

FY 2014 Specialty Crop Block Grant Program

Maine Department of Agriculture, Conservation and Forestry

Final Report

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Project 1: Supporting Maine Specialty Crop Producers with Food Safety Audit Preparation

Final Report – Previously Submitted

Project summary

The purpose of this grants was to assist Maine specialty crop growers as they undertook the task of preparing for various food safety certifications for their produce operations demanded by their markets.

Maine has a growing population of small farms. More and more of their markets demand GAP certification before they will buy their crops. This grant allowed all crop growers in Maine to receive assistance understanding food safety, creating their own Food Safety Plans, and preparing for a GAP/GHP or Produce GAP Harmonized audits so that they could increase their markets and hopefully their profitability as well.

Previously, grants were written for 2012-13 and 2013-14 that funded a person full time to do this work. This grant built on that base. This grant was a one year project and funded a 2/5 position to do this work. The thinking behind this was that the materials needed to accomplish this certification work had been created by AgMatters LLC and that until FSMA becomes enforced (2016), there will be no major changes in audit expectations. AgMatters LLC felt that the one-on-one assistance to growers would be able to be met by this proposed part-time position in this year of the grant, and it did.

This project began on October 1, 2014 and ended on September 30, 2015.

Project approach

The focus of this grant has been to share the information growers need to incorporate food safety practices into their systems, and also to make the process of certification do-able, no matter what size the operation is. AgMatters LLC has simplified the preparation process, yet maintained the integrity of the audit and of the importance of food safety. AgMatters LLC has presented to over 200 growers during the term of this grant.

The intent has been to make sure that growers are totally prepared for their food safety audits by sharing with growers specifics about what auditors are looking for. Food safety is too serious an issue to play games with, all growers need to understand and take the preventive actions required of them. 40 farms AgMatters LLC worked with have been certified during the term of this grant

The impact of these grants has been felt by consumers of local foods in Maine as they purchase fresh produce in grocery stores. Producers took all precautionary steps advised by Food Safety materials and demanded by GAP/GHP and Produce GAP's Harmonized audits and other audits.

This project improved and enhanced competitiveness for specialty crops in Maine. These certifications are all about meeting standards that apply no matter what the size of the operation. They allow all farms to compete on the same playing field, as they attain levels of certification that are well respected throughout the states.

The potential economic impact of this project was the ability for growers to sell products to larger markets, hospitals, and schools. In the last four years, we have watched this happen on a grand scale. Many of the farms audited have grown exponentially. Many have added packing houses, or added value added preparation of some crops, or are growing specialty items that never would have moved in their other markets. They have added delivery trucks and taken a great deal of pride in this growth. Others have been quite happy to maintain status quo. Whatever the economic choices made by individual farms, they all have become more aware of and improved their Food Safety practices.

During this grant, AgMatters LLC has spoken at many Maine Vegetable and Small Fruit Twilight and Annual Meetings; the Pomological Society Annual Meeting; participated as a speaker in a Food Safety Webinar sponsored by the Conservation Law Foundation; participated as a panelist in a Food Safety Conference sponsored by Lambert Coffin Attorneys at Law; participated in several food safety workshops sponsored by Maine’s Extension Service; worked with Maine Farmland Trust and presented workshops on Food Safety at three of their “Harvesting Maine’s New Wholesale Possibilities” trainings, participated in MOFGA’s “New Farmer” training, and in Maine Farmer’s Market Conference sharing the basics of food safety training.

Growers have greatly appreciated the one-on-one assistance, AgMatters LLC has had over 50 one-on-one meetings with individual growers during the term of this grant. Growers are grateful for the speed with which we are able to meet with them, the knowledge gained from the interaction, and the ability for them to call us anytime with questions. Growers we have worked with have told us they could never have undertaken the job alone and are very grateful for our help. **No one we have worked with has failed their audit.**

Activity	Results X = accomplished
<p>Prepare for and carry out a large-group Food Safety updates at MVSFGA and Maine Pomological meetings at the Agricultural Trade Show in Augusta in January 2014. These meetings will make growers aware that assistance with these audits is just a phone call away. They will also provide an opportunity for growers who have gone through the process to share their experiences.</p>	<p>X AgMatters LLC participated and been a guest speaker at Maine Vegetable and Small Fruit Twilight and Annual Meetings; the Pomological Society Annual Meeting; a speaker in a Food Safety Webinar sponsored by the Conservation Law Foundation; participated as a panelist in a Food Safety Conference sponsored by Lambert Coffin Attorneys at Law; participated in several food safety workshops sponsored by Maine’s Extension Service; worked with Maine Farmland Trust and presented workshops on Food Safety at three of their “Harvesting Maine’s New Wholesale Possibilities” trainings,</p>

	participated in MOFGA’s “New Farmer” training, and in Maine Farmer’s Market Conference sharing the basics of food safety training.
Advertise this grant and update materials and posted them on www.agmattersllc.com web page or mention them on AgMatters LLC Facebook page.	X MDACF has also linked its readers to our website.
AgMatters LLC will create or collect materials that will aid growers in their audit process.	X We have created templates for different FS audits as well as informational pieces on sanitizers. We compile ideas we learn and share them with growers. Many of these forms are on our web site, but we bring hard copies to each work session.
AgMatters LLC will supply growers with materials and access to the latest information in Food Safety as it applies to their operations via emails, internet, or directly.	X We try not to bombard growers too much, however we share what we believe is important to their operations.
Individual work sessions will occur over the phone, via email, and/or by personal visit in order to get the farm ready to undertake these audits. Materials will always be available in hard copy, via email, or downloadable from our web page	X We worked with over 50 growers individually.
AgMatters LLC will speak at any agricultural meeting and prepare materials for dissemination in other’s newsletters (Farm Bureau, MOFGA, Blueberry News...) about the grant.	X AgMatters LLC has shared information with each of these entities as well as sending out new information via email to a distribution list of 100 growers.
AgMatters LLC will collect and utilize suggestions and criticisms received from evaluations throughout the grant term. These will be reported in final report.	X AgMatters LLC has received only the kindest and most positive feedback possible from those we have worked with.
AgMatters LLC will work with markets to ascertain their requirements of growers.	X Hannaford has been the most receptive market for growers.
AgMatters LLC will work with GAP/GHP; Produce GAP’s Harmonized; or another third party audits.	X We have worked with two growers who did Produce GAP Harmonized, the rest did GAP/GHP.
AgMatters LLC will work with individual farms and assist with implementation of their Food Safety Plan and in dealing with manure, water, fertilizer, safety and hygiene, packing house, storage, transportation and traceback issues.	X AgMatters LLC has gone back to farms to help them implement their food safety plan. Many times this is simply looking over what is being done

	to make it better.
AgMatters LLC will continue to update and educate themselves about food safety audits and issues by reading, working with Maine’s State-Federal Inspectors, and making calls to experts in the field.	X AgMatters receives FDA and USDA updates as well as Produce Safety updates from Cornell. We share information with our State Dept. of Ag, and auditors as we learn of issues.
AgMatters LLC will read, study, and implement changes to program suggested by growers in their feedback.	X Our feedback has been kind thanks. However we make changes to our materials as we learn of specific emphasis requirements directed by USDA for auditors.
AgMatters LLC will contact major markets for produce in Maine about their expectations for growers.	X There is confusion out there. Many markets are not sure what exactly they will expect from growers in another year. We believe that FSMA will guide some of these decisions.
AgMatters LLC will complete the final report for this grant	X

AgMatters LLC has benefitted from project partners. The Maine Small Fruit and Vegetable Growers Association, The Maine Pomological Society, and Maine Farmland Trust have connected us with their producers and invited us to participate in their meetings to make sure that everyone is aware of this food safety assistance. The Maine Department of Agriculture, Conservation & Forestry has helped to make growers aware of how we can help them succeed by sharing our link on their web site and keeping us in the information loop.

Food Safety is a commitment, it is a new way of doing business. It can open doors of communication on every farm by establishing a common language and standards of operation.

Goals and outcomes achieved

AgMatters exceeded all goal expectations of this grant. The goal this year (2014-15) was to work with 30 growers one on one and we worked with 50 individually and over 200 in small groups. Of these growers, our goal was that 30 would become certified, in reality at least 40 became certified during the span of the grant.

Project Goal	Outputs	Output Performance Measure	Outcomes/ Targets	Outcome Performance Measure	Long-term Impacts
To assist at least 30 Maine Specialty Crop Growers	*At least 30 Specialty Crop Growers will receive	*Number of participants worked with	*All participants will report that the	*At least 30 growers who received this assistance will	Maine farmers will develop a process for preparing for

prepare for a GAP/GHP audit or a Produce GAPs Harmonized audit.	materials needed and one on one assistance as they prepare for a successful GAP/GHP or Produce GAPs Harmonized audit.	*Number of successful audits conducted in Maine from Oct. 1, 2014 through September 30, 2015. * Evaluation data will be used to make improvements to the program.	assistance provided by AgMatters LLC either made the process simpler and more streamlined.	have successful audits as a result of this tutelage. This data is available on the USDA website and from Maine's auditors and will be reported in the final report.	their food safety audits, thus encouraging them to repeat the process in future years. This makes them eligible for selling their produce to major markets.
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A minimum of **30** growers who participate with this grant will receive assistance preparing for Food Safety audits such as GAP/GHP , Produce GAP's Harmonized Audits, This will include recertification, new certification, or increased certification levels for these farms.

Outcome: A list of participants for the grant and a list of certifications earned during the year will be maintained by AgMatters LLC.

Reality: AgMatters LLC spoke to over 200 individuals and worked one on one with 50 farms over the course of this grant.

The one on one grower work will continue to evolve and improve, based on grower feedback.

Outcome: Evaluations will be given to each grower. Resulting criticism and suggestions will be studied and incorporated into the program. Results will be saved and summarized so they can be reported in the grant final report.

Reality: All 30 evaluations received commended the program and the interactions between AgMatters LLC and themselves. Growers were grateful that the program exists and did not want it to change.

AgMatters LLC will hold a large group meeting at the Maine Agricultural Show in January, 2015.

Outcome: Numbers of attendees will be kept.

Reality: There were 114 growers who attended AgMatters LLC's sessions for the MVSFGA meeting at the Trade Show and 24 who attended from the Maine Pomological Society's meeting.

AgMatters LLC will speak to at least three other grower meetings during the year, sharing information about the grant and encouraging others to undertake a Food Safety Audit.

Reality: Outcome: Records will be kept of all speaking engagements, as well as numbers in the audience.

Reality: AgMatters LLC was invited to speak about GAP and Food Safety in a Webinar on Food Safety on 10/1/14 put on by the Conservation Law Foundation (20); at MOFGA's New Farmer Training on 12/14/14 (28); at the Maine Farmer's Market Conference on 1/25/14 (31); at Maine Farmland Trust's "Harvesting Maine's New Wholesale Opportunities" at Bate's College on 2/7/15 (25), in Belfast on 2/21/15 (21), and in Machias on 3/7/15 (23). AgMatters LLC was also a panelist on a Food Safety panel at a Conference sponsored by Lambert/Coffin in Orono (60). Numbers in audience are in parenthesis.

Materials put together by AgMatters LLC to assist growers with this process will be shared on their website (www.agmattersllc.com) and updates will be sent out in regular email notifications to growers on a regular basis.

Outcome: A summary of these materials will be made in the final report.

Reality: AgMatters LLC has created and updated materials as necessary this year of the grant. Materials include Food Safety Book templates for all certifications for GAP/GHP and Produce Harmonized GAP. They also include handouts on using bleach as a sanitizer; general information on food safety for specific fruits and vegetables (with a concentration on those eaten raw; fact sheets on Produce Safety and Flooded Fields; information about Maine's new pesticide applicator license; information on water quality criteria; and other materials on similar topics that growers have asked about. AgMatters LLC sends out several emails a year to a grower list of about 100 on updates with FSMA and GAP topics.

AgMatters LLC shared the results of this grant with the MVSFGA and the Maine Pomological Society's annual meetings held at the Maine Agricultural Trade Show held in January of each year.

Project beneficiaries

In this last year, we have worked with many newer farmers who have never worked with food safety before. We take this to be a good omen for the future. Not only are there many new farmers, there are several who are taking on traditional agriculture in different directions. We have worked with two new farms who are growing their greens in recycled fish water. Many others are growing almost exclusively in tunnels or greenhouses. One has the first zero emissions greenhouse in the state. These are exciting times in Maine agriculture.

In terms of numbers of actual certifications, AgMatters LLC believes the numbers of audits increase in years when financial assistance has been available to help growers off-set the cost of an audit. We work closely with Hannaford's Close to Home Program and helped them to shape the language of their offer to producers of up to \$750.00 of the cost of their audit. So their growers have definitely benefitted from the work of this grant.

This grant benefitted growers from Maine and several from NH and Massachusetts as well. AgMatters LLC worked with many organizations to provide important information to all. These groups include: Maine Organic Farmers and Gardeners Association; Maine Farmland Trust, Hannaford Supermarkets and their Close to Home Program; Maine Vegetable and Small Fruit Growers Association; Maine Pomological Society; several Maine Wild Blueberry Growers; and Good Shepherd Food Bank. AgMatters LLC also worked with the Conservation Law Foundation and Lambert/Coffin Attorneys at Law in their endeavors to education their populations about food safety.

This project increased the marketability, and raised the reputation of local produce and producers. It allowed farms to share with the public market the methods they employ to produce the best product they can. It allowed all growers to work towards common standards and use that information to better inform the public of what it is they do to earn that certification.

This project gave farmers the assistance they needed to implement Food Safety Practices demanded in their audits in ways that they can live and work with and to do it with people that they trust (AgMatters LLC staff). This grant did not certify anyone, but it did provide guidance towards successful certification in non-threatening ways.

Lessons learned

Maine is a land of many small farms. At first, most small growers felt immune to the market demands of certification. However as growers try to make a living, they are looking for more outlets for their produce. Hospital, school, and nursing home markets are there, but have the need to protect their populations. Therefore many have created their own standards for food safety, or accepted GAP/GHP standards.

Growers who used to be able to sell to others who resold their produce, are now likely to be asked if they are certified. The only growers completely unaffected by this are those who only sell through their own farm stands.

Maine's produce growing population is increasing and the need for this type of assistance remains as high today as it ever has. Market expectations are increasing, and so far, only one market has offered to help off-set the costs of certification.

Based on the success of this grant and similar grants we have written to assist Specialty Crop growers, AgMatters LLC believes strongly that the impact of one on one service to growers plays a major role in the success of these grants.

The worst thing we have encountered is the need to dispel half-truths that people hear about food safety. To do that, one has to be able to engage in conversation in a non-threatening way, and know the facts! Some of those half-truths include things like-"you can't have animals on your farm if you want to be certified"...or "we could never afford an audit"...or "we cannot monitor our fields from turkeys and seagulls".

One of the best results of this grant has been the development of a story bank of stories and ideas that AgMatters LLC is able to share with growers to illustrate how different farms meet food safety requirements in unique, but correct ways. Typical Maine ingenuity!

A grant has been written and accepted by the Maine DACF to carry on this work in the same format with a 2/5 position in 2015-16.

All funding for this grant has been used as budgeted and requested from MDACF.

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Lauchlin W. & Linda B. Titus

Project 2: Increasing the Nutrition Knowledge and Consumption of Specialty Crops by Maine Children and Adults

Final Report – Previously Submitted

Project Summary

Maine Agriculture in the Classroom (MAITC), Maine School Garden Network (MSGN), and FoodCorps conducted this project as partners to educate Maine schoolchildren, teachers, parents and volunteers about specialty crops. The project provided ready to use classroom lessons for teachers, hands-on experiential learning in the garden and direct links to Maine’s specialty crop producers.

Project Purpose

Nutritious and delicious specialty crops are being produced in every county of our state, but without nutrition education in the classroom and awareness building provided through school gardens many citizens will never purchase them. Schools across Maine are initiating school garden programs (now over 150 participate in the MSGN registry). Less than 5% of these schools currently have any staff that is compensated for work in these gardens. The FoodCorp program has assisted schools across the state since 2011 in garden education and local food procurement. MSGN provides monthly newsletters, easy to access information on the website, and school garden visits by the coordinator to answer questions and establish links to specialty crop farmers in the area. MAITC provides lessons, fieldtrips and professional development for classroom teachers. Together these partners prepared the next generation to purchase more of Maine’s specialty crops, cook and preserve them in their kitchens and integrate them into everyday healthy meals!

Project Activities

FoodCorps

In 2014/15 Twelve FoodCorps members served in 47 Maine schools during the school year, reaching 11,713 students and building and/or revitalizing 15 school gardens.

These members reached out to 71 local farmers and distributors to help get local Maine food into school meals.

They also engaged 240 volunteers who served 1,177 hours, helping with school gardens and local food-related activities.

Due to their efforts, 2,277 pounds of produce was harvested from school and community gardens; 3,412 pounds of local produce was served in school cafeterias; 1,304 pounds of local produce was prepared and served in classroom taste tests; and 988 pounds of local produce was donated to feed hungry Maine people.

203 food-related educational events (taste tests, cooking classes, etc.) took place and 22 new food items/recipes were introduced to students.

Maine School Garden Network

Has coordinated 16 training workshops for school garden educators, local farmers and school food service staff with 530 participants including collaboration with Farm To School, The Youth Ag Summit and 13 separate regional meetings.

Has continually updated and expanded MSGN website resources on gardening, nutrition, and collaborations with local farms and school food service staff. This resulted in a 4.87% increase in website sessions and 6.96% increase in users.

Has added 63 school nutrition directors to newsletter subscriptions

Website is being redesigned to feature collaborations.

Has Provided 12 Newsletters. E-Newsletter subscriptions grew by 85% to reach 1262 people.

Newsletters were also made available to audience of 365 people on Facebook, marking a growth of 287% in the duration of the project.

Has Provide direct outreach and assistance to over 120 school gardens across the state to facilitate networking and problem solving between programs and increase awareness of local specialty crops and new resources in nutrition curriculum to carry the gardens into the school classrooms. Twenty gardens received direct visits.

Maine Agriculture in the Classroom

MAITC currently has 30 specialty crop lessons posted on our lesson page with alignments to state and national standards. There are 3 more currently being professionally formatted and aligned, and a new 28 page book and 20 page activity book, entitled “Potatoes for ME” is in the developmental stage for release in March 2016.

MAITC has provided over 75 hours of training for classroom teachers and Pre-service teachers (college juniors/seniors studying to become teachers)

25 Teachers at Summer Institute attended 5 fieldtrips to specialty crop farms and were exposed to 8 different presentations on the utilization of this Ag information into their classroom curricula.

In May 2015 MAITC streamed the National Ag Literacy Matrix onto our website with a dynamic system of current information on agriculture and specialty crops nation-wide.

Goals and Outcomes achieved

Significantly increased pounds of produce harvested from school and community gardens;

Increased to 3,412 pounds of local produce served in school cafeterias;

Created a platform for 1,304 pounds of local produce to be prepared and served in classroom taste tests;

Maintained the number of pounds of local produce donated to feed hungry Maine people.

71 more local farmers and distributors worked to get local Maine crops into school meals..

Held 203 food-related educational events (taste tests, cooking classes, etc.) using 22 new food items/recipes.

Held 16 training workshops for school food service, school garden personnel, local farmers, volunteers and teachers.

Increased the number of website visits by 4.87% with a 6.96% increase in users.

School nutrition directors have increased awareness to specialty crop by adding newsletter subscriptions

30 specialty crop lessons are posted online with alignments to state and national standards.

A new 28 page book and 20 page activity book, entitled "Potatoes for ME" is ready for release in March 2016.

75 hours of training for classroom teachers and Pre-service teachers provided,

The National Ag Literacy Matrix has been streamed onto our website

25 Teachers at Summer Institute attended 5 fieldtrips to specialty crop farms and were exposed to 8 different presentations on the utilization of this Ag information into their classroom curricula.

Percentage increase in the use of Maine specialty crops in participating schools:

In 2015 \$3,782,660 were invested in local food with 88.5% being local specialty crops (fruits and vegetables). In 2013 This figure was under \$3,000,000. This is an increase of 20.6%

Percentage increase in school gardens

From 112 registered gardens in 2013 to 130 in 2015 = 16% increase Percentage increase in specialty crop farmers connected with schools

In 2014-15 there were 244 new farmers from a group of 626 total farmers that provided specialty crops to Maine schools. That is a 39% increase in specialty crop farmers connected to schools. In 2013 MSGN introduced 17 new farmers to school food service personnel. With the help of FoodCorps and Maine Farm to School this number increased to 244 in 2015.

Beneficiaries

47 Maine schools during the school year, reaching 11,713 students

71+ local farmers and distributors

School Garden personnel at 15 school gardens

Food insecure Maine people

530 educators at the Regional Gatherings

Teachers using the lesson site
63 School Nutrition Directors
1,2000 students participating in the volunteer reading project

Lessons Learned

With 7,351 pounds of produce harvested in 84 school gardens, students attending these schools were more receptive to trying new fruits and vegetables after they participated in growing them.

1,612 pounds of produce from school gardens were used in school cafeterias in 93 new recipes. Students were more apt to try new recipes when produce was grown in the school garden and when they participated in taste tests or menu selection.

Over 79% of Maine schools are participating in local procurement, 5% more plan to start in the next year. 50% plan to increase in the future.

Specialty crop procurement accounts for more than school lunch. Maine School Districts are serving local items throughout the day. 57% at breakfast, 95% at lunch, 28% for snacks and 39% through the fresh fruits and vegetable program. (National Farm to School Census 2015)

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Project 3: Enhancing Consumer and Producer Awareness of Maine Maple Syrup

Final Report – Revised

Project Summary

Work will continue on the marketing plan developed by Nancy Marshall Communications. Further development of the website and social media marketing presence will continue as will social media training for members as advised in the marketing plan. Speakers are planned for the 2018 January Ag Trade Show in Augusta and at the 2018 Maple Mania being held in Greenville. Ongoing positive media is being shared with the public and the association members through the new website and the Facebook page as well as Pinterest, Twitter and Instagram. The new logo comprised of something other than the outline of the state will now appeal to and attract more national and international company attention.

This project was pursued in order to help increase sales and capture full retail value of syrup by helping producers enhance the quality and safety of their products and take the opportunity to market the benefits of maple syrup to the public. The goals were derived from a 2011 Maple Task Force Study Group recommendation which found: “There is a great need for education for producers, processors, buyers and the public about the value of syrup, the benefits of sugar bushes to both individuals and the public and the process of producing syrup.”

Project Approach

For specific tasks and activities performed related to Goal 1, updates to the food safety plan for producers have been made at <http://extension.umaine.edu/programs/natural-resources/maple-syrup-production/maple-food-safety-plans/>. Visits to the maple food safety plan webpage have increased in the last year. As FSMA continues to be implemented, more changes may be added to meet FSMA guidelines as they are interpreted for the maple industry. An article entitled, “Maple Food Safety Plans – Do You Need One?” was published in the June 2017 issue of the Maple Syrup Digest Vol. 56 No. 2. This journal is published by the North American Maple Syrup Council.

These activities fall under two recommended project areas as listed by the AMS (USDA/Agricultural Marketing Service):

- d. Developing “Good Agricultural Practices”, “Good Handling Practices”, “Good Manufacturing Practices”
- f. Enhancing food safety

For specific tasks and activities performed related to Goal 2, the committee has made progress on the goals of their Nancy Marshall Communications marketing plan by:

- Developing a quality rack card explaining and promoting maple production in Maine. This card has been printed and used at the Big E, Cumberland Fair, and Fryeburg Fair and at the seven Visitor Information Centers managed by the Maine Tourism Association.

- Developed a new color logo with a black and white version for specific applications



- Developed the “Maine Maple Story” and educate customers about the uses of maple syrup
- Increased awareness of the many uses of Maine maple syrup
- Increased awareness of the differences in the taste and quality of Maine maple syrup vs. maple syrup from other states
- Increased understanding of supporting local producers and the Maine way of life
- Beginning to leverage Maine’s strong brand identity and entrepreneurial spirit to tie into Maine’s “Maple Story”

Goals and Outcomes Achieved

Goal 1 – Food Safety

Food safety has become an important topic for consumers. The Food Safety Modernization Act of 2011 has one mandate that directly applies to maple producers: *Facilities that manufacture, process, pack or hold human food would be required to identify potential food-safety hazards and implement controls to reduce such risks.*¹ While maple is exempt because most operations are considered farms, since they manufacture food even though it is considered a low risk food, they are required to maintain food safety records. The guidance for this is still being written at this time. While many maple producers will be exempt from the hazard analysis portion of the produce safety rules, they still must comply with the revised Current Good Manufacturing Practices.² Many producers are also proactive about producing the safety and highest quality product possible. Creating and using a food safety plan helps them maintain the highest possible standards.

UMaine Cooperative Extension has worked closely with the maple industry, authoring the Maple Syrup Quality Control Manual, presenting the Maple Grading School for fourteen years and providing research on maple microbial contamination and best canning practices. Discussions on writing maple food safety plans and avoiding microbial contamination of maple syrup have been incorporated in all maple grading schools. Specific sessions on the requirements of a maple food safety plan and Good Manufacturing Practices for maple were presented at Maple Mania in June 2017. Food safety articles have been included in the last three quarterly issues of the Maine Maple Producers newsletter.

¹ <http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm334114.htm> Accessed October 31, 2016

² <http://www.accessdata.fda.gov/SCRIPTS/cdrh/cfdocs/cfcr/CFRSearch.cfm?CFRPart=110> Accessed October 31, 2016.

Goal 2 – Promotional Material and Website Improvements

The marketing committee of the Maine Maple Producers Association composed of ten members representing both small and large sized operations and north, central and southern producers sent out requests for proposals to five Maine advertising agencies

Website improvements

The website improvements are being implemented by the Maine Maple Producers Association website committee. This committee has evaluated the needs of the membership and the public and added a “Stripe” payment system to their website for new and renewing memberships and for Maple Mania registrations.



Social Media Efforts

Facebook – <http://www.facebook.com/MaineMapleProducersAssociation> Facebook page likes have increased 39% since October of 2016 and peak post reach is about 1400. 61% of fans are women and 37% are men. 89% of fans are between 25 and 64 and some of the most popular posts are recipes and how to use syrup in cooking. Popular posts also include where to buy syrup, managing invasive plants in the sugarbush, and fall foliage posts.

Established and populated the following social media accounts:

<https://twitter.com/puremainemaple>

<https://www.pinterest.com/puremainemaple0240/pins/>

<https://www.instagram.com/puremainemaple/>

Beneficiaries

The 452 licensed producers as of 2014 have benefited from the work in this project, and an unknown number of hobbyist who will be able to utilize the food safety and outreach information. Producers and the public will now have the benefits derived from the information.

Lessons Learned

Work has progressed more slowly than thought because of the challenge of coordinating multiple committee members' busy works schedules. A committee of ten adds the depth and perspective to decision-making that is sometimes lacking in smaller committees and generally, results in better, longer lasting, if slower, decisions.

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Project 4: Improving Maine Potato Yields through Increased Rotation Lengths and Improved Rotation Crop Profitability

Final Report - Previously Submitted

Project Summary

Potato producers in Maine are in need of mechanisms in which to improve potato yields in order to sustain market viability. One such mechanism, as identified by the Maine potato industry's "Yield Initiative Taskforce," is through the lengthening of rotations (increasing the time between potato crops on a piece of land). Economic challenges arise under this scenario in Maine due to increasing times between potatoes (typically the main cash crop), lack of crop diversity in current potato cropping portfolios, and lastly, a lack of identified potential alternative crops, alternative markets for existing crops, and value-added processing potentials for new and existing rotation crops.

The goal of this project is to identify potential crops that could be grown in conjunction with potatoes that would allow producers improved economic returns, allowing growers to expand current rotation lengths while directly and indirectly improving potato yields. Through the iterative process of identifying climate suitable alternative crops, their market potential, value added potential, and effects upon potatoes, we seek to improve the overall sustainability of the Maine potato industry for the coming years.

Project Approach

The Maine Potato Board (MPB) hired a Crop Development Specialist (CDS) in August 2015 to implement and provide oversight for this project.

The MPB hired the research and planning firm Planning Decisions, Inc. (PDI) to identify and research the market potential for alternative crops. Since June 2015, PDI has been analyzing published data, reading reports, and interviewing numerous growers, food processors, wholesalers, grocers, and others involved in the Maine and New England food system. PDI presented a progress report to the MPB on September 24, 2015 which detailed their activities from June and clarified their direction through the end of the project. An additional update was provided on November 06, 2015 via teleconference. The final report was received by MPB by December 31, 2015.

The CDS assisted with advertising and organizing a 1 day conference hosted by the US Organic Grain Collaboration in Presque Isle on November 11, 2015. The US Organic Grain Collaboration is a pre-competitive industry effort led by organic food companies that have identified the need for collaborative action to address key challenges in expanding the supply of organic grain in the US. This conference is a result of Aroostook County being identified as an investment opportunity for organic grain production. The conference was well attended by both organic and conventional growers interested in learning more about the marketing opportunities for organic grain crops.

The CDS is assisted with the organization and planning of, and presented at the annual Maine Grain Conference hosted by the University of Maine Cooperative Extension. The conference is tentatively scheduled for March 23, 2016 and will be held in Presque Isle. The primary focus of the conference will be “Grain Storage and Post-Harvest Handling”. Three keynote speakers have accepted invitations to present. The speakers include a grain storage engineer, a large scale diversified organic grower and processor, and a large scale diversified conventional grower who works with neighboring potato operations to produce seed grade grains and soybeans. Other topics will include pulse crop production, seed and grain quality testing, research updates from the University of Maine, crop insurance updates, and information on grain storage loan programs.

The CDS has made several contacts with companies interested in procuring raw ingredients from Maine growers. These companies include:

- Full Sun Company – Vermont – Organic and Non-GMO sunflowers and canola
- Sevita ProSeeds – Ontario, Canada – IP food grade soybeans for seed and processing
- Bay State Milling – Massachusetts – Food grade hard red spring and hard red winter wheat
- Northern Girl – Maine – Kids Eating Maine Carrots pilot project
- Various Maine based flour mills and malt houses interested in a wide array of food grade grains

The CDS has announced these opportunities through emails and personal communications with growers. Additional details and updates will be provided on January 20, 2016 at the Maine Potato Conference via a presentation titled “Alternative Crop Opportunities”.

The CDS is actively working with individual growers who are currently producing or are considering producing alternative crops on their operations. Some farms are experimenting with sunflowers, wheat for flour and malt, winter spelt following an early potato harvest, buckwheat as a temporary summer cover crop, and organic emmer and durum wheat. The CDS developed plans to work with these growers during the 2016 season to increase production and improve the quality of these alternative crops through varietal selection, seeding date and rate, and fertility and crop protection strategies.

The CDS was successful in writing 2 research proposals for the 2016 growing season. One project was hosted at the University of Maine Aroostook Farm and investigated the agronomic and marketing potential of several pulse and oilseed crops. The second project was hosted on 2 cooperating growers’ farms investigating the potential of producing whole seed potatoes.

Project Results

The activities performed through this project are ongoing. Overall growers understand the financial and biological importance of integrating alternative crops into their rotations and are interested in learning more about potential opportunities. This project began toward the end of the 2015 growing season making implementation of alternative crops for 2015 difficult. The winter off season will be a good opportunity to gather additional information and explore opportunities for 2016.

The CDS has been cooperating with research personnel from the University of Maine Cooperative Extension, Virginia State University, Southern Aroostook Soil and Water Conservation District, and privately held companies to plan a scope of work for 2016.

Project Activities

Outreach to growers, industry professionals, and crop service representatives has been primarily through attendance at conferences, meeting, and email and personal communication.

Trade Conferences:

2016 Potato Expo – Las Vegas, NV
Potato Technology Expo – Charlottetown, PEI
Northeast Potato Technology Forum – Fredericton, NB

Presentations:

“Alternative Crop Opportunities” – 2016 Maine Potato Conference – 250 attendees
“Alternative Crop Economics” – 2016 Agronomy and Soil Health School – 75 attendees
“Viability of Integrating Field Peas into Organic Cereal Grain Rotations in Maine” – 2016 Maine Grain Conference – 85 attendees

Research Projects

“Managing Planting Density of Seed Potato Crops for Production of Whole Seed” – PI
“The Potential of Pulse Crops to Lengthen Potato Crop Rotations in Maine” – PI
“Malting Barley Variety Trial” – in conjunction with University of Maine
“Fall Rye Variety, Seed Treatment, and Seeding Density Trial” – in conjunction with University of Maine

Collaborative Efforts

Assisted US Organic Grain Collaboration with planning their November 2015 conference
Assisted with planning 2016 Maine Grain Conference
Participated in FocusMaine’s “Agriculture Outreach Meeting”
Participated in University of Maine and University of Vermont sponsored trip to Sweden investigating alternative grain production systems and equipment
Assisted with planning 2017 Maine Grain Conference
Assisted US Organic Grain Collaborative in planning and hosting workshops targeting increasing production of organic grains and produce crops in Maine

Grower Projects

Market development and increased production of milling quality bread wheat – 2 growers
Technical support for sunflower production – 3 growers
Technical support for increased cover crop production – 1 growers
Technical support for malt barley production – 1 grower
Assisted with Bruise Testing Program and Sprayer Calibrations

Goals and Outcomes Achieved

Primary goals for this project were to introduce and familiarize the newly hired CDS to the potato industry (growers, industry professionals, University personnel). Presentations at trade conferences from November 2015 through March 2016 focused on presenting background information on alternative

crop possibilities and marketing opportunities as well as agronomic information on their production. Prior to the 2016, the CDS was able to work with a number of growers looking to expand their operations to include a level of alternative crop production. These on farm projects were successful and are likely to continue and expand in the upcoming 2017 growing season. A number of suitable alternative crops have been identified and were grown successfully on a small scale in Northern Maine. Additional work needs to be done to determine if their success can be replicated over several seasons. The marketing potential also needs to be investigated further to determine if these crops may be better suited to larger wholesale growers, smaller scale local niche growers, or both. To date this project has been well received by growers and others in the potato and grain industry.

Beneficiaries

Beneficiaries of this project include the approximately 300 potato growing operations throughout Maine, approximately 85-90 organic and conventional grain growers, 25 industry professionals and crop services representatives, and 5 potato growers who have hosted one or several of the CDS projects.

Lessons Learned

The lack of processing infrastructure in Maine makes developing markets for high value produce crops difficult. Production of alternative, high value produce crops require substantial capital investments from growers for specialized equipment and storage facilities as well as increased managerial resources. Without a defined stable market, these investments are difficult to justify. Research into alternative produce crops is ongoing, however in the meantime, the primary focus of this project to date has been the production of alternative field crops such as pulses, oilseeds, and cereal grains with diverse marketing potential. These crops can be produced using equipment and infrastructure currently existing on most potato operations and are good gateway crops for growers to experiment with as the financial risk is relatively low. While traditional marketing of these alternative field crops will likely not generate the per acre revenue that potatoes do, smaller local and niche markets are being explored that may have the potential to generate revenues substantially greater than traditional small grains.

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Project 5: Maine Potato Integrated Pest Management

Final Report – Previously Submitted

PARTNER ORGANIZATION

Maine Potato Board
University of Maine Cooperative Extension

PROJECT SUMMARY

The management of insects, diseases, and other pests is integral in sustaining the \$500 million Maine potato industry. Without reliable and sustainable pest management strategies, potato growers face the potential for severe crop losses resulting in significant reductions in profits and threats to long-term viability. To ensure an adequate response to the pest-related hazards confronting potato growers, the University of Maine Cooperative Extension Potato Integrated Pest Management (IPM) Program will provide support through field monitoring, disease forecasting, and distribution of educational materials. The program will employ 10 seasonal aides, maintain 200 specialized insect traps, coordinate a statewide network of electronic weather stations, and survey 75 potato fields on a weekly basis. Applied research regarding late blight spore mortality and fungicide residual will aid in the development of a late blight decision support system and information delivery will be enhanced through the development of a late blight smartphone app. The economic impact of the Potato IPM Program on the Maine potato industry has averaged nearly \$14 million for the past five years. With continued funding this program will provide growers with current information on specific and timely pest management strategies in order to minimize pesticide applications and maximize potato yield.

PROJECT PURPOSE

The \$500 million potato industry is the largest agricultural sector in Maine. The management of insects, diseases, weeds, and other pests is integral in sustaining a healthy Maine potato crop. Without reliable and sustainable pest management strategies, Maine's potato industry faces the potential of severe crop losses resulting in significant reductions in profits and threats to long-term viability. The current market demand for perfect, pest and damage-free produce and crops, combined with the public's desire to decrease pesticide use for human health and environmental reasons, comes at a time when Maine potato growers face ever increasing production costs and pest pressure. Potato growers are increasingly relying on a multidisciplinary Integrated Pest Management (IPM) approach to ensure that Maine's potato crop is pest and damage free while attempting to minimize the amount of pesticides that are applied.

The increasing number of emerging pests and diseases in Maine, including potato mop-top virus, necrotic strains of potato virus Y (PVY), white mold, nematodes, and new strains of potato late blight, indicate a significant need for research and educational outreach. Potato wart (a quarantinable pest) has been found in Prince Edward Island and represents a potentially devastating economic impact if found in Maine. In order to mitigate the risks associated with existing and emerging potato pests, a close and direct connection between growers and the University of Maine Cooperative Extension Potato Integrated Pest Management (IPM) Program is vital. Through this project, information gathered through multiple sources, including direct observation, trapping, weather data, and predictive modeling, was delivered to stakeholders in Maine and throughout the region via electronic and standard newsletters, websites, and telephone message centers. The data produced continues to help IPM scientists track potential pest

outbreaks and provides growers with current information on specific and timely treatments in order to minimize the number of pesticide applications and maximize potato yield. This project builds upon previous project funding from the Specialty Crop Block Grant Program (SCBGP) that have allowed for continuation of University of Maine Cooperative Extension's potato pest monitoring and research efforts.

ACTIVITIES PERFORMED

Staff involved:

James Dwyer, Crops Specialist, University of Maine Cooperative Extension
Griffin Dill, IPM Professional, University of Maine Cooperative Extension
James Dill, Pest Management Specialist, University of Maine Cooperative Extension
Steve Johnson, Crops Specialist/Plant Pathologist, University of Maine Cooperative Extension
Dave Lambert, Plant Disease Diagnostician, University of Maine Cooperative Extension
Sean McAuley, Scientific Technician, University of Maine Cooperative Extension
Donald Flannery, Maine Potato Board
Tim Hobbs, Maine Potato Board
Ten seasonal program aides

In cooperation with the Maine Potato Board, University of Maine Cooperative Extension implemented a comprehensive integrated pest management program for potato growers. Ten seasonal program aides surveyed 62 potato fields on a weekly basis during the growing season. These fields were located in the potato producing areas of northern and central Maine. Information from the surveying effort was communicated to the Potato Industry via a weekly newsletter, a website and a telephone hotline. During the growing season, monthly meetings were held with the field and technical staff of local companies, which provide service to potato growers.

A special program was held for field workers to identify Potato Virus Y, Potato leaf Roll Virus, and other potato pathogen symptoms. This training session was targeted towards field workers who surveyed fields for diseased plants. An annual Potato Pest Management Conference was held in December 2014 and the annual Maine Potato Conference was held in January 2015 to update technical field staff and growers on the latest potato pest management research from the University of Maine.

Project Results

For the 2015 crop season the University of Maine Cooperative Extension's Potato IPM program:

Monitored: 62 potato fields on a regular basis.
Operated: 50 Heliothis style pheromone traps for European corn borer.
Operated: 60 sticky type pheromone traps for European corn borer.
Operated: 70 yellow pan water traps for aphid collection.
Operated: 8 pheromone traps for Black cutworm detection.
Operated: 5 Black light traps for European corn borer
Evaluated: 4 aphid trapping techniques at 10 locations as part of a multi-state research project
Established: A series of five 16-foot high tower traps in Aroostook County to monitor aphid species activity and timing of aphid flights

Client contacts made:

2,500 individual personal grower contacts, May through September.

A weekly newsletter with current regional pest updates was emailed to approximately 375 industry staff in Maine, New Brunswick and Eastern United States.

Three issues of Spudlines, a periodic newsletter regarding pertinent potato pest/crop management matters, was distributed to a mailing list of approximately 780 individuals.

Pest information was posted on umaine.edu/potatoes/ipm

Pest information was posted on a telephone hotline which received nearly 2,000 calls June through September.

Cooperation:

Maine Potato Board hosted six monthly meetings for the field and technical staff of companies and agency staff that work with potato growers to get the latest information on pest issues.

Seventy grower cooperators directly participated in the program by having field scouts survey their farms.

Consultants brought disease and insect samples to the Presque Isle Cooperative Extension office and the Pest Management Office in Orono for identification.

Monitored Chain Retailer Stores:

Plant material capable of hosting potato late blight was monitored at chain retailer stores in northern and central Maine. Stores were monitored on a weekly basis. In 2009 potato late blight was detected at multiple big box stores throughout the state of Maine. The infected plant material was being sold and distributed throughout the state. No potato late blight was detected at these stores in 2015.

Trained at Potato IPM Scout School:

Trained 20 individuals including chemical sales staff, on-farm employees, consultants and others.

Training provided information on:

Potato Late Blight identification

aphid identification

European corn borer identification

Colorado potato beetle identification

secondary pest identification

economic thresholds

scouting techniques

insect models for Maine producers

disease models for Maine producers

Trained at Potato Pest Management Conference:

125 individuals attended the December 2014 Maine Potato Pest Management Conference, which updated growers and technical staff on the latest pest management research information, which included:

1. Aphid collection results and management strategies
2. PVY survey and results
3. Potato wart risks
4. Update on potato storage diseases
5. Update from the Maine Board of Pesticides Control

Pheromones ECB
 Vaportape for traps
 Grower report sheets
 Yellow sticky card traps
 PVY test strips
 Yellow paint for water pan traps
 Office supplies
 Hardboard sheets to place traps on
 Flags
 Switches for black light traps
 Sample bags
 Safety equipment
 Eye wash
 Gloves
 Boots
 Leggings
 Total expended..... \$ 12,982

Total Direct Charges \$125,000
 Indirect Charges..... (None Allowed)
 Total Expended \$125,000

GOALS AND OUTCOMES ACHIEVED

A primary goal of this project was to effectively identify and respond to the insect, weed, and plant disease issues facing Maine’s potato growers. Through the intensive monitoring program and subsequent educational outreach (via informational websites, hotlines, newsletters, conferences, and grower meetings) associated with this project, potato pest issues were effectively managed, ultimately resulting in a multimillion dollar economic impact on Maine’s potato industry (as described in the BENEFICIARIES section).

Through the educational outreach associated with this project, additional objectives including an increase in grower awareness of potato pest issues, increased grower knowledge of pesticide risks, and minimization of pesticide use through the implementation of IPM practices, were achieved.

To help quantify and evaluate the goals and outcomes of this project, a written survey was distributed at the 2015 Potato Pest Management Conference with a specific question regarding an increase in grower knowledge. Of the respondents, 100% indicated an increase in knowledge pertaining to pest management. Growers also indicated increased knowledge in the following specific areas:

- Effective management of potato virus Y (12.5% of respondents)
- Aphid management (4.6% of respondents)
- Virus suppression via the use of stylet oil sprays (4.6% of respondents)
- Effective timing/scheduling of pesticide application (1.5% of respondents)

Increased implementation of IPM strategies among program participants was also evaluated through farm survey work completed during the 2015 growing season. The use of stylet oil applications in place of traditional chemical options was recommended as an efficient, low-toxicity method for reducing transmission of stylet-borne viruses. Five years ago only one seed grower was utilizing this practice. The 2015 field survey work indicates nearly a 44% increase in the adoption of this strategy among Maine's potato seed growers. The monitoring of European corn borer (ECB) populations associated with this project also yielded an increase in IPM implementation. As a result of these monitoring efforts, 53% of program participants were able to abstain from applying ECB sprays altogether, while the other 47% were able to reduce applications to just one spray. This signifies a considerable decrease in pesticide use and a significant economic gain for growers. Another change in IPM implementation resulting from this project was in response to growing pesticide resistance among the state's Colorado potato beetle populations. While many growers rely solely on in-furrow treatments to control this pest, 32% of program participants made foliar applications with specially selected products to combat the emergence of resistance.

BENEFICIARIES

The beneficiaries of this project include all of Maine's 400 commercial potato growers and their approximately 57,000 acres of potatoes, national and international growers who rely on Maine's seed potato crop, hobby farmers and backyard gardeners, as well as a multitude of researchers and industry personnel who utilize the information generated from this project.

Economic Impact:

10 seasonal program aides were provided with summer employment.

A written survey was distributed at the December 2015 Potato Pest Management Conference asking attendees to assign a dollar value to determine the conference's economic impact on their operation. The results were as follows:

\$500 - \$1000:	3.1%
\$1000 - \$2000:	1.5%
\$2000 - \$5000:	7.8%
Over \$5000:	28%

Based upon the number of participants, this equates to a **\$222,000** economic impact from the Potato Pest Management Conference.

During the 2015 growing season in Maine potatoes colonizing aphid populations were active at moderate levels during most of the season, but in August colonizing aphid populations, especially Green peach aphids, rose significantly. Non-colonizing aphid populations were very active during the entire growing season. The Potato Industry was alerted to this activity. Some seed growers utilized stylet oil, a non-traditional insecticide because non-colonizing aphids are capable of transmitting Potato Virus Y and traditional insecticides do not prevent these aphids from transmitting virus. It is too early to determine the 2015 economic impact for the project's aphid work, though virus levels were significantly reduced during the 2014 season, representing \$4 million in prevention of crop loss.

Weather conditions during the 2015 growing season were very conducive for the development of potato late blight. Cooperative Extension IPM staff alerted industry personnel to the conducive conditions and recommended specific types and timing of fungicides to best protect the crop taking. Potato late blight did develop in 2015, however, even with the conducive weather conditions, a major potato late blight epidemic was averted. The dollar value of the losses prevented can be estimated in the millions of dollars.

During the 2015, growing season European corn borer activity was generally low; however, some areas of elevated activity were detected. Information collected by the University of Maine Cooperative Extension Potato IPM program indicated that:

53% of the potato growers did not apply a material for ECB
47% of the potato growers applied 1 application of a material for ECB

Using this data to calculate insecticide materials saved and losses avoided, the European corn borer component of the University of Maine Cooperative Extension Potato IPM program had a **\$6,742,500** positive impact on the Maine Potato Industry.

Colorado potato beetles: 32% of the farms made foliar applications to manage Colorado potato beetle populations. This represents a significant increase in Colorado potato beetle activity.

55,000 acres x 32% of farms exceeding threshold = 17,600 acres potentially impacted
17,600 acres x 270 cwt x \$10/cwt x 10% potential yield loss = **\$4,752,000 losses avoided**

Economic impact from the insect monitoring aspect of the program for the 2015 season is currently being estimated at \$11,494,500. With \$95,000 spent on insect pest monitoring and outreach, this represents an estimated 120 to 1 return on investment.

LESSONS LEARNED

As a result of this project, the changing nature of potato pest dynamics has become more evident to the project staff. The emergence of new pest threats as well as the ever changing weather variables forces project staff, growers, and potato industry personnel to adapt pest management techniques to a rapidly evolving system. Weather and changes in pest profiles present a challenge when implementing a crop pest management system. New strains of potato late blight have been introduced into the state of Maine. These new strains have differences in how they react to the weather and their sensitivity to some fungicides.

The issue of non-persistent virus transmission and non-colonizing aphids is a topic on which more research is needed. New strains of potato virus Y have been introduced into North America, which can cause an internal necrosis in potato tubers. These new virus strains have the potential to cause a significant negative impact for seed, table and processing producers.

The European corn borer population in the northern part of the state of Maine appears to be different from the population in central and southern Maine. In the northern area, there appears to be a strain

difference, therefore a combination of pheromone traps and black light traps are utilized. Black light trapping is highly effective, but very costly and very time consuming.

Rain events make keeping regular field monitoring schedules impossible at times. Adapting to weather events is one of the challenges which any field based program encounters.

There is an anticipation that IPM programs will always reduce pesticide usage, due to changing weather and pest pressures, sometimes pesticide usage is reduced and sometimes the usage is increased in order to maintain produce quality. The utilization of an IPM approach in potato cultivation remains popular and continues to increase in use.

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Project 6: Enhancing the Competitiveness of New England Specialty Crops through Regional Collaboration

Final Report

Project Summary

Schools, hospitals, restaurants, and other institutions are more conscious about where the food they're serving is sourced from. Consumers are demanding local food and transparency about where their food is grown. State and federal contracts are including language which stress the importance of buying local or regional food before buying nationally or even internationally.

To meet those demands and requirements schools, institutions, and restaurants are looking to purchase more regional specialty crops but are struggling to do so. This is an area of purchasing which is becoming more and more important yet harder to accomplish.

From an industry perspective, producers are hungry for and always say there is a need for education and educational opportunities. Evaluations from previous HNE-sponsored conferences reinforce this desire. Direct buying and one-on-one meetings with buyers are very uncommon but are expected to be positively received by the industry.

This project broke down barriers to regional specialty crop purchases at the wholesale level by:

Component 1, Producer Education: specialty crop producers had the opportunity to better understand the wholesale buying and marketing opportunities at the 2015 and 2017 Harvest New England Agricultural Marketing Conference and Trade Show.

Component 2, Consumer Education: educating consumers during HNE Day at the 2015, 2016, 2017 Big E, New England's largest agricultural exposition, on the importance of regional food, where they can source it, and the importance of demanding it. This was accomplished through the *Passport to New England* where consumers, both adults and children, had the opportunity to learn about New England specialty crops by engaging in agricultural trivia in each state.

Component 3, Producer Buying Opportunities: Harvest New England in partnership with multiple state-specific groups provided one-on-one matchmaking meetings between wholesaler buyers and wholesale specialty crop producers.

This project built on previously funded projects and complimented and enhanced previous work through the following:

Component 1, Producer Education, Harvest New England Ag Marketing Conference and Trade Show was a component previously funded by the USDA SCBG-FP program. The 2011 and 2013 conference was extremely well received. The survey conducted at the 2013 conference concluded that 78% of respondents said they had an increase in sales as a result of marketing techniques learned at the 2011 and 2013 conference. The difference between the previously

funded conference and the 2017 conference is the specific topic of focus. The focused area in 2011 and 2013 was direct to consumer sales. 2014 SCBG funds has allowed us to build upon the previously established conference and shift the focus for the 2015 and 2017 conference to wholesale marketing and marketing opportunities. New speakers, new tracks, and new seminars and workshop were developed for the 2015 and 2017 conference respectively. The 2011 and 2013 HNE Conference has had great significance to the industry, resulting in a positive impact and change, and is important to the target audience. A record attendance number reinforced the importance of the regional conference. Through continued funding, HNE had the opportunity to expand educational opportunities beyond direct-to-consumer topics and further develop and expand the conference for specialty crop producers.

Project Approach

Component 1, Producer Education, Harvest New England Ag Marketing Conference and Trade Show
In August 2014, the HNE board began planning the 2015 Harvest New England Agricultural Marketing Conference and Trade Show to be held in February 2015. The committee reached out to the Food to Institution New England (FINE) and the MA Association of Agricultural Commissions to create a conference which would work towards solely enhancing the competitiveness of New England specialty crops through wholesale channels. .

A total of 29 breakout sessions and two general sessions were provided to nearly 500 producers, which reported being a specialty crop producer, selling specialty crops or working with specialty crop producers and over 300 trade shower exhibitors and conference presenters.

The keynote speaker, Jonathan Raduns from FreshExpress presented on marketing strategies to improve sales for fresh fruits and vegetables. The general session speaker on day two discussed how to work with and think like a millennial to improve your business.

Other breakout sessions included:

- Branding your product and building a strong brand
- Breaking into the institutional market
- Merchandising and display techniques
- Establishing contracts with institutions
- Finding grant and loans
- Benefits of a marketing co-op
- Working with food hubs and processing centers
- Business succession
- Pros and cons of wholesaling to grocery stores and national chains
- What farmers need to know about selling to a distributor
- Budgeting
- Successful value-added products
- Capitalizing on the farm to table experience

Planning for the 2017 conference began in 2016. The planning committee thought that adding a hands-on options would be well received and two tour agendas featuring specialty crop farms were assembled and promoted. In the end, only enough participants attended to run one tour.

In December, information was released throughout the region by all of the six New England state departments of agriculture. The extent of the promotion in each state varied. Most included email distribution, information in an agency publication, on agency websites and communication to specialty crop commodity associations in each state. Information was also posted on the Harvest New England website and distributed to all previous conference attendees.

New this year, a Facebook event was developed and managed by the New Hampshire Department of Agriculture in conjunction with the registration manager that was hired. This was the first time, HNE had a presence on social media.

Again this year, scholarships were offered through the ME Dept of Ag's SCBG allocation to the conference. 19 scholarships provided New England specialty crop producers the opportunity to attend.

The keynote speaker selected was Craig Ostbo from Koopman Ostbo Marketing Communications in Portland, OR. Mr. Ostbo was the keynote speaker at the National Specialty Crop Block Grant Coordinators Conference in August 2015 and he was willing to travel to the Northeast to be the keynote and general session speaker at the 2017 HNE Conference. His presentations were all very well received and had a great response by attendees.

Component 2, Consumer Education, Harvest New England Day at the Big E HNE Day at the Big E was held again this year on September 29, 2017. All the materials produced for the 2016 event were purchased in a larger, more cost effective in 2016 quantity which allowed for the purchase of materials needed for the event in 2016 and 2017.

The postcards (passports) were distributed on the front lawns of the New Hampshire and Massachusetts/Rhode Island buildings. Here, HNE staff encouraged and explained to Big E attendees how the program worked. The program ran from 10:00 a.m. to 4:00 p.m. Passport go-ers had until 5:00 p.m. to turn in their completed passport in exchange for a reusable bag which promoted New England grown specialty crops.

It was decided the logistics of the program would remain the same as 2015 and 2016; users would pick up their passport and find the stamping location within each building. They would be asked one or two questions about specialty crops within their state to obtain a stamp. Once all six stamps were collected they would complete three additional questions on the postcard about specialty crops and redeem the passport for a reusable specialty crop-themed bag.

Component 3, Producer Buying Opportunities, Matchmaking One-on-Ones:

At a regional level, HNE executed two one-on-one meetings in Maine and one-on-one meetings in NH and MA. All with very positive outcomes as a result of effective partnerships.

In Maine, the first one-on-one's were held at the 75th annual Maine Agricultural Trades Show and they were a success. There were 33 producers who signed up, 9 wholesale buyers, and 9 wholesale related service providers; due to an unfortunate storm weather did impact those able to attend and as a result there were 21 producers, 5 wholesale buyers and 5 wholesale related service providers. The second one-on-one was held at the 76th annual Maine Agricultural Trades Show and proved to be a success, particularly for the producers who were in attendance. This show there were 26 producers, 12 wholesale buyers and 8 service providers.

Goals and Outcomes Achieved

	AWARDED	ACTUAL
GOAL	To educate specialty crop producers and provide buying opportunities between specialty crop producers and wholesale buyers to increase sales and consumption of New England grown specialty crops.	We certainly reached our goal of educating specialty crop producers and providing buying opportunities between specialty crop producers and wholesale buyers with the intention of increasing sales and consumption of New England grown specialty crops.
PERFORMANCE MEASURE	<p>Each component will have a specific performance measure to ensure the overall goal is met.</p> <p><i>Component 1:</i> Specific questions on the evaluation form asking if specialty crop producers are better aware of how to work with wholesalers and institutions and market their specialty crop products as a result of attending the conference.</p> <p><i>Component 2:</i> The number of consumers who complete the passport during the 2015, 2016, and 2017 Big E and the responses to the follow up survey which ask participant to assess their change in knowledge about regionally grown specialty crops and where to source them.</p> <p><i>Component 3:</i> The number of wholesalers and New England producers who participate in the one-on-one buying meetings and follow up survey results afterward.</p>	<p><i>Component 1:</i> Questions were added to the conference evaluation specific to wholesale buying and purchasing and to measure if there was an increase in specialty crop sales as a result of knowledge gained at the HNE Conference.</p> <p><i>Component 2:</i> The number of passports were counted and a follow up survey was answered by participants at the time of participation to assess their change in knowledge.</p> <p><i>Component 3:</i> Pre and post surveys were completed which yielded the results below.</p>

TARGET	Overall, there will be a 15% increase in the amount of New England grown product consumed and purchased.	Data provided by the National Ag Statistic Services is a challenge to compare. The 2012 census vs. the annual surveys do not provide data on the same categories or information on a state and regional level. Therefore it is hard to determine the actual increase in the amount of New England grown product consumed and purchased. However, based on the outcomes mentioned below, one can conclude there has been an increase in purchases and consumption of specialty crops throughout the region though that exact number cannot be determined.
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Major successful outcomes in quantifiable terms:

Component 1, Producer Education, Harvest New England Ag Marketing Conference and Trade Show
According to survey respondents, the benefits of attending the 2015 and/or 2017 Harvest New England Conference are extensive including:

- 58.33% ('15) and 63.16% ('17) of people said it was a great or really great conference
- 36.08% ('15) and 42.6% ('17) of people said their knowledge improved quite a bit or even a ton as a result of attending
- 64% of people said they are better aware of how to work with wholesalers and institutions as result of attending
- 16.87% ('15) and 5.83% ('17) were socially disadvantaged farmers and 19.12% ('15) and 36.46% ('17) have been farming for less than 10 years

Component 2, Consumer Education, Harvest New England Day at the Big E On average, 95% had a change in knowledge about what a specialty crop as a result of participating in the program, 80% said they will eat and buy more New England grown specialty crops and that they now know where to buy New England grown specialty crops. Participants were from the six New England states in addition to New York, Florida, Georgia, Minnesota, Michigan, Tennessee, Pennsylvania, California, Ohio, Texas, Hawaii, and New Jersey.

Component 3, Producer Buying Opportunities

In Maine, advance survey took the form of participant sign up versus actual attendance which was captured at sign in for the event the day of. One of the exciting things for Maine was that there were that we had a 100% repeat attendance from the wholesale buyers and service providers year over year, with others reaching out throughout the year to encourage repeating this event; while there were only 4 repeat producers, the result of a total of 35 producer buying relationships were made during these two years.

In 2016 :

- 33 producers signed up, 21 attended
- 9 wholesale buyers signed up, 5 attended
- 9 wholesale related service providers signed up, 5 attended

In 2017:

26 producers signed up, 18 attended (4 were those who attended the first year)

12 wholesale buyers signed up, 11 attended (5 were those who attended the first year)

8 service providers signed up, 7 attended (5 were those who attended the first year)

Beneficiaries

For each component of this project, the following beneficiary groups can be identified:

Component 1, Producer Education, Harvest New England Ag Marketing Conference and Trade Show

- New England specialty crop producers, approx 750 total in 2015 and 2017.

Component 2, Consumer Education, Harvest New England Day at the Big E:

- New England specialty crop producers
- Fairgoers at the 2015, 2016, and 2016 Harvest New England Day at the Big E.

Component 3, Producer Buying Opportunities

In Maine:

- 35 specialty crop producers
- 11 wholesale specialty crop buyers
- 9 service providers services wholesale specialty crop producers

In NH:

- Eight NH specialty crop producers
- Thirteen NH wholesale specialty crop buyers

In MA:

- Eight MA specialty crop producers
- Ten MA wholesale institutional buyers

Lessons Learned

Component 1, Producer Education, Harvest New England Ag Marketing Conference and Trade Show

Outreach and marketing is key to the success of the conference. In 2017, a registration manager was hired to assist with conference administration (not paid for with Specialty Crop Block Grant Funds) and it made a huge difference. HNE board members were able to promote the conference better and spend more time identifying speakers, etc. We offered a scholarship program (paid for by ME Dept of Ag's SCBG allocation to the conference) and we could have awarded more scholarships but did have enough qualifying applicants. The tours were a nice offering but didn't have the response we were hoping for.

Component 2, Consumer Education, Harvest New England Day at the Big E: The one area that HNE always falls short on is staffing and/or volunteers. HNE members worked the event with only one break throughout the day. Given it's a very outgoing and interactive job, it turns out to be a rather exhausting day. More volunteers would make it a more effective and enjoyable event for all.

Component 3, Producer Buying Opportunities

Overall in Connecticut this activity was a huge disappointment. The state agency had anticipated working with an association that had established relationship with wholesale buyers of specialty crops. When that wasn't feasible in 2016 and logistics of the conference and timing affected an event in 2017 *and* the state agency found themselves short staffed by 50% the availability to organize an event became unmanageable. As a result, increasing efforts at the 2017 HNE Conference was the most logical and realistic use of funds.

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Additional Information

Project 7: Honeybee Exposure To Pesticides In Maine – The Question About Neonicotinoids

Final Report

Project Summary - Neonicotinoid insecticides are commonly used for control of many insect pests in several important Specialty Crops grown in Maine. These insecticides are relatively inexpensive, highly effective in controlling pests, provide persistent control, and have low human toxicity, as far as known. However, neonicotinoid insecticides are banned in many countries in the European Union (Stafford 2013), some landscapes in Canada, and are considered in some US states for a ban. In fact, in the fall of 2013 a bill was introduced into the Maine legislature to ban neonicotinoids temporarily in Maine. This bill was withdrawn before debate. This class of insecticides has been implicated in honeybee colony collapse and other deleterious effects on honeybees and some native bee declines. Bee pollinators are extremely important to the production of many Specialty Crops grown in Maine, specifically the small fruit, tree fruit and the cucurbit crops. However, the data is far from conclusive that these insecticides are the cause of honeybee declines. This is NOT to say that these insecticides are not harming bees. However, in Maine there is almost NO DATA on the exposure that honeybees experience with neonicotinoid insecticides, or for that matter any pesticides. The intent of this proposal is to collect data on honeybee exposure so that informed decisions can be made regarding bee exposure to neonicotinoid insecticides AND other pesticides in different regions and landscapes in Maine. An informed decision on risk due to pesticides cannot be made without information on potential exposure. Quantifiable exposure rate is the FUNDAMENTAL basis for all toxicological risk assessment.

In this project we conducted a statewide survey of pesticide exposure to honey bees. We found that overall exposure was quite low. Agricultural areas had higher levels of exposure, but there was no significant difference in oral or contact risk quotients due to land-use type. We also found that conifer forest was associated with the low exposure rates.

Project Approach - This research project involved one objective. The approach to addressing this objective is described below.

Objective 1: Conduct a statewide survey of pesticide exposure to honey bees by assessing the contamination of pollen collected by foraging worker bees.

Survey. During the winter of 2015, beekeepers throughout Maine were solicited to volunteer their time and colonies to assist in trapping pollen throughout the state. We initially selected beekeepers who had at least two colonies, and represented a diversity of geographic regions in the state and a diversity of landscapes within which their apiaries were imbedded. However, poor overwintering success in many apiaries across the state necessitated finding additional volunteers just prior to the spring. A total of 26 volunteers/sites were involved in this project. In addition,

colonies located in six lowbush blueberry fields were sampled season long by the Drummond laboratory, for a total of 32 sites (Fig. 1). The 32 pollen samples were sent to the Connecticut Agriculture Experiment Station where Dr. Brian Eitzer ran a screen for 166 different pesticides and metabolites using HPLC and mass spectrometry with a modified QuEChERS (for Quick, Easy, Cheap, Effective, Rugged and Safe) procedure.

A general linear model, using data representing each apiary site as a stratum, was used to determine if differences existed between contact and oral risk quotients. Linear regression was used to assess if a constant ratio in difference between contact and oral risk quotients existed. In all cases logarithmically transformed risk quotients were used in our analyses to meet the assumptions of homoscedasticity and normality. General linear models were also used to test if estimated proximate land-use type determined by the volunteer beekeepers (ie. wild blueberry, other agriculture, and non-agriculture) and geographic location in the state (represented by latitude, longitude, and the interaction of the two coordinates) determined pesticide and metabolite concentration, contact risk quotient, and oral risk quotient. The dependent variables were logarithm transformed (base 10) to meet the assumptions of the analyses of variance. Poisson regression was used to test the effect of land use type on the mean number of pesticide and metabolite detections and the Shannon diversity index of pesticide contamination in trapped pollen. To test the hypothesis that apiary sites close in geographic distance are more likely to be exposed to similar measures of pesticide exposure (# detections, ppb, diversity, oral and contact risk quotients) we used a Mantel test. The geographic distance matrix was a squared Euclidean distance and the pesticide exposure matrix with the 5 pesticide exposure measures (defined above) used a Sorenson similarity metric. Both asymptotic and randomization tests were performed.

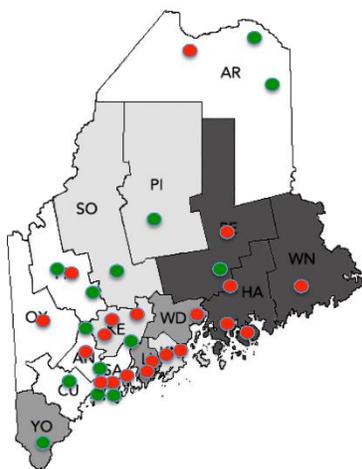


Figure 1. Locations of honeybee colony apiary sites in 2015. Red dots represent the locations of agricultural sites and green dots, non-agricultural sites.

Goals and Outcomes Achieved –

In 2015 we conducted a statewide survey of honeybee exposure to pesticides with assistance of volunteer beekeepers. Pollen trapping was conducted at 32 sites in the spring, summer, and early fall. Apiary locations ranged from unmanaged natural landscapes to managed agricultural or urban landscapes. Pollen samples at each site were aggregated over the collection dates and chemical residue analysis was conducted on each pollen sample for 190 pesticides and metabolites using HPLC/MS. Twenty-five different residues were detected for an average of 2.9 detections per site. Detections were dominated by fungicides, but risk, calculated as: ppb residue concentration / LD₅₀, was mostly due to insecticides. Beekeeper perceived land-use in the vicinity of the apiary was associated with significant differences in the number of detections and residue concentrations, agricultural landscapes being greater than non-agricultural. However, there was no significant difference in oral or contact risk quotients due to land-use type. The landscape composition surrounding apiaries, derived with GIS, determined pesticide exposure for honeybees when total detections, log pesticide residue concentration, and log contact risk quotients were used as measures. Partial least squares explained 43.9% of the variance in pesticide exposure due to landscape composition. The most important predictors describing pesticide exposure were: area (ha) of blueberry, coniferous forest, and urban/developed land cover types. Maine is the most forested state in the U.S. (as determined by % land area forested, 93%) and a negative exponential decay was observed between the land area in conifer forest and the number of pesticide detections per apiary. *We provided a report of our research findings to the Maine State Board of Pesticide Control (via Mr. Gary Fish) and the Maine Senate (via Dr. Jim Dill). Dr. Drummond also presented 1 presentation at the Maine State Beekeeper's meeting in 2015 to recruit volunteer beekeepers for this project and then 6 presentations about the project's findings to Maine beekeeper associations in 2016 and 2017.*

Beneficiaries: The beneficiaries are the approximately 600 Maine beekeepers throughout the state, as well as, state agency officials and the general public who are concerned about bee health and pesticide contamination in our environment. The public will specifically benefit by having a base-line database available regarding pesticide risk to bees. This will serve to inform the public and legislators who wish to introduce legislation regarding pesticide monitoring or regulation in Maine.

Lessons learned.

The main lesson learned is that risk to bees (honey bees specifically) due to neonicotinoids appears to be extremely low in Maine, much less than other more agricultural states in the U.S. In addition, the risk to pesticides in general for honey bees is very low. This is an extremely important lesson because it will allow beekeepers to focus on management of *Varroa* mite as the major cause for colony declines. In coordination with this project and its findings, the Maine Apiculturalist, Ms. Jennifer

Lund, has initiated a major educational program for Maine beekeepers in managing *Varroa* mite.

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Additional Information:

Dr. Drummond has recently submitted a scientific manuscript to a peer-reviewed journal for publication:

Drummond, F.A., E. S. Ballman, B. D. Eitzer, B. Du Clos, and J. Dill. Exposure of honeybee colonies to pesticides in pollen, a statewide survey in Maine. *Environ. Entomol*

Project 8: Increasing The Food Safety Margin Of Wild Blueberries Through Improved Intervention Measures

Final Report - Previously Submitted

PROJECT SUMMARY

The Wild Blueberry Commission of Maine proposes using \$56,875 in Specialty Crop Block Grant (SCBG) funding for the project “Increasing the Food Safety Margin of Wild Blueberries through Improved Intervention Measures”. Dr. Vivian Wu and her research team conducted research to develop effective intervention technologies using chemical washing (chlorine, chlorine dioxide (ClO₂), lactic acid, and ozone) to reduce microbial loading on frozen processed wild blueberries. This project has developed outcomes that increase the margin of food safety for Maine wild blueberries that will protect the consumer and the economic wellbeing of Maine’s 510 growers and the \$250 million economic contribution of wild blueberries to the Maine economy. The efficacy of sanitizers at short contact times in inactivating inoculated foodborne pathogens from the surface of wild blueberries was evaluated. Blueberries were inoculated with a pathogen cocktail. Individual chemical sanitizers and/or combinations were applied with single spray or double spray equipment on the surface of berries. Treated blueberry samples were frozen storage at -17°C for 1 week. Bacterial enumeration was conducted. Results from enumeration show a > 5 log CFU (colony forming unit) pathogenic reduction when the optimal sanitation spraying system was established and spray sanitation measure was coupled with freezing. Specifically, the double spraying treatment of chlorine and lactic acid in combination with freezing resulted in 6.8 log CFU/g (detection limit <1 log CFU/g) reduction of *L. monocytogenes* at 3min contact time. Other double spraying combinations such as chlorine dioxide + chlorine and chlorine dioxide + lactic acid with freezing resulted in > 6 log CFU/g reduction of *L. monocytogenes* at 3min contact. *S. Typhimurium* was reduced to 7.1 log CFU/g (detection limit < 1log CFU/g) with double spraying chemical treatments such as chlorine + lactic acid and chlorine + chlorine dioxide, in combination with freezing. Successful outcomes of the project provides wild blueberry processors with effective intervention methods to increase the food safety margin of the crop.

PROJECT APPROACH:

To help the wild blueberry industry utilize effective intervention methods to maintain and improve the food safety margin for wild blueberries, the first objective was to comprehensively evaluate the decontamination of chemical washing (chlorine, chlorine dioxide, lactic acid, and ozone) on microorganisms associated with wild blueberries using short treatment times by comparing the inoculated berries to those that have not been sanitized.

The effective methods (single or in combination) was then applied in a double spraying system that is similar to the single chlorine spraying system used in the common IQF processing facility (Objective 2 of the project). The optimal method (optimal treatment) was compared with single treatment and the control which, in this case, is the inoculated wild blueberry samples that have not been sanitized, for testing the effectiveness of microbial decontamination.

A bacterial cocktail with two strains each of *S. Typhimurium* (ATCC 6962 and ATCC 14028) and *L. monocytogenes* (ATCC 19115 and ATCC 49554) was used to inoculate the surface of blueberries by a dipping method. Frozen blueberries (25g) without prior washing or decontamination were placed on sterile petri dish and inoculated with 2.5ml of bacterial cocktail suspension prepared for each pathogen. The inoculated blueberries were shaken for 2 minutes at 160rpm (Barnstead Thermolyne, Roto Mix-Type 50800) to allow the attachment of pathogens to blueberries. After 2 min the cocktail liquid was drained out and the berries were dried for about 1-2 hours in a laminar flow hood. The initial level of inoculum on surface of inoculated blueberries was approximately 7 log CFU/g for *S. Typhimurium* and *L. monocytogenes*. Fresh solutions of chemicals in distilled water were prepared the same day of each experiment. The treatments tested included: chlorine (Cl₂, 200ppm), aqueous chlorine dioxide (ClO₂, 15ppm), and lactic acid (2%) for objective-1 and combination chemical sanitizers treatments including chlorine (100ppm) and lactic acid (2%), aqueous chlorine dioxide (10ppm) and lactic acid (2%), chlorine (200ppm) and aqueous chlorine dioxide (15ppm), chlorine (100ppm) and aqueous ozone (5ppm), aqueous chlorine dioxide (10ppm) and aqueous ozone (5ppm), and lactic acid (2%) and aqueous ozone (5ppm) for objective-2 double spray system. The control treatments included distilled water wash and un-treated inoculated blueberries. To imitate industrial setup similar to those used in blueberry processing, a portable conveyer belt with a fixed overhead double spray modified with whirlijet nozzle was designed and used to do the treatments. Inoculated blueberry samples were spread on the conveyer belt and 150ml sterile distilled water (control) or different individual chemical solutions or combination sanitizers for double spray were sprayed from a designated height while the berries were rotated and moved on the conveyer belt. The treated blueberries were left on the conveyer belt for different contact times (10sec, 1min and 3min). To complete the treatment, blueberries from wire screens after contact time were transferred to sterile stomacher bags. To evaluate the efficiency of these chemicals combined with frozen storage, after each treatment time, one set of blueberries was stored at -17°C for 1 week. Bacterial enumeration was conducted before and after freezing.

GOALS and OUTCOMES ACHIEVED:

Two objectives as planned were successfully accomplished:

1. To evaluate the effectiveness of different chemical sanitizers using short contact times in combination with freezing on microbial reduction
2. To develop an effective double spraying system for microbial reduction by combining two chemical sanitizers along with freezing.

Outcomes have been achieved within the scope of this project include:

1. The chemical sanitizers when used for shorter contact times and combined with freezing, effectively reduce the level of foodborne pathogens from the surface of blueberries without adversely affecting berry quality.
2. The use of multiple barriers (hurdles) such as combination of chemicals and freezing storage together, eliminates *L. monocytogenes* and *Salmonella* at significant reductions of at least 5 log CFU.

BENEFICIARIES

The outcomes of this project are to benefit the vast majority of Maine's 510 wild blueberry growers and all value added processors producing or using IQF wild blueberries.

LESSONS LEARNED

This study showed efficacy of effective sanitization protocol which has low-dosages of multiple sanitizer "hurdles" applied together with standard industrial individually quick freezing process without adverse effect on quality of produce. The efficacy of all these sanitizers is increased significantly in inactivating foodborne pathogens, when combined with freezing. The low-dosage chemical sanitizers, when used individually resulted in at least 5 log CFU/g reductions of these pathogens even with short contact times. *L. monocytogenes* populations were best reduced with lactic acid treatment in combination with freezing followed by ClO₂ and Cl₂ (LA > ClO₂ > Cl₂) while *S. Typhimurium* populations were best reduced with chlorine treatment in combination with freezing followed by ClO₂ and lactic acid (Cl₂ > ClO₂ > LA). Our results conclude that, industrial treatment times when used with appropriate and low dosage chemical sanitizer, in combination with freezing can effectively reduce foodborne pathogens to 5 log CFU/g. This multiple "hurdles" protocol developed in this study with double spray combination treatments proved that > 5 log CFU/g reduction of foodborne pathogens can be achieved. Use of the double spraying system with lower and safer concentrations and also more industrial practical time periods will be the most convenient and practical approach for food processors in order to further reducing foodborne pathogens without adversely affecting the quality of produce. As most of these sanitizers are inexpensive, this improved method can also be cost-effective for food processors. Therefore, the food safety margin of blueberries can be increased by incorporating this sanitization strategy into the existing processing protocols.

CONTACT PERSON

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ADDITIONAL INFORMATION

Objective-1: Evaluating the effectiveness of different chemical sanitizers using short contact times in combination with freezing on microbial reduction:

The efficacy of all these sanitizers used in this study increased significantly ($p < 0.05$) in inactivating foodborne pathogens, when combined with freezing at -17°C for 1 week. Treatment with

sterile deionized water did not significantly reduce the levels of the pathogens ($p > 0.05$) as compared with all sanitizer treatments.

Objective- 2: Developing an effective double spraying system for microbial reduction by combining two chemical sanitizers along with freezing.

The concentrations of sanitizer's for double spray combination treatment were chosen after conducting several preliminary studies and based on these studies the best chosen concentrations are: chlorine 100ppm, chlorine dioxide 10ppm, lactic acid 2%, and ozone 5ppm. Chlorine at 100ppm and chlorine dioxide at 10ppm were used for combination treatment with lactic acid and ozone. However, the same concentration of chlorine (100ppm) and chlorine dioxide (10ppm) did not show effective bacterial reductions when these sanitizers were used in combination for synergistic effect in our preliminary studies. So, for chlorine and chlorine dioxide synergistic effect combination, the concentration of chlorine was increased to 200ppm and the concentration of chlorine dioxide was increased to 15ppm.

The synergistic effect of sanitizer combinations used in this study increased significantly ($p < 0.05$) in inactivating foodborne pathogens, when combined with freezing.

This project which imitates industrial conditions is worth to be considered by Maine Wild Blueberry industries, where these conditions can be easily incorporated to possibly eliminate pathogens more effectively.

Project 9: Improving Integrated Pest Management Practices for Maine Wild Blueberry Growers

Final Report - Previously Submitted

PROJECT SUMMARY

Wild blueberries are commercially grown on 44,000 acres in Maine. These fields have been developed from native plants that occur naturally in the understory of the forest. Because of the pruning practices employed, only half of the acres are available to be harvested every year. Most wild blueberry fields are pruned to the ground every other year. In the growing season immediately following the pruning, the vegetative and formative growth takes place. Flower buds are formed during this season. The advent of warmer temperatures, a longer growing season and more uneven precipitation has increased the weed, insect and disease pressures for wild blueberry growers in Maine.

Weed Resistance Issue

The use of a principal herbicide hexazinone to control weeds, with few herbicide alternatives, has resulted in less effectiveness and more shift in weed types resulting in poor weed control and loss in production. Herbicide resistance has not been an issue in the past because of the two year crop cycle that allows herbicide use principally in the non-crop year or prune year. New herbicides with different modes of action are needed to maintain weed control and prevent substantial, if not complete, crop loss.

Implementing an effective IPM weed control program requires multiple control options in different herbicide groupings. Herbicides with similar modes of action are identified by a group number with the same mode of action. Rotating between groups will prevent weed resistance from developing from similar chemistry's that have a specific mode of action. For growers to effectively implement weed IPM they need the control options from different groups, weed identification and mapping techniques, and an understanding of resistant management. IPM practices to use herbicides with different modes of action will be necessary to be successful.

Over the past 30 years wild blueberry yields have increased from an average of 20 to 100 million pounds a year, largely because good weed management which has allowed the use of greater fertility, pollination and irrigation as well as maintain good disease and insect pest controls. If the weeds are not effectively controlled then all other inputs will not maintain the increase in production. Prevention of weed resistance is essential to maintaining and improving the productivity of the wild blueberry industry in Maine.

Disease Issues

Disease occurs when susceptible plants, infective pathogens and suitable weather conditions to cause infection all occur together. Accurate information on disease infection risks allows growers to correctly implement IPM methods to control diseases. Weather data from a network of 15 weather stations will be used to provide information risk for two of the most important diseases for wild blueberries, mummy berry and Botrytis.

Mummy berry disease is caused by a fungus, *Monilinia vaccinii-corymbosi*, and is currently the number one economically damaging disease affecting wild blueberries. Without effective control, this disease can decrease growers' wild blueberry yields up to 80% by killing flower and leaf buds and infecting developing fruit. *Botrytis cinerea* is a fungus that attacks flowers during wet periods and kills the

flowers. The accuracy of the mummy berry forecast also will improve if we understand the timing of production and duration of survival of the fungal structures (apothecia) that produce the infective spores of *M. vaccinii-corymbosi* in the spring.

Wild Blueberry growers utilizing control options within the context of an IPM system are currently using the fungicide, chlorothalonil, to control leaf spot diseases in the prune year. Growers are largely applying this fungicide in late June to control Septoria leaf spot, powdery mildew and leaf rust. Both the fungi causing powdery mildew (*Microsphaera vaccinii*) and leaf rust (*Thekopsora species*) can produce multiple cycles of spores in one season which increases their risk of developing fungicide resistance as does the use of a single fungicide over wide acreage. New materials with different modes of action and biopesticides need to be tested for effectiveness. Resistance management is a key component of a well-designed IPM system. Identifying alternative control options and reduced risk options also reduces market risk when a material becomes unacceptable for use in foreign markets thereby limiting use of a control material.

Insect Pest Issue – Blueberry tip midge

Over the last two seasons growers have been challenged with the new invasive pest, Spotted Winged Drosophila. Recently another pest, the blueberry tip midge *Dasineura oxycoccana* (Gagne 1989), has caused significant crop loss in wild blueberries. This pest is not new to the region, but it appears to have shifted from cranberry onto wild blueberry recently and in some areas of Maine, the pest can be found in fairly moderate to high densities. Dr. Frank Drummond, Entomologist at the University of Maine has shown that blueberry tip midge can cause on average 50% flower bud reduction in 3 out of 4 years due to heavy larval feeding early in the prune year. This phenology suggests that management should be targeted soon after sprout emergence occurs in the prune year. Dr. Drummond will conduct research to determine if a spring focused tip midge IPM program can minimize wild blueberry crop and economic loss.

Insect Pest issue - Common Sap Feeding insects

Observations by researchers in some New Brunswick wild blueberry fields have shown that current prune year fertility and disease management practices may result in plants having an increase in soft, succulent tissue attractive to sap feeding insects that are common in Maine wild blueberries (Lynch, 2014). Excessive feeding by the insects could result in reduced plant health and crop yield. Dr. Drummond will investigate if current fertility and disease management practices are hosting sap feeding insects that are damaging the crop and reducing yield in Maine wild blueberries fields.

PROJECT APPROACH

Weeds

To evaluate herbicides with different modes of action that will effectively control the resistant weed species and to educate growers on management of these weeds by rotating or combining these herbicides to provide effective control and prevent yield reduction from competition of weeds not controlled.

Activities Performed (AP)

Experiments that were conducted to evaluate timing and combinations of herbicides with new modes of action, details of these experiments were provided in the 2015 annual report includes:

Evaluation of fall and spring applications of herbicides targeting resistant weeds in wild blueberry fields

Single vs split applications of post-emergent herbicides for spreading dogbane (*apocynum androsaemifolium*) control in wild blueberry fields

To educate growers on management of these weeds by rotating or combining these herbicides, activities include:

Presentations on weed resistance identification and measures to determine and reduce weed completion to improve yields in 2016 were made at the Agricultural Trade Show in Augusta in January, and at the Wild Blueberry Spring meetings in Waldoboro, Ellsworth and Machias in March, at ICM scouting sessions in Warren, Orland and Jonesboro in April, May and June and at the annual wild blueberry growers field day in July. The 2016 Wild Blueberry Pesticide Charts were updated with new herbicides including the AI/Group numbers needed to manage for weed resistance.

Diseases

To provide growers with data on infection risk for mummy berry and Botrytis, to identify key conditions affecting germination of pseudosclerotia of Monilinia and develop a model of germination, to evaluate fungicides for efficacy in controlling leaf spots.

Activities performed

Thirteen weather stations were deployed from April through May 2015, with the majority by mid-April in time for the disease forecast. We were able to provide forecasts from mid-April to May and then Botrytis reports to mid-June. Disease reports were provided via a blog on the cooperative extension blueberry website, via email list, and as recorded phone messages. Mummy berry, Botrytis, and leaf spots were rated in the fields with weather stations from early June through mid-September as appropriate for each disease. We collected all weather stations in October 2015. We obtained virtual data for 10 of the locations with weather stations from Skybit from April through end of September for comparison to measured weather data from the weather stations.

We set up pseudosclerotia (mummy berries) from 5 blueberry fields in a location at the University of Maine Campus in August 2014. With heavy run off with snow melt, these plots flooded and were underwater for about a week. Attempts made to drain them with a ditch but this was not successful. We were unable to get any useful data out of these plots. The experiment with pseudosclerotia under controlled conditions in the lab was set up in the fall of 2014 and evaluated in 2015.

Six fungicides were tested for their efficacy in controlling leaf spots. The fungicides were applied once in June and leaf loss and disease was rated in August and September. Flower buds and stem length was measured in November 2015.

Insect pests

To develop a safe and effective plan for management blueberry tip midge (BTM) including monitoring, trapping and controls. To determine if fertility practices are hosting sap feeding insects that damage the wild blueberry crop and reduce yield. Disseminate results and management implications for these pests to growers at annual Extension schools.

Activities performed

BTM Monitoring: A good monitoring tool for BTM would be for adult trap captures in yellow bowl traps to precede the onset of damage. I did not find this to be the case in 2014 or in 2015.

Crop Loss from BTM. We conducted a study of crop loss in 2016. Previous studies demonstrated that blueberry plant response in flower-bud production can be quite variable. In 2010-2011 trial we found NO difference in flower-bud clusters per stem due to blueberry tip midge however, stems with blueberry tip midge infestation developed significantly fewer flowers than those without tip midge infestation.

BTM control. In 2014-16 we conducted insecticide trials to determine the best control option for Blueberry tip midge.

Sap Feeding insects and crop loss. Plots were laid out to test for sap feeding insects and fertility treatments were applied to each of 4 plots including a control. Soil and leaf tissue samples were taken at the recommended times in the prune year. Throughout the growing season, into the early fall, standard plant growth parameters were measured in each plot. Leaf spot disease lesions, and sap feeding insect incidence and damage were measured in each plot. Studies were conducted determine the health attributes of clones in the 4 treatment regimes.

Educational sessions were provided to growers about BTM Integrated Pest Management tactics and results and management implications of sap feeding insects on crop loss were presented to growers at the annual Extension Wild Blueberry Schools in 2016.

GOALS AND OUTCOMES ACHIEVED

The experiments listed in the Activities Performed yielded some significant results.

Weeds

Several herbicides, both registered and unregistered, are currently under review for use on wild blueberry. Indaziflam (6.5 oz/a), flumioxazin (12 oz/a), halosulfuron (1 oz/a) and isoxaben (1.33 lb/a) are pre-emergence herbicides, while rimsulfuron (4 oz/a) may be used pre- or post-emergence. Application timings are being refined due to blueberry phytotoxicity after late pre-emergence applications. Examined here are an established problem weed, red sorrel (*Rumex acetosella*), and a newly emerging problem weed, horseweed (*Conyza canadensis*). Red sorrel is resistant to several herbicides, competes with blueberry (may also compete with blueberry rhizome establishment) and the plants are problematic at harvest. The red sorrel treatments were applied to ten plots each on 14 May 2015; five plots were also treated with hexazinone (0.4 gal/a) by the grower (Wyman's of ME, Jonesboro) on the same day. Effects on wild blueberry and red sorrel cover and phytotoxicity, as well as on broadleaf weeds and grasses, were evaluated in June and September. The horseweed treatments were applied to ten plots each on 11 November 2014 (flumioxazin 11/26); five plots were also treated by the grower (Sunkhaze Farm, Township 32) with hexazinone (6.6 pt/a) and diuron (1.6 qt/a, 5/12/15), and mesotrione (3 oz/a, 6/16/15). Effects on wild blueberry cover and phytotoxicity, and horseweed, other broadleaf weed, and grass covers were evaluated in June and July. Horseweed phytotoxicity was not rated as the plants were either dead or unaffected. Data for both trials were analyzed using Tukey's tests to determine significant differences ($\alpha=0.05$). There were no significant differences in wild blueberry cover in the red sorrel trial at either evaluation. Phytotoxicity was initially highest in the halosulfuron treatments, and was significantly higher than all other treatments except rimsulfuron alone; there were

no differences in phytotoxicity by September. There was also initially no differences in red sorrel cover; phytotoxicity was highest in the flumioxazin-grower treatment and was significantly higher compared to the check, indaziflam, halosulfuron and isoxaben. In September, red sorrel cover remained similar in the treatments alone but was almost eliminated in the grower-treatments; phytotoxicity levels reflected this, as red sorrel injury was 90-100% in all grower-treatments. Other weed cover was low, 0-14% cover overall; and there were no differences in broadleaf weed or grass covers at either evaluation. Wild blueberry cover in the horseweed trial was low overall; this was because the horseweed occurred in bare spots at this site. There were no significant differences in blueberry cover at either evaluation. There was no phytotoxicity in the treatments alone in June, but there was delayed phytotoxicity noted in the flumioxazin treatment in July. The grower-treatments resulted in minor phytotoxicity in June in the rimsulfuron treatment, which was only significantly higher than flumioxazin treatment. However, there was significant phytotoxicity in the grower-treatments in July; this was due to injury from the grower applying mesotrione on a hot day between the two evaluation dates. At the June evaluation, horseweed cover was significantly lower in the rimsulfuron treatment compared to the other treatments alone; by July, rimsulfuron remained lowest but was no longer significantly different. There was no horseweed in the grower-treatment plots at either evaluation. Broadleaf weed and grass covers were low in this trial as well. There were no differences in broadleaf weed cover at either evaluation. In June, grass cover was highest in the halosulfuron treatment and was significantly higher than the flumioxazin treatment and all grower-treatments. In July, grass cover in the halosulfuron treatment almost doubled and was significantly higher than the aforementioned treatments, plus indaziflam alone.

Spreading dogbane (*Apocynum androsaemifolium*) is a major weed pest in wild blueberry fields, and is difficult to control with many of the industry's currently registered herbicides. In spring 2015 we initiated a trial at the University of Maine's Blueberry Hill Experiment Station Farm to examine the effect of two newer herbicides, Callisto (mesotrione) and Matrix (rimsulfuron), on dogbane control. Young dogbane was sprayed post-emergence to four 1 x 2 m plots either once at the full rate (Callisto 6 oz/a mixed with Matrix 4 oz/a) or in a split application at the half rate (3 oz/a and 2 oz/a applied two times, respectively), both alone and as tank mixes, for a total of six herbicide treatments. Wild blueberry and dogbane cover and phytotoxicity were compared in June and July to each other, and to an untreated check and the Blueberry Hill Farm's 5/13/15 preemergence application of a mixture of Velpar 2 lb/a, Sinbar 2 lb/a and diuron 1.6 qt/a. Control of other broadleaf weeds and grasses were also assessed. It should be noted that at the June assessment, the split application treatments were assessed just prior to the second herbicide application. Initially in June, all treatments except Matrix at 4 oz/a and the split 2 oz/a treatments had significantly more dogbane injury than the check, but only the Blueberry Hill Farm's treatment significantly reduced dogbane cover. By July, dogbane injury approached 90% in the Callisto split and Callisto+Matrix split applications and dogbane cover was reduced to less than 10%. Dogbane cover was significantly lower in all treatments compared to Blueberry Hill Farm's treatment, but only the two Callisto treatments and the split Callisto (3 oz/a) + Matrix (2 oz/a) treatments were significantly lower than the check. The Callisto and Callisto+Matrix tank mixes resulted in higher dogbane injury and lower cover overall, which suggested that Callisto is more effective in controlling this weed. The lack of total control was due to new dogbane emerging after the herbicide applications; new dogbane shoots were observed at the second application of the split treatments and at the July assessment. The Matrix 4 oz/a and Callisto+Matrix split treatments resulted in slightly lower blueberry cover, but phytotoxicity (chlorosis) was 20% or lower at both evaluations and so was considered acceptable. The split Matrix and Callisto+Matrix treatments resulted in the highest injury by July.

Other weed cover in the plots was very low, below 12% overall; by July there were no significant differences among treatments.

Support from these studies has resulted in a new label for halosulfuron-methyl and an indaziflam label is expected next year so wild blueberry growers will have these herbicides with different modes of action to prevent weed resistance.

Disease

Thirteen weather stations were set up in blueberry fields. We had some hardware difficulties with the weather stations in the spring and so we were not able to get all of the weather stations working at the start of mummy berry season. We had numerous growers and members of the Blueberry Hill Research Farm who monitored mummy berry plots twice a week during the disease period. Throughout the disease risk season from early to late May, we were able to provide multiple forecast reports on mummy berry, as well as, the occurrence of frost for most of the blueberry growing areas. In May and June, we were able to provide some information on Botrytis blight risk to the growers. Due to a format change with the blueberry grower meeting in March, we did not survey growers in March 2015. We did present data on the effectiveness of different timings of fungicide applications for controlling mummy berry and Botrytis to growers. We had cooler conditions in April 2015 which delayed the start of mummy berry season until early May. The apothecia (cups) started to develop in late April, but most fields did not have susceptible plants until early May. The season was about two weeks in most areas with the last possible infection periods near to bloom about May 22nd. It was difficult to determine when the apothecia were gone this year since by May 16th most sites appeared to only have dried up apothecia but then on May 17th and 19th growers found more mature cups in some plots. Most growers reported using at least two applications of fungicides to control disease this year. Control was good in most fields with less than 5% disease, but some fields with inadequate control had up to 33% of stems with disease. Botrytis ranged from 0 to 17% in some fields with weather stations.

We ran into difficulty comparing the real and virtual data when we found the virtual data was estimated at 6ft of the ground and the real weather stations were taking measurements approximately 4 inches off of the ground. This produced a large discrepancy in temperature and length of leaf wetness. The virtual data is being recalculated and we hope to compare the two sets of data in the spring of 2016. We will compare virtual and real data for another year in 2016.

The incubator experiment on pseudosclerotia germination had lower levels of germination than in a previous experiment. There also was a lot of variation in the proportion of pseudosclerotia that germinated in the different fields and so a comparison on the timing of germination between fields was not possible. From pseudosclerotia that did germinate, it was found that pseudosclerotia require at least 900 chill hours before germination and that longer chill hours require less post-chill hours for germination. More structures and apothecia are usually produced with longer chill hours. Apothecia can persist from 2 to 4 days and many pseudosclerotia start germination but do not produce apothecia.

We tested the efficacy of six materials, three currently being used, prothioconazole, pyraclostrobin and boscalid mixture, chlorothalonil and three lower risk materials, *Bacillus subtilis* material, citric extract, and extract from *Reynoutria spp.*, for control of leaf spots. We made a single application of the materials at the end of June and ratings in August, September and November. There was no effect of the

treatments on leaf loss or disease levels in August. Leaf loss ranged from 17 to 22% in August and was consistent among all treatments and the control. Leaf spot diseases were at low levels when measured in August. Septoria leaf spot affected from 1.5 to 5% of leaf area. Powdery mildew as found on less than 4 % of leaf area, and rust was negligible. There was a significant correlation between levels of Septoria leaf spot and leaf loss in August. Levels of leaf loss were higher (25 to 45%) and were significantly different between treatments in September. Leaf loss in September in the prothioconazole, pyraclostrobin and boscalid mixture, chlorothalonil treatments was significantly lower than the control, but *Bacillus subtilis* material, citric extract, and extract from *Reynoutria spp* treatments did not differ significantly from the control. Levels of Septoria and powdery mildew were very low (<1%) in September and not significantly different between treatments. Rust levels in September were higher ranging from 1 to 8% than in August and were significantly lower in the prothioconazole, pyraclostrobin and boscalid mixture, chlorothalonil treatments than in the control. The levels of leaf rust in the *Bacillus subtilis* material, citric extract, and extract from *Reynoutria spp.* treatments did not differ significantly from the control. Rust in September was significantly correlated with leaf loss in September. From measurements in November, there was no significant effect of the treatments on stem length, number of leaf buds, or number of flower buds. There was a significant but weak correlation of higher leaf loss in August correlated with lower levels of leaf buds. There were no significant correlations between leaf loss in September and disease levels or leaf loss in August.

Insect Pests

Blueberry Tip Midge (BTM) First, I conclude, that unlike the situation in cranberry production, yellow bowl traps do not provide a consistent early warning of infestation and timing for insecticide applications. In addition, adult BTM are extremely small and difficult to taxonomically identify. There are several species of Cecidomyiidae where the adults can be confused with those of BTM. Therefore, at present I am not recommending that growers monitor for BTM by deploying yellow bowl traps. However, in wild blueberry I have shown that tip midge can be monitored by assessing the occurrence of the first leaf curl in the field. Insecticide trials timed on this first leaf curl biofix in 2014-2016 resulted in good control of tip midge. The insecticides Rimon, Success, and Entrust or one application of Assail and Mustang Max all are effective against tip midge. But resurgence of damage later in the season suggests that applications must be made continually throughout the period of tip midge attack. My studies have demonstrated that blueberry plant response in flower-bud production can be quite variable often with no significant difference in flower-bud production on infested compared to non-infested stems. In three of the six studies (five years, six locations) in which I have conducted this trial, there was a significant reduction in the numbers of flower bud clusters produced on infested stems. However, when flower number per stem was assessed in five studies (four years, five locations), four of five studies showed a significant potential crop loss in terms of reduced numbers of flowers per stem. I also found that for an average level of production currently in Maine, 3,000 lbs/acre, the economic injury level is about 7-10% infestation (the level where the cost of control equals the cost of crop loss). This is currently, much greater an infestation level than is generally found in Maine when considering tip midge infestation over an entire field.

Outputs: I presented the results of my tip midge research and recommendations in the 2015 Bar Harbor at the WILDBREW meetings, a wild blueberry research meeting for both grower and scientist

attendees³. I also will write a Factsheet on the integrated Pest Management of blueberry tip midge when the last data on flower bud loss is collected (May 2017) from our crop loss trials conducted in 2016. In addition, this last replication of flower bud loss due to tip midge infestation is collected and analyzed I also plan on submitting a manuscript for publication to a scientific journal.

Sap Feeding Insects Determine if current fertility and disease management practices are hosting sap-feeding insects that damage the crop and reduce yield. Results and management implications will be disseminated at grower annual Extension schools in winter 2016.

Effects of Fungicides on Feeding Insects: Four species of sap feeding insects were collected in sweep samples on 2 Jul. I did not observe any effects of the fungicide treatments. It is interesting, that although not significant, there were more of the four species of sap feeding insects in the non-treated control plots than the fungicide treated plots. As far as leaf retention, the fungicide plots had significantly more leaves in October than the non-treated control. The differences were that fungicides had retained more than 90% of their leaves compared to only 75% of the non-treated controls. As far as actual fungal induced leaf spot, we did observe a treatment effect. Pristine + DAP fertilizer resulted in more leaf spot than either Bravo or Pristine without fungicide. The control was not significantly different from any of the other treatments. We also observed no fungicide effects on premature flowering.

Studies to compare stem density, length, branching and number of flower bud clusters. Subplots were pooled within main plots. The only significant difference was in the number of flower bud clusters/stem. Plots treated with Pristine + DAP fertilizer or Bravo had significantly more flower-bud clusters than stems treated with Pristine along or the untreated checks. There were no significant differences in stem density, branching, or stem length among the treatments.

There were significant differences in levels of nitrogen, calcium, potassium, phosphorus, and aluminum among the treatments. Pristine + DAP treatments had significantly more nitrogen and phosphorus than the other treatments. There was also significantly a significant difference in levels of potassium in Bravo-treated plots compared with plots treated with Pristine and mean separation indicated more aluminum in Bravo-treated plots compared with plots treated with Pristine + DAP and higher levels of calcium in the Pristine + DAP treatment than Pristine alone.

As mentioned previously, my analysis of flower-bud clusters in 2015 suggested that Bravo might increase potential yield, but that Pristine will only increase potential yield when nitrogen fertilizer is applied. This did not appear to be the case when plots were re-sampled in 2016. Despite the significant difference in numbers of flower-bud clusters/stem noted in the fall of 2015 there was no significant difference in the subsequent crop year in number of flowers or in yields among the treatments.

³ Drummond, F. and J. Collins. 2015. Effectiveness of insecticides against blueberry tip midge. WildBREW annual meeting, Bar Harbor, ME.

Outputs: A grower presentation on this research was made during the 2016 Summer Field Day in Jonesboro, Maine⁴⁵. We plan on presenting the results through the 2016 field season during the 2017 Blueberry School this coming march. A factsheet will be written after the full two cycles of this study are complete in 2017.

BENEFICIARIES

Maine's 500 wild blueberry growers and six grower/processors will receive tremendous benefits from the results of the research efforts to study to develop appropriate lower risk control measures for resistant grasses and broadleaf weeds and diseases for Maine's 44,000 acres of wild blueberries. Without effective management, the five year average annual yield loss due to herbicide resistance is estimated to be a 50% crop loss.

The estimate of disease losses can be up to 80% of the crop. The wild blueberry industry loss is estimated at 50 million pounds annually or a potential loss of about \$23 to \$40 million in farm gate revenue a year to Maine's wild blueberry growers.

The blueberry tip midge appears to have moved from the southern part of the U.S. to endanger wild blueberry growing areas in Maine. Dr. Drummond's work with blueberry tip midge has been shown to cause 50% flower bud reduction with associated reduction in yield. Growers benefit from study recommendations that add to their management program of this pest.

The public will benefit from production practices that allow growers to produce wild blueberries at an affordable price and volume so that consumers will be able to afford to eat more healthy wild blueberries. The benefits of a healthier society are incalculable.

LESSONS LEARNED

Weeds

The addition of indaziflam and flumioxazin improved the effectiveness of red sorrel control when combined with hexazinone and should be evaluated further. Also, fall timing applications of indaziflam and flumioxazin in the prune year should be evaluated to prevent crop year growth of red sorrel. Horseweed was not resistant to the mixture of labeled herbicides used by the grower, so it is best controlled with spring pre-emergence applications.

The split Callisto treatment was the most effective in controlling spreading dogbane; it resulted in the lowest dogbane cover and greatest dogbane injury along with the split Callisto+Matrix treatment, but considering the two were equal in cover and within 2% of each other in phytotoxicity, the addition of Matrix did not improve the control and therefore is unnecessary.

Disease

⁴ Collins, J. and F. Drummond. 2016. Fungicides and sap feeding insects in wild blueberry. Annual Summer Wild Blueberry Field Day, Jonesboro, ME.

Weather stations provide useful data for disease infection risk, but must be checked for at least one month in advance of deployment to decrease the chance of hardware failure at the critical start of the season. Factors affecting pseudosclerotia germination probably include treatment of pseudosclerotia before chilling periods, soil moisture and temperature, and air temperature. The current fungicides being used for leaf spots appear to have some efficacy in controlling rust but may not be timed for the effective control of Septoria. Earlier timings of applications will be tested.

Insect pests

Conclusions: I have not found any evidence that fungicides applied during the prune year in wild blueberry result in a hazard by increasing sap-feeding insects or stimulate premature flowering. Fungicides do result in significantly greater leaf retention, but not relief from fungus attack to the foliage. Sampling potential yield, measured as flower buds in the spring of 2016 also did not enable me to observe economic benefits of applying fungicides. The main question is whether fungicides, by resulting in leaf retention, increase potential yield the following year. This study has been replicated and the final results will be collected and analyzed at the end of the 2017 field season. Therefore, it is too early to make any recommendations at this point having only completed one replication in time of this study. The two trials of this study have been funded by this project (2015 and 2016) and a subsequent project titled: “Integrated Pest Management Program for Maine Wild Blueberry Growers” that was initiated in 2016 and will be finished in the fall of 2017.

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ADDITIONAL INFORMATION

Identification of modes of action of registered herbicides may be found at:

<https://extension.umaine.edu/blueberries/wp-content/uploads/sites/56/2010/05/2016-Maine-Wild-Blueberry-Pesticide-Chart-Herbicides.pdf>

Weed identification information available for growers on the wild blueberry web site at:

<http://umaine.edu/blueberries/factsheets/weeds/blueberry-weed-images/>

Blog reports on disease can be found at; <https://extension.umaine.edu/blueberries/blog/>

Project 10: Building a Hops Industry in Maine

Final Report – Previously Submitted

Project Partners

University of Maine Cooperative Extension

Project Summary

Maine is a national leader in production of craft beers, yet most are brewed from ingredients grown elsewhere. While local brewers have expressed a strong desire to make their products with local hops, there is presently little growing capacity for this crop in Maine. Development of a successful hops industry requires knowing which varieties are best adapted to Maine's climate, and which have the most desirable brewing characteristics. Resistance to downy mildew, a potentially devastating disease of hops is another important characteristic that needs to be determined. Through 2014 to 2015, we have established a randomized, replicated trial of twelve promising varieties of hops at the Agricultural Experiment Station in Monmouth. Over the next two to three growing seasons, we will evaluate growth characteristics of these plants, including survival, productivity and resistance to downy mildew, to determine the suitability of these plants to Maine growing conditions and to develop recommendations for their establishment and care. The varieties will also be evaluated for brewing and flavoring qualities at the Food Science Laboratory at the University of Maine in Orono. Results of these tests will be shared with growers and brewers through workshops, fact sheets and videos. This project has seen the successful establishment of a trial that will soon provide Maine farmers with critical information for developing successful hop yards, and growing of hops that can further the success of Maine's growing craft beer industry.

Project Purpose

This goal of this project to provide local farmers with the information they need to successfully grow hops to supply the growing craft brewing industry in Maine. The first step toward accomplishing this goal, from a research and education perspective, is the establishment of a replicated trial of hops at the Agricultural Research Station in Monmouth to evaluate plant characteristics, including winter survival, growth rate, maturity date, yield, and disease tolerance of varieties with potential for our unique climate. The objective of this proposal was to establish the hops trial, such that, in the coming seasons, data collected from the trial would form the basis for both locally based horticultural recommendations and guidelines for local brewers wanting to incorporate locally grown hops into their products.

Project Activities

During the 2014-2015 growing seasons, planting of the replicated and randomized trial of hops varieties was completed at Highmoor Farm, the Maine Agricultural and Forest Experiment Station in Monmouth. The twelve varieties comprising the trial were selected in consultation with experts from Cornell University for high survival, yield and flavoring potential. The plants were obtained as tissue culture stock from the Cornell University hops propagation program. During the first season, seven varieties were planted in the trial in early June. Five varieties, which were unavailable at the time of ordering during the first season, were obtained in the spring and planted within the trial with the seven varieties planted the previous year. The plants were spaced five feet apart within rows with fourteen feet

between rows. Each experimental plot has five plants of one variety. Each variety is represented (replicated) three times within the planting in a randomized design for statistical analysis. A fourteen-foot high trellis was constructed to support the bines. During the 2015 growing season the two to three bines from each plant were trained to twine suspended from the trellis overhead. Excess bines were removed. Fertilizer was applied according to Cornell recommendations to each plant in late May. Samples of nine varieties of hops were harvested 16 September 2015 from the trial and sent to the Food Chemical Safety Lab at the University of Maine in Orono to develop protocols to analyze and compare acids and other flavoring components in the cones. During the upcoming seasons, data will be collected on plant characteristics, yield and susceptibility to disease, especially downy mildew. The cones will be harvested from each variety to collect yield data and evaluate characteristics among the varieties. Samples of each variety will be sent to the Food Technology Laboratory at the University of Maine in Orono for flavor component analysis to determine bittering and other flavor characteristics that effect product qualities.

Goals and Outcomes Achieved

- The hops trial proposed for the initiation of this project is now established, with twelve hops cultivars selected for their potential in this region planted over two seasons, and a trellis constructed to support the bines.
- Samples of cones collected from the trial in the second growing season have been sent to the Food Science Laboratory at the University of Maine in Orono to be used to develop protocols to measure chemical characteristics of the different varieties of interest to local brewers. Full analysis of the varieties will be carried out once the plants are fully established (anticipated 2016-17)
- In July of 2015, approximately 30 growers participated in a tour and demonstration of the hops trial as part of a field day sponsored by the Maine Pomological Society and the Maine vegetable and Small Fruit Growers Association. Several farmers commented that they had attended the day specifically to see the trial and the planting generated many questions from the participants.
- As part of the project, we worked with the steering committee of the New England Vegetable & Fruit Conference to develop a special hops session as part of the conference, which will be held in December of 2015.

We anticipate in the coming two to three seasons data collected from the hops trial will generate research-based recommendations for varieties suitable for production in Maine, and provide cultural and pest management practices that promote optimal yields and quality. Data collected from chemical analysis of different hops varieties at the University of Maine Food Technology Laboratory will generate research-based recommendations on flavoring characteristics, such as bittering, and other brewing characteristics, that brewers can use to develop distinct and unique flavor qualities for their products.

Beneficiaries

Maine has over 1000 small, diversified farms that could potentially adopt hops as a crop. In addition, Maine currently has over 60 commercial breweries that would be interested in purchasing locally grown hops. Should the results of this project yield hops varieties with high potential for good production in

Maine and good flavoring qualities, numerous Maine farmers could take advantage of the growing market demand for locally grown hops. Already several small hops plantings are being developed within the state and growers have been seeking information about production practices and variety selection. Maine brewers should soon have access to locally grown hops, which would increase the marketing strength of their products by promoting more Maine ingredients and uniquely Maine qualities.

Lessons Learned

- Based on our experience in getting this trial established, it is clear that tissue-cultured hops plants establish well and have good initial vigor in the first season of growth, while providing a much lower risk of disease infection than plants propagated from rhizomes.
- All varieties within the trial established well, although, based on early observations, we anticipate significant differences in bine vigor and cone quality among the varieties.
- During the late summer of 2015, the bines appeared to be showing reduced vigor as a result of drought stress. We hope to install a simple drip irrigation system to reduce drought stress in the future.
- Foliar disease symptoms were also noted in the summer of 2015, caused by *Alternaria*, a relatively common fungus. Disease management in the form of fungicide sprays will very likely need to be incorporated into any hops production scheme.
- The trellis constructed to support the bines is fourteen feet tall. By the second growing season it is clear that a taller trellis will improve bine growth, and ease harvest time and labor. We intend to modify the existing trellis next season to better accommodate the vigorous bine growth of these plants.
- Enquiries received regarding the trial and interest shown by growers during a summer field day suggest that the information that the generated from this project is needed by potential hops growers, and will help them make appropriate decisions when considering hops as a commercial crop in Maine.

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Additional Information

This project will continue for two more growing seasons, for which funding will be needed to carry out data collection and analysis for the different hops varieties in the trials, and to develop the educational resources to support farmers who want to establish hop yards in Maine.