complete the course, is partially completed. We had a test group of managers to take the course initially, in order to give us feedback on both content of the material and the ease of taking the course online. This group gave us invaluable feedback; and we're implementing their suggestions as we go forward. To date, however, no manager has been certified.

Method used during project which ensured that project funds were used only to enhance competitiveness of specialty crops:

From MFMA's 2014-07-09 report to MDA: "We can verify that 67% of our member vendors are 100% solely specialty crop producers. MFMA will then provide the remaining 33% of the total budget in matching funds and in-kind contributions. We're increasing the total budget from $45,224 (the USDA grant amount) to $68,500. MFMA will provide $23,276 in cash and in-kind contributions to account for the 33% of the budget attributed to non-specialty crop users of the program."

This method was accepted at that time to balance the total dollars used between USDA specialty crop grant dollars and MFMA's dollars. During project implementation, the *first* dollars used were MFMA's; the next dollars requested were SCBG funds, attributed to the 67% of our member vendors who are solely specialty crop producers. So that's how they were traced: We took the total dollars this project needed, multiplied it by .67; that equals the SCBG funds that directly matched our specialty crop producers. The remaining dollars this project needed came from MFMA's general budget.

Project Income: $270

This project initially projected $13,000 of income, based on $85 to take the online certification course and $45 to purchase a hard copy of the manual. To date, no manager has paid to take the course. We pre-sold six copies of the manual and are just now marketing the revised manual for sale. The $270 project income was used towards updating the manual in 2014 after legislation changed, thus meaning Chapter 7 on Food Safety and Food licensing needed to be updated; then reprinted and recompiled.

GOALS AND OUTCOMES ACHIEVED

2. Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.
3. If outcome measures were long term, summarize the progress that has been made towards achievement.
4. Provide a comparison of actual accomplishments with the goals established for the reporting period.
5. Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Measurable Outcomes #1 and #2:

Increase the percentage of farmers' market managers who have successfully completed the Market Manager Certification Program by 5% the first year and 10% on an annual basis.

Partially completed.

We had 10 (14%) of our member market managers start and partially complete the beta certification course. Due in part to the anticipated change in statute, however, we put the course on hold because we did not want to certify managers on incorrect information.

Measurable Outcome #3:
Increase the size, overall efficiency, food safety compliance, and program offerings at existing Farmers' Markets. This is to be directly measured through follow-up surveys conducted by the MFMA.

Not completed.

Measurable Outcome #4 and #5:
Help increase the number of markets that accept SNAP benefits by 10% in the first year following completion of the market manager completion program, with a continued 10% increase on an ongoing annual basis.

Completed.

In Minnesota in 2011, there were 14 markets accepting SNAP EBT; as of December 2013, we had 66. MFMA employed a multi-pronged approach to assisting markets to increase specialty crop purchases through SNAP EBT:

- We worked with Blue Cross Blue Shield and their state-contracted agency, the Minnesota Department of Human Services, to help markets use incentive dollars to increase both SNAP EBT purchases overall, and specialty crops specifically.
- We worked with several markets to help them develop their local assets to fund incentive dollars to increase both SNAP EBT purchases overall, and specialty crops specifically.

Measurable Outcome #6:
Substantially increase the coordination between the multiple agencies that are currently serving our Minnesota Farmers' Markets; as well as, fostering and developing the relationships between the agencies and Farmers' Market representatives.

Completed.

This project, in conjunction with two other concurrent projects, was really the catalyst that uncovered many inconsistent interpretations of statutes, rules and policies that directly impact farmers' markets and vendors throughout Minnesota. While these issues negatively impacted this project from reaching its successful completion by deadline, they were a gift in that they helped MFMA develop strong working relationships with many of our collaborating partners: MDA, MDH, University of Minnesota Extension, BCBS, DHS, metro and out-state delegated authorities, etc.

Measurable Outcome #7:
Due to the projected expansion of existing markets and increase in new markets, there will be an increased demand for additional specialty crop production/producers. As of 2010 there were 125 established farmers' markets in Minnesota; and with a projected 5% yearly increase in the number of available farmers' markets, it is estimated that a minimum of 2-5 specialty crop producers will be needed to satisfy demand at each new selling venue. This leads to 12-30+ additional yearly selling venues for current and future specialty crop producers.

- At the end of 2013, Minnesota had 166 farmers' markets, which is an increase of 41 markets over the three years.
- We do not have documentation on any change in numbers of *specialty crop* producers. To show an increase in specialty crop producers, the Board & staff who started this grant would have needed to measure the specialty crop producers at that time; that initial count never happened, so a change in numbers cannot be verified.

Elaboration on the completion of the activities included in the approved project proposal:

- Assemble current Farmers' Market managers to provide input on current needs and documentation requests
  - Accomplished at the 2013 Fall and Spring Conferences; input from 45 and 55 people, respectively.
- Update and reprint current Minnesota Farmers' Market Manual
  - The manual was completely overhauled and researched during the duration of this project – through 2013-12-31. The rest of the editing, reformatting and reprinting ended up in 2014, outside of the project, and financed 100% by MFMA.
- Creation of training documentation
- Collection/creation of supporting market documents required to operate a Farmers' Market
  - This was part of the manual rewrite; researching and creating the tax and legal documents needed to operate a farmers' market but outside the expertise of MFMA personnel.
- Website design and Website implementation
  - We uploaded our work-in-progress revised manual to the Moodle website -- and from above -- "We had 10 (14%) of our member market managers start and partially complete the beta certification

course. Due in part to the anticipated change in statute, however, we put the course on hold because we did not want to certify managers on incorrect information."

Based on this experience with the Moodle website and its associated cost, we will need to find a cheaper way to deliver the course going forward.

- Notification & marketing of Program availability
  - Via email and phone calls, we handpicked the 10 (14%) of our member market managers to test the beta course

BENEFICIARIES

- Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.
  - Current market managers & vendors: all now have access to current and compliant information regarding farmers' markets in Minnesota.
  - Emerging markets and vendors: every year, MFMA receives many inquiries from entities that want to start a farmers' market; and vendors who want to sell at farmers' markets. These people all receive current and compliant "Here's How to Get Started" fact sheets.
  - Both MDA and MDH have expressed their appreciation to MFMA on our collaborative approach to dealing with these issues.
- Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.
  - This is very preliminary data, but we had two cities in 2013 require that their new farmers' markets become certified through MFMA before allowing the markets to start.
  - We anticipate that markets and vendors who become certified through MFMA's course will receive a reduction in their liability insurance fees.
  - This project is available to the 200+ farmers' markets and 5000-6000 vendors in Minnesota.
  - 67% of our vendor members are solely specialty crop producers. Our vendor members usually run about 200 each year; so 200 x .67 = 134. There are more specialty crop produce vendors in the state, but they are not members; so I left them off the count since I cannot uniquely identify them easily.

LESSONS LEARNED

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

This project ran into substantial barriers from the onset – and was amended five times in order to attempt to resolve those issues. The first problem arose when MFMA lost the staff person who led this project, thus setting it back about nine months. Once the research phase started, it quickly became apparent that the information in the existing 2008 manual (the basis for the certification course) was incomplete and noncompliant with current statute. This extended the research phase substantially, both in uncovering current and accurate information – and in driving the effort to change old statutes and rules that were actually detrimental to farmers' markets and vendors. (Note: All MFMA public policy efforts were funded by MFMA monies, not SCBG funds, since, by definition, they are NOT solely specialty crop specific. This narrative just gives context to the issue.) Information on incorporation and taxation was especially difficult to compile, requiring extensive research and interviews with accounting and legal professionals. Additionally, several months were lost in 2013 while MFMA, with assistance from MDA & USDA, developed a way to make this particular project compliant with the "***solely*** enhancing specialty crops" mandate of the grant program.

Obviously, there are ***no*** farmers' markets that sell ***only*** specialty crops and since this project was developed for all market managers, we had to redesign the project and budget to fit the documented 67% of MFMA's membership that sells 100% specialty crops.

Bottom line: this market manager certification program is essential for the long term success of farmers' markets and vendors in Minnesota and MFMA is fully committed to its implementation; it just was not a good fit for the specialty crop block grants because it cannot meet the 'solely' criteria very easily within the diverse framework of MFMA's membership.

CONTACT PERSONS

- Kathy Zeman, Operations Manager, (320) 250-5087 kzeman@mfma.org
- Jesse Davis, Outreach and Programs Coordinator, (218) 259-9675 jdavis@mfma.org

ADDITIONAL INFORMATION

- Provide additional information available (i.e., publications, websites, photographs) that is not applicable to any of the prior sections.

Project G

MN Specialty Crop Block Grant
FINAL PERFORMANCE REPORT

Submitted by: Paul Hugunin, 651-201-6510

E-mail: paul.hugunin@state.mn.us

Date: 12-30-2014

PROJECT TITLE

1. Provide the project's title.

   Maximizing the Market for Minnesota Specialty Crop Producers

PROJECT SUMMARY

2. Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.
   - *Issue: The online Directory was not mobile phone friendly and the number of consumers using mobile phones to access the internet was growing rapidly and continues to grow*
   - *Issue: To be relevant to wholesale buyers such as schools and restaurants, the number of farms listed in the wholesale database needed to increase from the baseline of 50 farms*
   - *Issue: Previous SCBG funded investments in sponsored search advertising (Pay-Per-Click) have been very effective and measurable. It would be foolish to discontinue the use of this targeted marketing technique that links consumers with specialty crop growers.*
   - *Issue: Promotional materials have proven to be a very valuable tool for assisting specialty crop growers in marketing their products. Specialty crop growers would benefit from additional new items that could be used on a variety of produce items and that would be suitable for use in the harsh weather conditions found at outdoor farmers markets.*

3. Establish the motivation for this project by presenting the importance and timeliness of the project.

   At the time of application, more than 1,100 producers were licensed to use the Minnesota Grown logo and the vast majority of these producers were raising specialty crops such as fruits, vegetables and nursery crops. More than 900 of these licensees were listed in the Minnesota Grown Directory of farms that sell directly to consumers. During the course of this project, the number of producers participating in the Minnesota Grown Program has increased to more than 1,200. Because the Minnesota Grown Program has direct participation from Minnesota specialty crop growers than any other Minnesota program or organization, the activities included in this project have the maximum impact possible. Timely implementation of this project allowed Minnesota specialty crop growers to keep up with societal and technical changes that impact their marketing, including the rapid growth of the number of consumers using smart phones to access the internet, the rapid rise of social media as a source of information about local businesses, and the continued importance of internet search engines as a marketing tool.

4. If the project built on a previously funded project with the SCBGP or SCBGP-FB describe how this project complimented and enhanced previously completed work.

   This project built on several previous SCBG investments:

   a) Previous SCBG projects helped design the online Minnesota Grown Directory, this project helped make the major improvement of making the online Directory more useable for consumers using smart phones to access the internet.

   b) Previous SCBG projects helped create the database of wholesale growers, this project helped by doubling the number of participating growers.

   c) *Previous SCBG projects helped dramatically increasing the number of consumers using the online Directory through pay-per-click (PPC) advertising, this project helped by continuing this previous success and by expanding PPC advertising to include paid ads on Facebook.*

PROJECT APPROACH

5. Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.

   Activity #1: Continuation of previous SCBG funded initiatives to improve functionality of the Minnesota Grown website by developing a mobile phone friendly site.

   - *June – September 2012: Design and programming proposals were solicited and received from several companies with the capability of creating mobile friendly websites. Proposals were received and in person interviews were conducted to select the vendor.*
   - *June - September 2012: After debating between development of a separate mobile friendly site vs creating a responsive web site that adjusts the data presented to fit the size and screen resolution of the device being used to access the web site, we decided to develop a responsive website. This is more modern technology than developing a separate websites for each size device and will be more cost effective to maintain going forward. This is a key strategic decision that impacts everything else with this activity.*

- *October 2012: DKS Systems of Golden Valley was selected to conduct the initial design and wireframes for the mobile friendly website.*
- *Design and wireframes completed by May 1, 2013.*
- *May – June: Programming and testing bids solicited*
- *July 18, 2013 DKS is selected and programming officially begins.*
- *Mobile friendly website utilizing a responsive design is launched on August 19, 2014!*
- *As a reminder, our online Directory includes a small percentage (just under 20%) of non-specialty crop farmers. To account for this given USDA's strict interpretation of the eligible activities, the MGPG pays 20% of the cost of all web improvements within this project.*

Activity #2: Expand and improve the online database of fruit and vegetable growers selling to wholesale markets.

- *November 2011 – January 2014: Recruiting additional farmers to participate in the online database.*
    - *We exhibited at the Minnesota Apple Growers Association conference January 2012, 2013 and 2014 to promote the database*
    - *We exhibited at the Minnesota Fruit and Vegetable Growers Association conference in January 2012, 2013 and 2014 to promote the database*
    - *We exhibited at the Minnesota Grape Growers Association conference in February 2012 and February 2013 to promote the database*
- *The number of listed farms has increased to more than 105 during this portion of the project.*
- *As a reminder, our online Directory includes a small percentage (just under 20%) of non-specialty crop farmers. To account for this given USDA's strict interpretation of the eligible activities, the MGPG pays 20% of the cost of all web improvements within this project.*

Activity #3: Continuation of previous SCBG funded initiatives to increase consumer purchases of fruits and vegetables by driving traffic to the Minnesota Grown website

- *The pay-per-click campaign includes Google Adwords and Microsoft adCenter (Yahoo and Bing).*
- *We also used Facebook ads to increase web traffic.*
- *Unique visitors from January 1, 2012 through June 30, 2012 rose by nearly 17% compared to the same period of time in 2011. From that point on, however, 2012 traffic decreased relative to 2011 due to drought conditions resulting in a shortened pick-your-own berry season, a very limited apple crop and a great deal of negative press focusing on how badly farmers have been hurt by weather. This definitely contributed to the sudden reduction in web traffic.*
- *Because PPC advertising is specific to a given set of keywords, we can ensure that SCBG funds are only used to promote eligible specialty crops. For example, people searching for "apples" are shown our ad promoting Minnesota Grown apples and are taken to our online Directory only if they click on the ad for apples. The MGPG uses PPC for promotion of non-specialty crops but they pay for that advertising directly with their own funds.*

Activity #4: Production of point-of-sale materials to identify and promote Minnesota Grown specialty crops.

- *In June of 2013, we printed and began distribution of 30,000 veggie tags for use in pricing vegetables. These are especially popular at farmers markets as they are weather resistant, can be used to promote a variety of produce items and can easily be placed in small trays of veggies.*

6. Present the significant contributions and role of project partners in the project.

   This project is a partnership between the Minnesota Grown Promotion Group (MGPG) and the Minnesota Department of Agriculture (MDA). MDA staff provide key implementation and administrative functions including management of the PPC campaign, design and distribution of promotional items and day to day guidance on design and programming of the website. The MGPG and its member organizations provide key input from the perspective of specialty crop growers and many of these organizations invite the MDA to exhibit and/or present topics at their annual membership meetings. This provides a vital opportunity to not only create awareness of the project's results but to gather input and feedback from growers.

GOALS AND OUTCOMES ACHIEVED

7. Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.

   - *PPC campaign on Google, Yahoo and Bing was executed and monitored throughout the project. Keyword and ad performance continuously monitored with adjustments to keyword bids as needed.*
   - *Web programming companies were solicited and interviewed. References were checked and DKS was chosen to design and program the new website.*
   - *Proposed design and other modifications to the online Directory were approved. Monitoring of progress was continuous, including weekly status phone calls between MDA staff and DKS staff.*
   - *A non-public testing site was used to preview and test the new site prior to launch. Members of the MGPG are instrumental in testing and providing feedback.*
   - *New online Directory was launched in August of 2014.*
   - *Google Analytics was used to evaluate the initial impact of the new online Directory format and technology.*
   - *Veggie tags were designed and bids solicited in spring of 2013. Printing was completed in June, 2013 and distribution to members began immediately.*
   - *Specialty crop growers were solicited for inclusion in the Wholesale Database via member newsletters and exhibits at grower conferences, including the MN Apple Growers Association, MN Fruit and Vegetable Growers Association, MN Grape Growers Association, and the Minnesota Organic Conference. As a result, the number of participating growers doubled to more than 100.*

8. If outcome measures were long term, summarize the progress that has been made towards achievement.

This project provided for one of the most crucial enhancements needed in our updated online Directory: providing better service to consumers accessing the site with their smart phones. Future SCBG investments are building on that attribute by addressing issues related to integration of social media with the website, improving member listings, and more.

9. Provide a comparison of actual accomplishments with the goals established for the reporting period.

Measurable Outcome #1
GOAL: To increase the number of mobile phone users visiting the online Directory and to increase the likelihood that they will purchase Minnesota Grown specialty crops as a result
of their visit.
ACTUAL: We spent a significant amount of time on the front end of the project investigating options and learning about current technology related to mobile phone friendly websites. During this process we decided to create a "responsive" website instead of creating a separate mobile friendly website. Basically, this means that our website will automatically adjust both the amount of data displayed and the format in which it is displayed based on the type of device being used to access the site. In other words, mobile phone users will see different information and layout than tablet users or those using full size displays such as PC's and laptops.

As expected, Google Analytics verifies that there was a dramatic increase in the number of people using the online Directory with a mobile device or tablet during the period of time covered by this project.

- *From calendar year 2011 to calendar 2014, the number of sessions with a mobile device increased from roughly 28,000 per year to more than 133,000 per year. Tablet-based sessions also skyrocketed from 5,000 sessions in 2011 to more than 50,000 in 2014.*
    - *During this same period, the number of desktop computer based sessions dropped from 261,000 to 182,000.*
- *Not surprisingly, as mobile phone users became more frustrated a website that was not mobile friendly, the bounce rate (people who left the site after viewing just one page) increased much more dramatically for mobile device users than for desktop users. The bounce rate for desktop users increased by 13% from 2011 to 2014, but by 30% for mobile phone users and by 40% for tablet users.*
- *Although we only have a couple of months of data with the new responsive website to use, we can already see positive results from the new design. Comparing data from the 1st three months of the new design against the same three months from 2013, the bounce rate for mobile device users dropped by nearly 10% and for tablet users it declined by 6.5%. (The bounce rate actually rose by nearly 8% for desktop users)*
- *Another encouraging result is that the Average Session Duration for mobile phone users stayed the same or increased very slightly and increased by 2.25% for tablet users.*
- *Because our next SCBG projects include continued improvement and monitoring of the new online Directory, we will continue to closely monitor these results.*

Measurable Outcome #2
• GOAL: To improve the new online database of Minnesota specialty crop producers

marketing produce to wholesale markets such as grocery stores, restaurants, and school food
service programs and to increase the number of buyers using the site.
• ACTUAL: The benchmark number of producers in our database was 50 at the start of this project. We finished this portion of the project with 109 farms listed. Of the 59 new farms, 48 farms (82%) were specialty crop producers.
The website is being used by more buyers than in 2011. According to Google Analytics, the number of pageviews increased by 16% in 2012 compared to 2011 (9,678 pageviews vs 8,342 pageviews). The most commonly searched for product is potatoes, with 165 searches in 2012 (up from 77 searches in 2011).

Measurable Outcome #3
• GOAL: To increase the number of consumers using the online Directory at www.minnesotagrown .com compared to the previous year.
• ACTUAL: Unique visitors in from November, 2011 through June of 2012 rose by 19% compared to the previous year. This is as good as or better than what we had hoped. However, drought conditions began to impact specialty crop producers such as berry growers starting in July and an early spring frost severely impacted the apple crop in the fall. As a result, instead of seeing continued increases, our unique visitor count from July, 2012 through November 2012 dropped by 19% compared to the same months in 2011. Because the months of September and October are generally our highest traffic months, our overall unique visitors in calendar year 2012 were approximately 4.5% less than calendar 2011.

Measurable Outcome #4
• GOAL: To design, develop and distribute new point of sale items for use in grocery stores
or food service establishments to identify and promote locally grown specialty crops.
• ACTUAL: We printed 30,000 veggie tags that are designed to withstand moisture from misted produce displays or inclement outdoor weather. These tags have room for pricing or product information and can be used in veggie trays or boxes of produce. The tags have quickly become one of the most popular items we carry, having distributed nearly half of the 30,000 tags to more than 125 different growers within the first 12 months. This is a new item so the original benchmark was zero.

10. Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.
    See previous answer.

BENEFICIARIES

11. Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.

    The primary beneficiaries are the now 1,200 plus farms that participate in the Minnesota Grown Program along with the following membership based organizations who collaborate with Minnesota Grown to serve Minnesota's specialty crop growers: MN Apple Growers Association, MN Christmas Tree Association, MN Fruit & Vegetable Growers Association, MN Grape Growers Association, MN Honey Producers Association, MN Nursery & Landscape Association, Central MN Vegetable Growers Association and the St. Paul Growers Association.

12. Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

During the course of this project we conducted an ambitious effort to gather data to quantify the economic impact of the Minnesota Grown Directory in both its printed and online form. To accomplish this, we conducted surveys of our participating growers as well as of actual consumers.

Consumer traffic to the online Directory is a valid measure of increasing the competitiveness of specialty crops. The MDA's 2013 survey of Minnesota Grown specialty crop growers provides clear evidence of the fact that consumers who use the Directory result in sales for specialty crop growers. Over 95% of specialty crop growers who responded to the survey report that the Minnesota Grown Directory has influenced at least a percentage of their sales. In fact, 12% of participating specialty crop growers reported that the Directory is responsible at least 25% of their direct to consumer sales. To put this into perspective, one member comments: "We get 4-5,000 customers to our farm annually. While I answered that 1-5% of my customers result from the Directory, that means 100+ customers a year, and at an average sale of $25-30/customer, that's still an incredible return on listing." For this one farmer reporting that less than 5% of his customer traffic results from the Minnesota Grown Directory, the Directory resulted in nearly $3,000 in sales.

Further evidence of how this Directory increases the competitiveness of specialty crops by generating actual sales of specialty crops can be found in results of the MDA's 2012 surveys of customers of berry farms, apple orchards and Christmas tree farms. This in-depth consumer research was funded in part by USDA's Federal-State Marketing Improvement Program (FSMIP). Of the nearly 500 apple orchard customers who participated in the survey, 6% reported using the online Minnesota Grown Directory to find and gather information about the orchard. These customers report an average purchase of $38.75 per visit to the orchard. For the more than 700 participating customers at pick-your-own berry farms, 20% used the Directory (on-line or print) to gather information about the farm they chose. Their average purchase price was $31.68 per visit. For choose and cut Christmas tree farms, 10% of their customers reported that the Minnesota Grown Directory provided them with information about the farm. The average purchase price for these customers was $73 per visit.

LESSONS LEARNED

13. Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.

At the time the project started, there were several different potential strategies for accomplishing the goal of reaching smart phone users with our online Directory. Options included development of a separate mobile site, development of one or more "apps" for mobile phones, and overhauling the current site to become "responsive" so that the content shown to the user would vary automatically depending on whether the user was on a smart phone, tablet or full size computer screen. We believe we are fortunate that we were deliberate enough in our research and interview phase to gain enough information to make the decision to build a responsive site. In the time since this project began it has become clearer every day that we made a wise decision that we will be happy with for the foreseeable future. We greatly appreciate the timing flexibility provided by both USDA and MDA that made this very positive outcome possible.

14. Provide unexpected outcomes or results that were an effect of implementing this project.
    N/A

15. If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

    The target of 250,000 unique visitors per year turned out to be unattainable due to extreme weather conditions that significantly impacted consumer access to several specialty crops, including apples. Demand for local apples and for the activities provided by local apple orchards is one of the main drivers behind web traffic during our key fall months of September and October. Minnesota's overall apple crop was estimated to be approximately 1/3 of a normal year. There was simply no way we could achieve our original target numbers given this natural disaster.

ADDITIONAL INFORMATION

16. Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.
    N/A

Project H

MN Specialty Crop Block Grant
FINAL PERFORMANCE REPORT

Submitted by: Karen Quiroz, Institute for Agriculture and Trade Policy (IATP), 612-870-0453

e-mail: kquiroz@iatp.org

Date: 12/12/2012

PROJECT TITLE: *Farm to School: Removing Barriers for Small and Mid-size Farmers*

PROJECT SUMMARY

1. Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.

This goal of the project was to enhance the competitiveness of specialty crops in Minnesota by addressing key barriers in the burgeoning K-12 school marketplace. As a key player in the national and state Farm to School movement, IATP has helped bring about the rapid adoption of Farm to School in Minnesota, where 145 K-12 districts now participate. Working with

partners such as the Minnesota School Nutrition Association, produce distributors and growers' associations, we have also identified key barriers that now constrain this market.

2. Establish the motivation for this project by presenting the importance and timeliness of the project.

Minnesota's Farm to School (F2S) activity has grown by leaps and bounds in recent years. While local specialty crops were largely absent from Minnesota's lunch trays even 4-5 years ago, they are now making their way back into the cafeterias of Minnesota public schools. Based on four years of survey data from Minnesota schools engaged in F2S, we have found the most common barriers to greater development of F2S to include:

- The short harvest season for locally grown fruits and vegetables and limited correspondence between Minnesota's "fresh" season and the K-12 school year
- Limited relationships between farmers and K-12 buyers and the lack of vehicles for coordination between farmers and schools
- New on-farm food safety requirements
- Limited familiarity with the K-12 marketplace among Specialty Crop producers
- The relative newness of local purchasing in the eyes of K-12 buyers

The growth of F2S has been impressive in recent years, but we need to address the above challenges if F2S is to benefit growers more fully, take root within the K-12 school system and the public at large.

3. If the project built on a previously funded project with the SCBGP or SCBGP-FB describe how this project complimented and enhanced previously completed work.

Not applicable.

PROJECT APPROACH

4. Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.

With support from the Minnesota State Special Crops Block Grant Program, IATP conducted educational and promotional activities as well as research and evaluation to support the growth and long-term stability of F2S. Based on data from early 2012 and developments we have seen during the year, we see that F2S has provided increased revenue for Minnesota farmers; improved the fresh food offerings at our state's public schools; and raised awareness of for local agriculture in school communities throughout the state.

The following statistics from IATP's evaluation of school food service directors provide a snap shot of F2S in Minnesota:

- The number of Minnesota K-12 districts participating in Farm to School has continued to increase, standing at 145 districts, more than double the participation rates of 2009.
- Purchases of Farm to School foods reached $1,328,000 or roughly double the amount sold in 2010. Of this amount, IATP estimates that $1.25 million is for fresh fruits and vegetables.
- Ninety-nine percent of the Minnesota school districts now engaged in F2S tell us that they plan to continue that work at the same level or to expand them in the year ahead.
- Eighty-four percent of the growers involved in F2S reported their experience as either "somewhat" or "very successful".

A majority of growers reported that prices received from K-12 buyers are "about the same" as prices received from other wholesale accounts for comparable product (dispelling the notion that schools pay poorly), and 95% indicated that they received "a fair price" from their school buyers.

GOALS AND OUTCOMES ACHIEVED

5. Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.

Data collection and evaluation: Conducted our annual Farm to School surveys of both farmers and school food service leaders; the latter conducted with the Minnesota School Nutrition Association. Please see links to survey reports at the end of this document and data highlights in sections 7 and 8 of this report.

Innovative strategies for processing locally grown fruits and vegetables: We conducted extensive research on small and mid-scale strategies for freezing local produce as a way of extending the products' availability throughout the school year and expanding markets for farmers. Our study assessed strategies ranging from schools freezing in their own kitchens, to mobile freezing units, commercial kitchens, small freezing enterprises and co-pack relationships. Our research included interviews with local and national food processing entrepreneurs, processing experts and foodservice leaders locally and nationally, researching potential co-pack partners in the region, drawing lessons from freezing strategies now being used around the country, and conducting detailed cost analysis of schools purchasing local farm products and freezing them on-site in school kitchens. Follow this link to a summary and full copy of the report *Frozen Local: Strategies for freezing locally grown produce for the k-12 marketplace* at http://www.iatp.org/documents/frozen-local-strategies-for-freezing-locally-grown-produce-for-the-k-12-marketplace. A hard copy with acknowledgement of the Minnesota Department of Agriculture is also included at the end of this report.

Connecting farmers with information and relationships in the K-12 marketplace: Our producer surveys have shown that farmers are particularly interested in obtaining market intelligence

about what local foods are in demand among K-12 buyers and information about how to connect with K-12 buyers. To that end, we have:

- Compiled detailed data on the local foods being used by K-12 districts and disseminated crop-by-crop data via various farmer membership organizations, the Sustag list-serve and other channels.
- Developed and shared lists of school districts engaging in Farm to School.
- Developed a state-wide interactive map showing participating districts and links to district websites where contact information for foodservice staff is available.
- Developed educational materials for growers (like "The 10 Things Farmers need to know about School Lunch") and made the best available resources from around the country available to growers on our Farm to School website.
- Built bridges between Hmong growers and the Minneapolis and St. Paul School districts.
- Helped plan and promote two events with the Minneapolis Public Schools to engage farmers and distributors in MPS's growing Farm to School program.
- Launched development of an innovative high school-level Farm to School curriculum to teach students about local agriculture and enlist them as "foragers" to reach out to nearby farmers and identify local sources of food for their schools' Farm to School program.

Food safety: Rising expectations among buyers for on-farm food safety have the potential to knock small and mid-size growers out of the K-12 marketplace. In response, IATP has:

- Provided insight to legal experts at William Mitchell Law School for their white papers about food safety and Farm to School.
- Coordinated with UM food safety experts and K-12 buyers to support development of food safety checklists for use by K-12 buyers that are appropriate to very small farms.
- Coordinated with various F2S stakeholders at the state level to identify strategies for enabling small and mid-size farms to improve their food safety practices in synch with shifting market expectations.

Increased purchasing of Minnesota Specialty Crops by K-12 schools:

- Supported training and information sharing with K-12 foodservice staff about on-farm food safety issues.
- Developed a state-wide listing of farmers that have already sold to K-12 school districts, including information like whether farmers are interested in participating in classroom activities and can hold student groups on their farm. This was distributed to 150 school districts around the state.
- Collaborated with the Minnesota School Nutrition Association through our Farm to School Task Force to develop and implement outreach and awareness-building efforts with K-12 foodservice staff.

- Developed and shared l resources for connecting K-12 buyers with local growers. Expanded web-based information for K-12 staff.
- Provided practical strategies for celebrating Farm to School Month at the school and district level and featured the activities of various districts in our Farm to School Month media outreach.
- Issued frequent updates to K-12 foodservice directors to keep them apprised of local and national developments in Farm to School.
- Collaborated with the Winona Area Public Schools on our research of freezing strategies for locally grown fruits and vegetables.

Engaging distributors and processors as allies in Farm to School:

- Raised consciousness about growing K-12 demand for local foods through our survey work, meetings and information sharing.
- Provided feedback to distributors and processors about the needs of K-12 buyers.
- Supported relationship development between sources of frozen locally grown produce and distribution partners serving K-12 schools.

Building the visibility of Farm to School and local agriculture among parents, students, K-12 foodservice staff, educators and other stakeholders:

- Issued periodic Farm to School e-newsletters, which included features on various farmers and strategies for incorporating Specialty Crops into school meal programs.
- Tweeting, blogging and posting Farm to School news on IATP's Facebook page.
- Expanded and improved the array of resource materials on our Farm to School website (www.farm2schoolmn.org).
- Issued media alerts and press releases prior to and during Farm to School Month, including providing region-specific lists of all participating schools districts to IATP media contacts
- Widely disseminated the findings of our Farm to School foodservice leader and producer surveys in Minnesota and beyond.
- Reached out to numerous Minnesota-based education associations about Farm to School Month and provided them with communication tools to support related communication with their members.
- IATP's Farm to School work was featured at the annual Minnesota Elementary School Principals Association conference in early 2012 and our work was highlighted on MESPA's website.
- Presented on Farm to School at the 2012 Minnesota School Board Association annual conference in conjunction with Steve Jones, Superintendent for the Sibley East Schools (a leader in Farm to School and student-run farming).
- Supported promotion of the U of M Extension – TPT documentary on Farm to School.
- Conducting numerous interviews with reporters in the print and radio media and the blogosphere upon the release of our Farm to School surveys and during Farm to School Month.

6. If outcome measures were long term, summarize the progress that has been made towards achievement.

We were able to collect data in early 2012 on progress toward our outcomes (see "goals" column in the table below). Based on that data we can say that Farm to School is well positioned for continued growth. Ninety-nine percent of the Minnesota school districts now engaged in F2S tell us that they plan to continue that work at the same level or to expand them in the year ahead. An additional 20 districts reported they have plans to launch new F2S programs in the 2012-13 school year. Further, while the amount of Farm to School sales rose significantly this year, they currently average $2.30 per year per student in participating schools. By comparison, the estimated value of fruits and vegetables purchased per student, per year under the existing National School Lunch standards is roughly $60.00 (and will increase under the new). We take that to mean that there is significant room for continued growth of Farm to School and many opportunities for greater economic benefit to farmers in our region.

7. Provide a comparison of actual accomplishments with the goals established for the reporting period.

As documented under question 8 below, the project outcomes were exceeded. Below is some additional detail on the accomplishments that supported our success.

Nearly 75 percent of participating school districts reported purchasing directly from farmers, up very substantially from 44 percent in 2009. A similar proportion also buy local foods via distributors (with some districts purchasing local both directly and from distributors), suggesting that Farm to School is now benefiting both smaller farmers who sell direct and "Ag in the Middle" farmers who wholesale.

Of participating districts, 53 percent indicated that they developed closer relationships with farmers in their area over the past year. We also saw an increase in the number of districts that directly involved farmers in educating student about Farm to School.

We have also seen an increase in the diversity of food being purchased: 27 different locally grown fruits and vegetables were used by more than ten districts across the state. By contrast, just 11 Farm to School foods were used this widely in 2009. Of school districts responding to our survey, 43% expanded scratch cooking activities last year and a similar proportion expanded their purchases of fresh produce. Farm to School is helping build the momentum around both of these trends, which will further expand marketing opportunities for our region's farmers.

Across the state, a growing number of schools also participated in Farm to School Month through menuing of local foods, special Farm to School events with students and parents, school visits by farmers, media outreach, in-school promotions, gardening and greenhouse

events, corn shucking parties, and a variety of other activities. IATP helped fuel this growth by promoting this month of observance with school leaders, providing tips, tools and ideas to connect schools with easy-to-use celebration strategies, and linking schools with farmers interested in supporting educational activities.

Our survey data validated the traction this is generating, showing that schools have begun more actively engaging farmers in educating young people about where and how their food is grown, and that farmers are seizing opportunities to educate students on and off the farm. We attribute this to increased direct purchasing from farmers, more numerous and stronger relationships between schools and farmers, growers' commitment to building their local food system, and many schools' increasingly ambitious plans for celebrating their F2S programs.

8. Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Goal	Benchmark	Targets	Actuals	Monitoring
Increase purchases of locally grown Specialty Crops by K-12 schools in MN	2010 baseline estimated by IATP at $550,000	$1 million	$1.328 million	Annual electronic surveys of participating school districts (covering CY 2011)
Expand the variety of specialty crops being purchased by K-12 schools	Average of 6 specialty crop items used per district in 2010	Average of 8 specialty crops purchased	Average of 8.1 specialty crops purchased per participating school district	Annual surveys of participating school districts
Raise the number of specialty crop growers selling to K-12 schools	2010 baseline estimated at 65 farmers	130 farmers	150 farmers	Annual surveys of farmers and of school districts, input from distributors
Growers experience high levels of satisfaction with their sales to K-12 buyers	Baseline will be obtained through farmer survey that is now in progress	At least 75% of farmers report their engagement with K-12 buyers is positive or very positive	84% of the growers reported their experience as either "somewhat" or "very successful"	Annual farmer surveys

BENEFICIARIES

9. Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.

The key beneficiaries are:

- Minnesota specialty crop growers in multiple product categories, particularly small and midsize farmers.
- Children in Minnesota's Public School system, particularly low-income students who participate in school nutrition programs.
- Our report on *Frozen Local* will benefit various sectors of the local and national Farm to School movement which has been sent to farmers groups, state K-12 foodservice staff and parents, schools and farmers who subscribe to our Farm to School e-newsletter. While we only began distribution two days ago, we have already received a very positive response.

10. Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

- Approximately 150 Minnesota specialty crop growers who sold into the K-12 market from various regions of the state including growers of fruits, vegetables, honey and dried beans, among others.
- 558,000 students or 68 percent of Minnesota's school age children whose schools offered locally grown specialty crops in their cafeterias.
- In addition, we project an economic impact of $1.33 million in direct Minnesota farm sales with multiplier effects of approximately $2.39 million using a conservative multiplier of 1.8. (Note: this multiplier has been frequently cited by UM Ag economists as an appropriate one for local food purchases.)

LESSONS LEARNED

11. Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.

After many years of hands-on experience designing, implementing and evaluating Farm to School initiatives, IATP has learned a great deal about the factors that tend to make Farm to School efforts successful and the barriers that continue to stand in our way. Our interest is now in fueling the "growth edges" of the Farm to School movement. We are pleased to have recently received partial funding from the USDA's new Farm to School grant program in the following emerging areas of work that we will pursue in 2013 and 2014:

- The short growing season is a significant constraint on F2S in Minnesota and the region, and limits the income potential of our growers. To increase incomes for growers in our region,

we need to look at season-extended production of fruits and vegetables and mechanisms for getting that produce processed and distributed in forms that work for K-12 buyers. We are undertaking research on how to promote wide-scale adoption of the most promising season extension strategies.

- In the existing constellation of "Farm to School foods," grains and pulses (such as lentils, dried beans and peas) are, by and large, an under-utilized food group. We will analyze the supply chains for regionally grown grains and pulses as another possible growth opportunity for F2S and Minnesota farmers.

- We invite you to review our report *Frozen Local: Strategies for freezing locally grown produce for the k-12 marketplace* at http://www.iatp.org/documents/frozen-local-strategies-for-freezing-locally-grown-produce-for-the-k-12-marketplace. The report includes an extensive set of observations and findings about the opportunities and challenges of freezing locally grown fruits and vegetables at small and mid-size scales. (See hard copy attached.)

12. Provide unexpected outcomes or results that were an effect of implementing this project.

Not applicable.

13. If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

Not applicable.

ADDITIONAL INFORMATION

14. Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

- Link to IATP's Farm to School Website: Please note that there are four sections on the website for farmers, parents, schools and students. Updates are ongoing: http://farm2schoolmn.org/

- Blog post on Farm to School Month in Minnesota 2012: http://www.iatp.org/blog/201209/digging-your-farmer-during-farm-to-school-month

- Link to IATP's 2012 report on the findings of our survey of school food service directors: http://www.iatp.org/documents/farm-to-school-in-minnesota

- Link to IATP's 2012 report on the findings of our survey of grower perspectives: http://www.iatp.org/documents/grower-perspectives-on-farm-to-school

- Blog post on recent USDA funding for season extension and grains/pulse research for the K-12 marketplace: http://www.iatp.org/blog/201211/iatp-receives-federal-support-for-regional-farm-to-school-innovation

- Link to the report Frozen Local: Strategies for freezing locally grown produce for the k-12 marketplace

http://www.iatp.org/documents/frozen-local-strategies-for-freezing-locally-grown-produce-for-the-k-12-marketplace.

Project I

MN Specialty Crop Block Grant
FINAL PERFORMANCE REPORT

Submitted by: Jonathan Horsman, Communications Director, Minnesota Nursery & Landscape Association (MNLA)
e-mail: jon@mnla.biz
Phone: 651-633-4987
Date: 02/15/13

PROJECT TITLE

6. **Provide the project's title.**

Minnesota Grown Landscape Plant & Tree Marketing Program

PROJECT SUMMARY

7. **Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.**

The purpose for which Minnesota Nursery & Landscape Association (MNLA) undertook this project was to promote and encourage the production, sale and use of Minnesota grown regionally adapted landscape plants and trees. Educating both producers and consumers of the environmental, commercial and aesthetic value of these landscape plants has been at the core of MNLA's service to its members and the public for more than 85 years. Educating the public to the value of locally produced landscape plants is crucial to the long-term success of the Minnesota nursery industry. MNLA is uniquely positioned to promote and encourage the use of Minnesota grown landscape plants. The need for an increase in these efforts will be critical as overall markets and economic conditions improve. This project is a multi-level marketing effort for current and potential future producers. Project components include promotion to the public of the environmental benefits of trees, shrubs, perennials and annuals, and promotion of the Minnesota Grown program. These components work toward the common goal of the project, which is to increase the competitiveness and long-term sustainability of the Minnesota nursery industry.

8. **Establish the motivation for this project by presenting the importance and timeliness of the project.**

Our project was built upon and takes advantage of the synergy made possible by the success of a 2009 Specialty Crop Block Grant obtained by the Arizona Nursery Association, the "Arizona Grown Landscape Plant & Tree Marketing Program". The majority of their budget went to a professional public relations and marketing firm. The

firm did extensive market research aimed at an external target audience made up primarily of single-family homeowners and secondarily of homeowner associations, cities, municipalities, the department of transportation, parks & recreation departments and community organizations. Working in partnership with the Arizona Nursery Association, we were in the first group of other states to license the usage and adaptation of their materials. Our industry has struggled to find a common message that promotes and encourage the production, sale and use of regionally adapted landscape plants and trees which could galvanize our members and would capture the attention of the public. The Plant Something campaign has the right message at the right time.

9. If the project built on a previously funded project with the SCBGP or SCBGP-FB describe how this project complimented and enhanced previously completed work.

Our project was built upon and takes advantage of the synergy made possible by the success of a 2009 Specialty Crop Block Grant obtained by the Arizona Nursery Association (ANA), the "Arizona Grown Landscape Plant & Tree Marketing Program". The majority of their budget went to a professional public relations and marketing firm. By licensing the use of the materials produced by their firm, we were able to create web pages, additional graphics for print and web, customized advertisements for use in a variety of print applications, digital banner ad products, flyers, and brochures. All these materials were made available to ANA, as well as all other states who have also been awarded grants that fund the use and promotion of the marketing program.

PROJECT APPROACH

10. Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.

We ran a public relations campaign designed to increase the competitiveness and long-term sustainability of the Minnesota nursery industry. Our campaign ran during the spring time when our members are working their hardest to serve their customers and communities – an ideal time to raise public awareness and shape public opinion about the value of Minnesota grown landscape plants and trees.

We adapted a marketing program (the text, graphics, and mode of delivery) built from a 2009 Specialty Crop Block Grant obtained by the Arizona Nursery Association (ANA), the "Arizona Grown Landscape Plant & Tree Marketing Program." We licensed the usage and adaptation of their materials, and leveraged our relationships in Minnesota to promote the benefits of purchasing and planting Minnesota grown plant material. The marketing campaign was broad-based and included venues that are most suitable for our Minnesota markets. Using their files and concepts, we created ads specifically for our Minnesota Grown Landscape Plant & Tree Marketing Program.

We have completed our final step of empowering the individual growers and industry companies with tools and materials they can use to educate about the value of Minnesota grown landscape plants and tree. We make the trademarked message and materials available for use in promoting plant and landscaping sales at Minnesota plant sellers. 11 companies requested these materials.

11. Present the significant contributions and role of project partners in the project.

Project discussions with Arizona Nursery Association (ANA) proved very productive and led to more states becoming involved in the Plant Something campaigns. We conducted several meetings before and during the campaign, comparing notes, strategies, and tactics for carrying out effective campaigns. The cooperation achieved by the state associations using the Plant Something campaign was unexpected and truly beneficial to all involved.

The Star Tribune proved to be a valuable partner in formulating the campaigns that ran on their site.

GOALS AND OUTCOMES ACHIEVED

12. Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.

Our big goal was to reach 50% of Metro Area adults with our campaign message. To accomplish this we ran:

- Three Full-page ads for Garden Minnesota Yearbook. 140,000 were distributed via several venues:
  - 2,000 (est.) at St. Paul Home & Patio Show
  - 6,000 (est.) at Minneapolis Home & Garden Show
  - 13,500 (est.) to prospective homebuyers via REALTORS©
  - 1,500 (est.) at Minnesota Landscape Arboretum
  - 17,000 (est.) at Minnesota State Fair
  - 100,000 inserted in April 11th Star Tribune newspaper. According to Star Tribune reporting, this alone reached approximately 340,000 metro area adults.
- One full page and four half-page ads ran in Midwest Home Magazine during 2012, which has a published circulation of 47,802 and readership of 142,000 per issue.
- One one-third-page ad in Minnesota Grown Directory and one banner ad in rotation at MinnesotaGrown.com. 190,000 print copies are distributed statewide through tourist centers, libraries, chambers of commerce, farms and retailers. The online directory annually has 250,000 unique visitors.
- To achieve our goal of reaching Metro Area adults with our campaign message and increase visits to GardenMinnesota.com and MinnesotaGrown.com, we utilized the most popular local website in Minnesota, StarTribune.com, and leveraged an existing relationship with them to maximize the amount invested in delivering our message online and via mobile platforms. StarTribune.com ran website ads from April 9 through June 16, and a mobile campaign from April 16 through May 26. Readers clicking on the ad were taken to a Plant Something landing page on GardenMinnesota.com where they could learn more about the value of plants, as well as follow links through to the MNLA member directory and the Minnesota Grown directory. The performance, measured by the media company's reporting software, shows that 1,075,076 adults (43% of the Twin Cities metro) were reached online throughout the campaign using Mobile Banners, Homepage Doublebill, Homepage 300x250, Run-of-site 300x250, and Run-of-site sponsorship banners. Note that some aspects of the StarTribune campaign were paid from an agriculture development grant received by MNLA this year, which had similar goals and work plan as this grant.

  - Mobile -
  Impressions: 802,015
  Clicks: 1,275
  CTR: .16%

  - Home Page Doublebill April 10, 2012 -
  Impressions: 848,861
  Clicks: 786
  CTR: .09%

  - Home Page Big Ad May 9, 12, 13 -
  Impressions: 984,218
  Clicks: 669
  CTR: .07%

  - Run of Site Big Ad -

Impressions: 3,237,882
Clicks: 1,044
CTR: .03%

- Run of Site Sponsor Banner -
Impressions: 2,262,996
Clicks: 401
CTR: .02%

- Digital Summary -
Total Impressions: 9,067,150
Total Clicks: 4,597
CTR: .05%

13. If outcome measures were long term, summarize the progress that has been made towards achievement.

No long-term measurements were established, though this program helps the goal of increasing the competitiveness and long-term sustainability of the Minnesota nursery industry by reaching half our market with the key messages of the campaign.

14. Provide a comparison of actual accomplishments with the goals established for the reporting period.

- *Goal: Reach 50% of Metro Area adults with our campaign message.* When put all together, the numbers listed under our goal above suggest we indeed touched at least 50% of Twin Cities Metro Area adults with the Plant Something message.
- *Goal: Increase visits to GardenMinnesota.com during the campaign compared to the number of visitors in the same time period in 2011 by 15%.* The baseline from 2011 (April 9 through May 26) using Google Analytics was 9,690 visits to GardenMinnesota.com. This year's visits during the same time period was 15,478. This represents an increase of 59.73%. By delivering 59% more traffic to GardenMinnesota.com, growers of trees, shrubs, perennials and annuals listed in the online GardenMinnesota.com directory received increase exposure to users intested in planting something.
- *Goal: Increase the visits to MinnesotaGrown.com from GardenMinnesota.com during the campaign compared to the number of visitors in the same time period in 2011 by 3%.* The baseline from 2011 (April 9 through May 26) could not be established due to a gap in site analytics. Thus, there is no way to establish an increase in 2012. The gap in reporting for visitors to MinnesotaGrown.com highlights the risk in utilizing free technology tools.
- Goal: Increase Minnesota grown plant sales 6% during the promotional period. MNLA will survey MNLA and Minnesota Grown member retail nurseries to report plant sales during same month cycles. The concept of surveying members on specific sales of Minnesota grown regionally adapted landscape plants and trees was deemed too unachievable and unscientific to complete satisfactorily. The link between our public awareness campaign and sales of Minnesota grown regionally adapted plants and trees was not strong enough, and did not meet a threshold of causality necessary to conduct a scientific survey.

15. Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

See answer to question 9.

BENEFICIARIES

16. Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.

The project benefited the entire Minnesota nursery crop industry. This industry, according to the 2002 economic impact study, has agricultural production of $347 million and total retail sales of $453 million. The impact of this grant will reach far beyond the 1,200 members of MNLA and 1,100 members of Minnesota Grown.

Project discussions with Arizona Nursery Association (ANA) proved very productive and led to more states becoming involved in the Plant Something campaigns. We conducted several meetings before and during the campaign, comparing notes, strategies, and tactics for carrying out effective campaigns. The cooperation achieved by the state associations using the Plant Something campaign was unexpected and truly beneficial to all involved.

17. Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

With 9,067,150 impressions on our Star Tribune campaign, and a readership on the magazines our ads were in of 1,050,000, we know we touched at least 50% of Twin Cities Metro Area adults with the Plant Something message. For GardenMinnesota.com, the baseline from 2011 (April 9 through May 26) using Google Analytics was 9,690 visits to GardenMinnesota.com. In 2012, the number of visits during the same time period was 15,478. This represents an increase of 59.73%. By delivering 59% more traffic to GardenMinnesota.com, growers of trees, shrubs, perennials and annuals listed in the online GardenMinnesota.com directory received increase exposure to users intested in planting something.

LESSONS LEARNED

18. Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.

Positive: As witnessed personally by staff, all who encountered the Plant Something materials had a favorable reaction to them. The message and methods of delivering that message are the best this industry has seen to date.

Positive: Project discussions with Arizona Nursery Association (ANA) proved very productive and led to more states becoming involved in the Plant Something campaigns. We conducted several meetings before and during the campaign, comparing notes, strategies, and tactics for carrying out effective campaigns. The cooperation achieved by the state associations using the Plant Something campaign was unexpected and truly beneficial to all involved.

Negative: The concept of surveying members on specific sales of Minnesota grown regionally adapted landscape plants and trees was deemed too unachievable and unscientific to complete satisfactorily. The link between our public awareness campaign and sales of Minnesota grown regionally adapted plants and trees was not strong enough, and did not meet a threshold of causality necessary to conduct a scientific survey. If such surveys are to be undertaken in the future, we will need a more robust plan and funding to achieve satisfactory results.

19. Provide unexpected outcomes or results that were an effect of implementing this project.

- Receiving the correct file formats of the campaign materials proved to be a challenge and necessitated more time spent doing ad creation than anticipated. This was because the ad agency kept trying intermediate solutions rather than sending the source files needed for customization.
- The Board of Directors of the Minnesota Nursery & Landscape Association adopted a new strategic plan, which shifted staff focus during 2012 away from public relations campaigns and toward providing tools to businesses to market themselves. This necessitated spending more time in the creation, preparation and running of ad campaigns that could both spread the message and be used for companies to market themselves.

20. **If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.**

Goal: Increase the visits to MinnesotaGrown.com from GardenMinnesota.com during the campaign compared to the number of visitors in the same time period in 2011 by 3%. The baseline from 2011 (April 9 through May 26) could not be established due to a gap in site analytics. Thus, there is no way to establish an increase in 2012. The gap in reporting for visitors to MinnesotaGrown.com highlights the risk in utilizing free technology tools.

CONTACT INFORMATION

Jonathan Horsman, Communications Director
Minnesota Nursery & Landscape Association
jon@mnla.biz, 651-633-4987
1813 Lexington Ave N
Roseville, MN 55113

ADDITIONAL INFORMATION

21. **Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.**

    N/A

Project J

MN Specialty Crop Block Grant
FINAL PERFORMANCE REPORT

This form is used to make a final report to MDA. It is due no later than 60 days following the end of your project.

Please submit electronically in MS Word format to Brian Erickson at brian.j.erickson@state.mn.us, or if accompanied by an invoice, to mda.accounts-payable@state.mn.us

Submitted by:___Marv Zutz_____

e-mail: _____mzutz@gvtel.com_____

Date:____12-31-13_____

PROJECT TITLE

Fine Fescue Seed Production for Economic Stability and Environmental Protection

PROJECT SUMMARY

Grass seed production is an important component of the agricultural economy in northern Minnesota, totaling over 40,000 acres in Roseau and Lake of the Woods counties. These acres are planted with either perennial ryegrass or Kentucky bluegrass. Both of these species can produce an attractive turf and are well received by turfgrass professionals and consumers. Unfortunately, both species require high levels of inputs in both seed production fields and when used as turf. Due to concerns about the environment, along with increased government regulation of turfgrass inputs, consumers are beginning to increasingly utilize lower-input species, such as the fine fescues (strong creeping red fescue, slender creeping red fescue, Chewings fescue, hard fescue, and sheep fescue). This is creating a situation where the northern Minnesota seed industry is depending on a product that may not be used by the consumer in the near future. In order to reduce the chances of severe economic losses in these rural communities, it is critical that new species (fine fescues) are tested for incorporation into the perennial cropping system of northern Minnesota. Testing should include both seed production potential and potential uses in the landscape. This approach would simultaneously evaluate additional potential uses for this important specialty crop and determine which cultivars could be produced in northern Minnesota.

Several researchers have shown that fine fescue species can provide excellent turf under low-input conditions when maintained at higher mowing heights. In order to expand economic opportunity for Minnesota farmers, research efforts should focus on alternative uses for these fine fescues species beyond higher-cut, low-use turf. We recently compared 17 cool-season turfgrass species for use on low-input golf course fairways (no irrigation, limited nitrogen, no pesticides) and found that the fine fescue species outperformed traditional fairway species such as creeping bentgrass and Kentucky bluegrass; however, we only studied one cultivar of each fine fescue species. More research is necessary before these species will be accepted by professional turf managers for this use.

The objectives of this study were to: (1) evaluate seed yield potential of fine fescue species in northern Minnesota and (2) evaluate fine fescue cultivars for novel uses in low-input golf environments.

PROJECT APPROACH

1. Briefly summarize activities performed and tasks performed during the grant period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.

Objective 1: Seed Production Trials

A replicated seed production variety trail was seeded on May 1, 2012 at the Magnusson Research Farm near Roseau, MN. Each entry was replicated four times and the trial was seeded in a randomized complete block design at a rate of 5.0 lb of seed per acre. Standard seed production management practices were followed with the trial receiving an application of

fertilizer on October 29, 2012 (70 lb/acre N; 35 lb/acre P_2O_5; 35 lb/acre K_20; 8 lb/acre S). Weeds were controlled with applications of commonly used herbicides on July 8, 2012 and September 29, 2012. Data was collected on various seed production characteristics starting in summer 2013. Data collected included percent of stand heading (4 dates, 1 date reported in Table 1), harvest date, heading (qualitative measure, not reported below), height at harvest, and seed yield. All data is summarized in Table 1 at the end of this document.

The results of this trial showed a very clear trend in species performance with strong creeping red fescue and Chewings fescue showing much greater seed yield than hard, hard blue, or sheep fescue. Unfortunately, even the highest performing cultivars exhibited yields that are not currently economically viable; however, changes in management practices based on agronomic research could move these yields to a level that would work for seed producers. The plant height data for the hard fescues indicates the species would not be prone to lodging in a seed production field in northern Minnesota. The sheep fescues included in this study did not produce at a level that would warrant any further investigation.

Objective 2: Low-input fairway evaluation of fine fescue cultivars.

A replicated turf trial consisting of four replications of 44 fine fescue cultivars and selections was seeded in June 2012 at the University of Minnesota St. Paul campus. Total seeding rate for each entry was 2 pure live seeds/cm^2. Traditional grow-in protocols included using a starter fertilizer, erosion control blankets, and regular irrigation. A fertilizer application of 0.5 lb N/1000 ft^2 was applied twice during the summer. A fall fertilizer application of 1.0 lb N/1000ft^2 was applied to reach 2.0 lb N/1000 ft^2 total for the year. Mowing height was 0.5 in (1.3 cm) and clippings were collected. Pesticides were only used if plot integrity was compromised due to disease, insect, or weed pressure. Beginning in May 2013, plots received traffic treatments of 0 or 6 passes per week using a golf cart traffic simulator. The traffic simulator consisted of two 454 kg traffic units on an axle containing 5-golf cart tires. This rate of traffic was found to be ideal for this type of research in an earlier study. Traffic treatments ended in September. In 2013, no chemicals or supplemental irrigation were applied. In 2013, the trial received 2.0 lb N/1000 ft^2, split into a spring and fall application of 1.0 lb N/1000 ft^2. Throughout 2013, turfgrass quality was collected monthly.

Results from 2013 can be found in Table 2 at the end of this document. When no traffic was applied, individual entries of hard fescue, Chewings fescue, strong creeping red fescue, and slender creeping red fescue performed at an acceptable level (turfgrass quality greater than 5.0). When traffic was applied, the number of cultivars performing at an acceptable level was reduced; in fact, only 'SR 5130' had an average quality of over 5.0. Several entries did, however, perform at a level that was statistically equal to the top-performing entry. The bulk of these entries were made up of hard fescue, Chewings fescue, and slender creeping red fescue. Of the worst-performing entries, there were several strong creeping red fescue cultivars and selections. Overall, this data suggests that we should concentrate germplasm improvement efforts on the hard, Chewings, and slender creeping red fescues if our goal is to

develop germplasm for use on low-input golf course fairways. We have seen similar results in higher cut (home lawn) turf as well.

Overall conclusions

When taking the results of both objectives together, there is potential for the development of new cultivars of Chewings fescue that could be used as low-input turf and grown for seed in Minnesota. Other species have deficiencies in either seed production or turf systems; however, we will continue to investigate the potential of these species in both systems with an emphasis on hard fescue and slender creeping red fescue. We would not recommend fine fescues for seed production at this point (more research is needed). The use of fine fescues on golf course fairways is recommended on golf courses where golfer expectations are in line with lower-input conditions.

2. Present the significant contributions and role of project partners in the project.

The Minnesota Turf Seed Council coordinated the project and assisted in delivery of information to the grass seed producers. Researchers at the University of Minnesota planned and executed the project (including delivery of information to stakeholders).

GOALS AND OUTCOMES ACHIEVED

3. Supply the activities that were completed in order to achieve the performance goals and measurable outcomes for the project.

We successfully executed the proposed research project. Our team has developed materials and presentations for the extension component of this grant. During the grant period, we discussed this research at numerous outreach events such as the Northern Green Expo (Jan 2013 in Minneapolis, MN), the Grass Seed Institute (Feb 2013 in Roseau, MN), and the Grass Seed Production Field Day (June 2013 in Roseau, MN).

Fine fescue fairway results were discussed through a virtual field day video presented in fall 2013 on our turfgrass science website. The videos were produced with the help of extension colleagues. We initially proposed presentation of findings at an annual turfgrass research field day; however, due to low attendance in recent years, and the advent of improved digital media technology, the extension turfgrass science team decided to try a virtual field day. This project was discussed as part of a presentation by graduate student Maggie Reiter on fine fescues for golf course fairways (available at turf.umn.edu under 2013 virtual field day). An onsite field day is planned for August 7, 2014 in St. Paul, MN and the plots that were part of this research project will be the focus of a short talk on fine fescues for golf course fairways. This will be a great opportunity to show stakeholders the potential of these grasses even beyond the project period. All data from the trial is also available on the turfgrass website (direct link: http://turf.umn.edu/files/2014/01/2013-Specialty-Crops-Fine-Fescue-data-Traffic-order.pdf)

We have published the results of the seed production study on the MN Turf Seed Council website: http://www.mnturfseed.org/2014.pdf. This progress report was distributed to growers at the March 2014 Grass Seed Institute where the research was the focus of a presentation by Dr. Watkins.

The virtual field day videos from the two years that would cover some of this research had about 550 views. Results for the fairway research were posted our on turf.umn.edu website which currently have about 25-100 visits per day. Link to the actual data that was posted: http://turf.umn.edu/files/2014/01/2013-Specialty-Crops-Fine-Fescue-data-Traffic-order.pdf

The research project is now complete and we will continue to communicate these results on Extension websites (turf.umn.edu and the MN Turf Seed Council website); we will also continue to present this data and our conclusions at various outreach events during the next few years. This outreach will help us move toward our goals, even though the projected targets were not met (see below).

4. If outcome measures were long term, summarize the progress that has been made towards achievement.
5. Provide a comparison of actual accomplishments with the goals established for the reporting period.

We proposed outcomes for both seed production and fine fescue use in turf situations. We have not yet seen an increase in fine fescue seed production in northern Minnesota. There are currently no acres of fine fescue seed production in northern Minnesota, which is short of our 2013 goal of 100 acres. Because the results of this research showed that consistent seed production across the fine fescue species is not possible, the project team will continue to conduct research projects that help identify why seed production is inconsistent. Farmers will not be willing to take economic risks on these 'new' species until we have shown more consistent seed production. Our data indicate that the potential for economically viable seed production of fine fescues in northern Minnesota exists; however, it is likely that farmers will need to change their management practices in order to maximize yield. Our research team can help farmers figure out what these new management practices should be. For turf use, our target in 2013 was 25% over baseline. We are not at the present time able to claim we have achieved this trend because obtaining baseline data in 2012 was very difficult. We do know that there is increased interest in fine fescue use among turfgrass management professionals (Brian Horgan and Samuel Bauer, University of Minnesota Extension, personal communication). The University of Minnesota turfgrass breeding program is leading another project funded through USDA-NIFA Specialty Crops Research Initiative that will survey professionals in the grass seed supply chain; this survey will help us better identify trends in fine fescue seed sales in Minnesota.

6. Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.

Baseline data for seed production was obtained through the Minnesota Turf Seed Council by interviewing seed production professionals in Roseau and Lake of the Woods counties. We will continue to monitor acreage using this same method.

As mentioned above, baseline data for turf use was not successfully obtained; however, as mentioned above, we hope to have some data about fine fescue use in the very near future through another USDA project we are leading.

BENEFICIARIES

7. Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.

Turfgrass seed producers benefit because they did not take unnecessary risk by planting fine fescues before knowing the seed production potential of these species. Golf course superintendents benefited because they now have important cultivar information for these fine fescues under fairway management conditions. Grass seed sales professionals benefit because there is now more information available about these species for use in Minnesota.

8. Clearly state the quantitative data that concerns the beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

As reported above, the hard fescue cultivars did not exhibit acceptable seed production in northern Minnesota, while other species, particularly the Chewings and strong creeping red fescues did show potential. This will allow our research team to focus on management practices that could improve the Chewings and strong creeping red fescues so that maximum economic potential of these species can be reached.

It was clear that several cultivars representing different fine fescue species could be used for lower-input golf course fairways in Minnesota. Data for trafficked plots showed that traffic from golf carts will decrease turf quality; however many cultivars show a less severe decline under stress. Turf plot data indicate that we should focus our efforts on improving quality of hard fescue, Chewings fescue, and slender creeping red fescue.

LESSONS LEARNED

9. Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.

The fine fescues exhibit inconsistent seed production when planted in Minnesota. Conversely, the fine fescues showed much greater potential when managed as a golf course fairway,

although significant differences in cultivar performance were still apparent. This project illustrated the importance of testing individual cultivars prior to growing on larger scales.

10. Provide unexpected outcomes or results that were an effect of implementing this project.

We did not know about the differences in seed production between the fine fescue species when grown in Minnesota. This is new information that will be of great value to stakeholders and other researchers.

11. If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

It is clear that in order to achieve our goals for fine fescue seed production in Minnesota, we will need to research new ways to manage these seed production fields.

ADDITIONAL INFORMATION

12. Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

Our initial information dissemination plan was too aggressive. Because of a late seed production season in northern Minnesota, data for the fine fescue seed production trial was only analyzed in December 2013. Therefore, we have not yet reported these final results to stakeholders; however, we are scheduled to present this data at the Grass Seed Institute in Roseau, MN on March 12, 2014 (expected attendance between 75 and 100). This event will coincide with the release of the data in the annual seed production report that will be posted at www.mnturfseed.org.

A late fall in St. Paul also precluded the dissemination of the fine fescue fairway results before the official completion of this project. We have now analyzed the data (Table 2 below), and will post it on the www.turf.umn.edu website (cultivar evaluation section) by January 8, 2014. Also, we will discuss these results with stakeholders at the Northern Green Expo in Minneapolis MN on January 8, 2014 (the presentation will be given to between 200-300 stakeholders).

Because we are going to continue collecting data on these trials in 2014, we will wait until the end of 2014 to consider our options for publication in a peer-reviewed journal. The fairway results will easily fit in a paper we are preparing that focused several fine fescue cultivar evaluations for lower input environments.