FY 2015 Specialty Crop Block Grant Program

Maine Department of Agriculture, Conservation and Forestry

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Project 1: Assistance for Specialty Crop Growers Affected by FSMA 2015-2016

By AgMatters LLC

Project Summary—This project provided Specialty Crop growers assistance in understanding how F.S.M.A.'s Produce Safety Rule (PSR) would affect their food growing and harvesting processes. The PSR is the first rule ever to regulate best practices for growing raw agricultural commodities. To date markets have attempted to regulate growth by requiring third party audits of growers specifically to ensure the Good Agricultural Practices are practiced. However growers could choose to sell to markets that did not require audits and by-pass these practices. This rule eliminated that option for many growers, and may also impact the standards of markets. AgMatters LLC took on the impartial role of tutors, supporters, advisors, and advocates to and for these growers in order to create a smooth transition to the implementation of the Rule and to help ensure their continued ability to sell their products and thus their continued financial success.

Project Approach—AgMatters LLC created and shared informational materials with growers outlining what was known about the rule. AgMatters LLC spoke at 10 different venues throughout the year and worked with many growers one on one to educate them as to exactly what the Rule looked like and might mean for their operation.

Goals and Outcomes Achieved—AgMatters LLC goal was to work with 25 growers, in actuality we reached over 141 growers. AgMatters LLC worked cooperatively with the Maine Department of Agriculture, Conservation, and Forestry to ensure that the message was united. We spoke at 10 different commodity meetings to share the message.

Beneficiaries—Maine Specialty Crop growers and markets were kept in the loop of what was happening with the Rule. We worked with over 140 growers who took home the message and shared it with their fellow growers and thus helped to spread the message about what was happening and spurred others to find out more. One must also consider the consumers have benefited in that growers are implementing a prevention model of food safety that has not existed to date.

Lessons Learned—When a new law rolls out, there are always delays. We have learned to adapt. Laws are written so that they must be interpreted to be applied. This has forced us to read as much as possible on updates and to use the TAN for clarification of language. Although these issues did cause frustration with growers, we did the best we could to share accurate information as soon as we got it.

Contact Information—Lauchlin Titus Lauchlin@agmattersllc.com 207-314-2655

Added Information--http://www.agmattersllc.com/

Project 2: Food Safety Audit Preparation Assistance 2015-2016
By AgMatters LLC

Project Summary—Specialty Crop growers want and need assistance with preparation for GAP/GHP audits in order to maintain and/or grow their markets and to produce "safe" food. In Maine, growers who wish to grow their business begin to sell to wholesale accounts. However, these wholesale businesses require some assurance of safety and many requests that growers receive GAP Certification to authenticate their growing and harvesting processes as being "Good Agricultural Practices". This is a new, different, and potentially costly expense for growers and they cautiously approach these new expectations. Are they worthwhile? Will they really make a difference? Do the costs of implementation allow them to continue to be profitable? Growers who are unprepared for an audit may fail the initial audit and still pay for it. It can be assumed that some percentage of these failures will be frustrated and abandon their business expansion plans.

This grant provided this assistance to growers and empowered them to be successful. This grant eased growers into successful certification by taking each through the process as it applied to their operation.

Project Approach—AgMatters LLC held group meetings and one-on-one meetings with growers to assist them in their preparations for their audits. Each session included a farm review, creating a food safety plan, and reviewing the audits the grower needed. Growers were left with a "to do" list and the ability to call, email, or meet again if there were any questions. AgMatters LLC also worked with markets to ensure the understanding of expectations for growers. AgMatters LLC created templates for Food Safety Plans and other resources that were shared with growers as they worked through the process.

Goals and Outcomes Achieved—In 2015-2016 over 43 Maine growers received one-on-one assistance on their farms preparing for food safety audits and in basic food safety and 28 growers received help via phone and computer networking. AgMatters LLC presented at over 15 meetings, including the Maine Agricultural Trade Show and reached over 350 growers through those venues. Materials were brought to each work session and were available on AgMatters LLC's web site for download.

Beneficiaries—There were over 70 growers who directly benefited from this grant by meeting one on one to understand and complete the process for certification. There were many more people who became aware of the process and gained some understanding should they choose to be certified in the future. The Specialty Crop Growers of Maine, Maine Markets, and buyers of local produce benefit from a better understanding of food safety, assistance with applying those principles, and thereby the safer production of Specialty Crops.

Lessons Learned—That there is a continued need for this assistance in Maine.

Contact Information—Lauchlin Titus, Lauchlin@agmattersllc.com 207-314-2655

Added Information--http://www.agmattersllc.com/

Project Title

Provide the project's title. (Must be the same title used in the approved State Plan or amendment.)

Project 3: Establish the Plant Something Marketing Campaign to Support Maine's Nursery and Landscape
Specialty Crop Industry.

Project Impact and Findings

Include a summary of the project results of 250 words or less, suitable for dissemination to the public. A statement of results provides a brief description of your project, its success, and/or lessons learned. A statement of results should:

1. *Include the name of the organization that led and executed the project (State department of agriculture or subrecipient);*
2. *Capture the project's purpose and activities completed;*
3. *Outline the outcomes and indicators achieved, results/important findings and lessons learned; and*
4. *Highlight the target population reached and products developed (including intended use and audience).*

In December 2015, the Maine Landscape & Nursery Association (MELNA) launched a state-wide campaign, *Plant Something! Plant Maine!* (*PSPME!)* by joining *Plant Something*, a grass roots, nationally established multi-media campaign to increase the public's support of local growers, nurseries, garden centers, and landscapers through awareness of the benefits of planting specialty crops for the landscape and garden.

In Maine, we aim to educate potential consumers about the human and environmental benefits of specialty crops produced and marketed by the state's horticulture industry. To that end, MELNA produced a *Plant Something! Plant Maine!* consumer website plantsomethingmaine.org, conducted social media and Maine-branded, statewide television campaigns and created print promotional materials supporting specialty crops for horticulture. Industry support was generated at statewide trade events. Key themes of "plant for better health, economic value, the environment, and your local community" were introduced and featured prominently in all consumer advertising and promotion vehicles and displayed at Maine nurseries and garden centers.

Adopted as a rallying cry and marketing theme by many MELNA members, *Plant Something Maine* is credited with adding value to and helping to build membership in the industry's marketing organization. In the project period, October 2015 to December 2016, *PSPME!* succeeded in building consumer interest and awareness and an online and on-the-ground community around all things related to planting and landscaping in Maine. Greater consumer demand fueled an increase in sales in Maine's nursery and greenhouse specialty crop industry of 22.34%, far exceeding our goal of 10 % sales growth, with a return on investment of $77.44 for every dollar granted.

Beneficiaries

Number of project beneficiaries: Maine's horticulture industry, an important component of the state's natural resource-based economy, is valued at more than $250 million annually. The

industry comprises more than 1,000 firms that collectively employ nearly 12,000 people, with 5,000 of them on a full-time basis.

Activities Performed

Objectives

Provide the approved project's objectives.

#	Objective	Completed?	
		Yes	No*
1	Raise public awareness of, and interest in, the benefits of horticultural specialty crops for human well-being and the quality of the environment, including good nutrition, physical activity, emotional and mental health, financial returns, and ecosystem services like pollinator support, wildlife habitat, home cooling, and reduction of stormwater runoff.	Yes	
2	Improve competitiveness and reduce costs of distribution of specialty crops grown and sold in Maine's horticultural specialty crops industry by rallying member businesses around the nationally successful *Plant Something* program, which has been credited for average increases of 10-15% in the sales of specialty crops in other states.	Yes	
3			
4			

**If no is selected for any of the listed objectives, you must expand upon this in the challenges and lessons learned sections.*

Accomplishments

List your accomplishments for the project's period of performance, including the impact they had on the project's beneficiaries, and indicate how these accomplishments assist in the fulfillment of your project's objective(s), outcome(s), and/or indicator(s).

Program Components	Accomplishment/Impact	Relevance to Objective, Outcome, and/or Indicator
Plant Something Program Development	Assembled and oriented a core marketing and promotion team with a shared vision for *PSPME!*. Held regional meetings with members of the industry to create interest and encourage participation in the *Plant Something* program. Launched *Plant Something* at the Grow Maine Green Expo with standing room only.	All program components contributed to the success of the project and led to enhancing the competitiveness of specialty crops. Industry sales increased through a 22.23% increase from $27,207,698.38 in 2015 to $33,286,743.40 in 2016. Job grew at a rate of 13.1%, from 458 in 2015 to 518 in 2016.
Advertising & Promotion	Established a unified marketing theme and branding – *Plant Something! Plant Maine!* – for Maine's horticulture industry	PSPME! TV spots helped advance key messages around the benefits of planting and

	Large banners and posters displayed at member nurseries and garden centers. Developed and aired TV spots to deliver the key messages of the *PSPME!* campaign and drive traffic to the *Plant Something* website by appealing to multiple consumer segments in Portland and Bangor TV markets.	gardening and drove viewers to the PSPME! website which helped us reach our average monthly goal of 300 visits. A young mom who is also a fitness leader refers to gardening as "relaxing exercise that's part of her family's daily routine," a high school student makes the connection between gardening and helping the environment.
Web, Social and Digital Marketing .	Developed a new website plantsomethingmaine.org an online hub and community of all things related to gardening and landscaping for Maine consumers and the horticulture trade. Built a Facebook page for PSPME!	Average monthly visits exceeded goal of 300. Noteworthy are website session duration, pages/session, extremely low bounce rate and high % of new visitors which is an indicator of audience building. Organic search is strong which proves that people are searching and finding our content. Direct search is also strong which indicates that there were a lot of visitors that knew the URL and came to the site by using it—good brand awareness, probably from offline advertising. 500 Facebook followers gave Maine a ranking of 4th in the nationwide Plant Something Program. $405.28 Facebook advertising spend reached 30,616 people with a total of 55,236 impressions. 6,092 people engaged with our page. 6,595 people viewed our video posts (commercials). 140 Instagram posts resulted in 268 followers with 2,400 "likes" (all organic). 233 Pinterest Pins resulted in 249 average monthly viewers (all organic traffic).
Consumer Events and Workshops	Created Plant Something Maine Weekend Promotion for member nurseries and garden centers. Promoted events and workshops for	Tom Atwell, long-time Maine Sunday Telegram/Portland Press Herald gardening columnist published an article that featured

	organizations and horticulture businesses through email marketing, the *PSPME!* website event calendar and social media.	Plant Something Maine Weekend.
Industry Events and Workshops	Launched *Plant Something! Plant Maine!* at MELNA's Grow Maine Green Expo. Conducted a Social Media Workshop at MELNA's 2016 Fall Education Workshop Series.	Introduced 25 participants to best practices for using/managing a Facebook business page to connect meaningfully with current and potential customers to build lasting relationships.
Industry Marketing Support	Increased statewide visibility of the campaign and obtained $36,000 of additional media exposure by securing participation from the Independent Garden Centers of Maine to brand all of their seasonal television ads with *Plant Something.* Developed a *PSPME!* sponsorship plan with specific participation levels and benefits.	When combined with PSPME! TV campaign described here, we reached 97.1% of our primary demo (women 35-54) an average of 9.3 times and achieved 882 GRPs over the 5-week advertising period. Began to engage vendors and manufacturers to generate interest in supporting and funding *PSPME!* with industry marketing dollars. Attracted additional sponsorship funding and a new source of revenue.
Community Partnership, Sponsorships & Collaboration	Initiated joint promotion opportunities with Coastal Maine Botanical Gardens (CMBG). CMBG Executive Director, Bill Cullina, appeared on camera in a PSPME! TV spot that featured the gardens and touted the benefits of Planting Something!	PSPME! key messages were delivered by a highly respected spokesperson representing a world class public garden and tourism destination. CMBG's email marketing and social media helped expand the reach of the PSPME! campaign.

Challenges

If you experienced any challenges during the project's period of performance, provide a listing of them below. Also, provide the corrective actions you took to address these issues. If you did not attain the approved outcome(s) and indicator(s), provide an explanation in the Corrective Actions column.

Challenge	Corrective Actions
We underestimated the time constraints of small businesses that make up the membership of MELNA.	Reduced number of physical meetings and relied more on email outreach and most recently a webinar. Established a Facebook marketing group to encourage input and feedback.
Average visits to our website fell off a bit before and after peak season as our advertising	Jump started communication and interaction with Maine consumers around the Maine

campaign ended.	Flower Show, with pre-promotion beginning in December, running through January and February and a significant gateway exhibit at the show in March.
Plant Something Maine Weekend was scheduled in May, busiest time of year for most members of MELNA, hindering participation and engagement.	Decided to schedule the event sometime after peak season to maximize participation and extend the promotion period.

Lessons Learned

Provide recommendations or advice that others may use to improve their performance in implementing similar projects

(see challenges)

Continuation and Dissemination of Results (If Applicable)

Describe your plans for continuing the project (sustainability; capacity building) and/or disseminating the project results.

- **Continue efforts to establish a well-supported, self-sustaining marketing and promotion program** to enhance the competitiveness and profitability of specialty horticulture crops in Maine.
- **Raise awareness of the benefits of horticultural specialty crops within the state of Maine**. Increase consistency and outreach to key audiences now somewhat familiar with the *Plant Something* campaign and hence even more likely to understand, and be influenced by, its message.
- **Reach more Maine consumers with greater frequency in peak season**. Add radio advertising and digital marketing to the media mix. Look at adding a "fall is a great time for planting" advertising campaign. Continue to grow the online community and engage more consumers statewide who are interested in gardening and landscaping.
- **Work with members of Maine's horticulture industry to identify and tap into available manufacturer and vendor promotional dollars** to support specific program components of *PSPME!* Continue to expand *Plant Something* media exposure through co-promotion with independent garden centers in Maine.
- **Recruit additional industry participants**.
- **Teach member businesses the value of marketing** and increase involvement in proactive marketing strategies. Fully develop and promote *Plant Something* Maine weekend and increase industry participation and engagement.
- **Step up collaboration with key organizations and businesses statewide**. Increase participation in the online event calendar and social media campaign. Work with Agriculture in the Classroom director and Maine School Garden Network on a plan to contribute Plant Something content/ material to curricula and explore ways to work together to promote school/community gardens. Identify co-promotion opportunities with the Maine Department of Tourism around agritourism. Create a *Plant Something! Plant Maine!* exhibit at the gateway to the Maine Flower Show at Thompson's Point in Portland.

Outcome(s) and Indicator(s)/Sub-Indicator(s)

Provide the results of the project outcome(s) and indicator(s) as approved in your State Plan and project proposal. The results of the outcome(s) and indicator(s) will be used to evaluate the performance of the SCBGP on a national level.

Outcome Measure(s)

Select the Outcome Measure(s) that were approved for your project.

- ☑ **Outcome 1**: Enhance the competitiveness of specialty crops through increased sales
- ☐ **Outcome 2**: Enhance the competitiveness of specialty crops through increased consumption
- ☐ **Outcome 3**: Enhance the competitiveness of specialty crops through increased access
- ☐ **Outcome 4**: Enhance the competitiveness of specialty crops though greater capacity of sustainable practices of specialty crop production resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources
- ☐ **Outcome 5**: Enhance the competitiveness of specialty crops through more sustainable, diverse, and resilient specialty crop systems
- ☐ **Outcome 6**: Enhance the competitiveness of specialty crops through increasing the number of viable technologies to improve food safety
- ☐ **Outcome 7**: Enhance the competitiveness of specialty crops through increased understanding of the ecology of threats to food safety from microbial and chemical sources
- ☐ **Outcome 8**: Enhance the competitiveness of specialty crops through enhancing or improving the economy as a result of specialty crop development

Outcome Indicator(s)

Provide the indicator approved for your project and the related quantifiable result. If you have multiple outcomes and/or indicators, repeat this for each outcome/indicator.

Goal	Performance Measure	Benchmark	Target	Results
Increased sales of horticultural specialty crops in Maine	Compare sales volume of horticultural specialty crops between 2015 and 2016 among participating member firms in MELNA.	2015 sales volume for specialty crops.	10% increase in sales between 2015 and 2016.	*PSPME!* program resulted in a 22.34% increase in sales in Maine's nursery and green-house specialty crop industry, from $27,207,698.38 in 2015 to $33,286,743.40 in 2016. Jobs grew 13.1%, from 458 in 2015 to 518 in 2016.
Increased public awareness of *Plant Some-thing* and the	Measure internet traffic to the *Plant Something* website.	No baseline available (program not yet launched).	300 visitors to the *Plant Something* website each month.	Visits to the website averaged more than 300 each month. Website session duration, pages/session, extremely low bounce rate and high % of new visitors

benefits and methods of planting horticultural specialty crops.				all indicate audience building. Organic search is strong to prove people are searching and finding our content. Direct search is also strong indicating there were a lot of visitors that knew the URL and came to the site by using it—good brand awareness, likely from offline advertising.

Data Collection

Explain what data was collected, how it was collected, the evaluation methods used, and how the data was analyzed to derive the quantifiable indicator.

We surveyed participating nurseries and garden centers in Maine to collect baseline data on sales and number of employees in 2015 and compared the values to data collected on sales and number of employees from 2016. In addition to these outcomes, we utilized Google Analytics data on website activity to assess effectiveness of our marketing campaign by tracking where our website visitors are from, which pages they visit, which links they are clicking, and how long they remain on each page.

Contact Person

Contact Person for the Project Don Sproul, MELNA Executive Director
Telephone Number 207-623-6430
Email Address mngmtplus@aol.com

Federal Project Expenditures to Date

Expenditures

Cost Category	Amount Approved in Budget	Actual Federal Expenditures (Federal Funds ONLY)
Personnel		
Fringe Benefits		
Travel		
Equipment		
Supplies	$8,700.00	$8,700.00
Contractual	$51,050.00	$51,050.00
Other		
Direct Costs Sub-Total	$59,750.00	$59,750.00
Indirect Costs		
Total Federal Costs	$59,750.00	$59,750.00

Program Income

Source/Nature (i.e., registration fees)	Amount Approved in Budget	Actual Amount Earned
MELNA Member Contributions	$2,000.00	$2,145.00
Total Program Income Earned	$2,000.00	$2,145.00

Additional Information

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

Project 4: MAINE POTATO INTEGRATED PEST MANAGEMENT

REPORTING PERIOD (10/1/2014 to 9/30/2015)

PROJECT SUMMARY

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.

PROJECT APPROACH

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
David Lambert, Disease Diagnostician, University of Maine Cooperative Extension
Sean McAuley, Scientific Technician, University of Maine Cooperative Extension
Meghan Dill, Administrative Assistant, University of Maine Cooperative Extension
Donald Flannery, Maine Potato Board
Tim Hobbs, Maine Potato Board
Ten seasonal program aides

Activities Performed:

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:
    1. Potato Late Blight identification
    2. aphid identification
    3. European corn borer identification
    4. Colorado potato beetle identification
    5. secondary pest identification
    6. economic thresholds
    7. scouting techniques
    8. insect models for Maine producers
    9. 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
    6. Weed control and related trials
    7. Late blight update

Trained at Maine Potato Conference:

- 258 individuals attended the January 2015 Maine Potato Conference, which provided growers, technical staff, and potato industry personnel with information regarding:
    1. PVY management
    2. Potato late blight management
    3. Rotation benefits
    4. Pink rot management
    5. Detection and management of wireworms
    6. Detection and management of aphids
    7.

Grant Expenditures:

All funds have been utilized at this date.

Personnel:

IPM Professional (3 months)
Expended amount …… $ 8,493
Scientific Research Specialist (3 months)
Expended amount ……...…… $ 7,842
Scientific Technician (9 months)
Expended amount …… $ 20,223
Seasonal Employees
Ten Seasonal Program Aides ($8.35/hr x 4,800 hrs)
Expended amount.……..... $ 40,080
Subtotal…… $ 76,638

Fringe Benefits

IPM Professional (3 months)
Expended Fringe (at 51.6%) ...……. $ 4,382
Scientific Research Specialist (3 months)
Expended Fringe (at 51.6%) ...……. $ 4,047
Scientific Technician (9 months)
Expended Fringe (at 51.6%) ...……. $ 10,435
Subtotal……. $ 18,864

Travel

Seasonal Extension employees operated from Fort Kent, Maine to Palmyra, Maine, which lie approximately 300 miles apart. The IPM program operated 5 vehicles (4x2 pickups) for personnel transportation. An average of 6,134 miles were traveled per vehicle over the course of 70 days at the University of Maine Motor Pool rate of $0.27 per mile with a $27.45 daily charge per vehicle.

1. Mileage ($0.27 per mile, $27.45 daily charge x 5 vehicles) … **$ 16,516**

Supplies

- Microscope slides
- Sample vials
- Disposable beakers
- 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.

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 2014 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: 14%
- $1000 - $2000: 21%
- $2000 - $5000: 17%
- Over $5000: 48%

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 5: Improving Maine Potato Yields through Increased Rotation Length and Improved Rotation Crop Profitability

Final Report (December 2016 – November 2017)

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's Crop Development Specialist (CDS) is responsible for implementation and oversight of this project. The CDS works in conjunction with growers, the Maine Potato Board Research Committee, the University of Maine Cooperative Extension and various crop service companies on a variety of research projects in support of diversifying and improving potato cropping systems in Maine.

The CDS has assisted in planning potato and crop conferences, research field days and farm tours. Announcements for these events have been made via email and personal communication. Research project results have been presented at conferences and workshops, by request and on the Maine Potato Board webpage.

The CDS actively works by request with growers currently producing or are considering producing alternative crops. Sunflower acreage has increased in response to a growing demand for local birdseed, wheat acreage has increased for the food and beverage industry and pulse crop acreage has increased for the feed and food industry.

Project Results

The 2016 cropping season provided an opportunity to trial several alternative crops on a research scale. Chickpea, lentil, field pea, and flax were grown on an experimental scale in Presque Isle and the project provided valuable information for their consideration as potential crop choices. All crops yielded well and were able to be produced using equipment found on most Maine potato farms. Disease pressure in chickpea and lentil suggested changes in spatial management and fertility may be necessary if they are to be grown on a farm scale.

Two Aroostook County farms agreed to host a project focused on producing whole seed potatoes to reduce the potential spread of bacterial soft rot pathogens through seed cutting. The results from this project suggest producing whole seed potatoes is possible however in order to do so and maximize yields within an acceptable size range, planting and harvesting schedules will need to be adjusted and/or spatial arrangement of seed pieces will need to be altered.

The CDS assisted growers on several projects per their request: market development and production of milling quality bread wheat, sunflower production for the birdseed market, malting barley production and cover crop production.

The CDS collaborated with several groups and institutions in planning conferences, workshops, increasing awareness and demand for organic crops and investigating alternative grain production systems and equipment.

A large-scale project, "Black Bean Production in Maine", was hosted by three Aroostook County farms in 2017. In total, 54 acres of black beans were planted and managed using recommendations from North Dakota, Nebraska, Michigan and New York. Row spacing, fertility practices, herbicide and fungicide use and efficacy and harvest methods were evaluated. Project results suggest black beans can be produced in Northern Maine, however additional research should be done with regards to weed control and harvest procedures. The harvested beans will be marketed locally and to a Northeast processor.

The CDS worked with a local seed dealer to trial several brassica species cover crops. Seeding and fertilizer rates were evaluated at demonstration plots at the University of Maine's Aroostook Research Farm. In addition to brassica species, Italian ryegrass was evaluated over several seeding rates, fertilizer rates and planting dates.

Other projects included evaluating herbicide efficacy on volunteer potato and product efficacy on common scab of potato.

The CDS collaborated with the University of Maine on the "Eastern Spring Barley Nursery" project for a second year as well as planning the 2017 Maine Grain Conference, Maine Soil Health Team and Maine Potato Conference. Other collaborations were with Coastal Enterprises, Inc. on the "Food and Beverage Market Access Evaluation".

Project Activities

Outreach to growers, industry professionals and crop service representatives has been achieved through attendance at trade conferences, presentations at industry meetings, email and personal communication, research projects and grower request projects.

Trade Conferences and Workshops

2016 Potato Pest Conference – Presque Isle, ME
2017 Maine Potato Conference – Caribou, ME
2017 Soil and Agronomy Workshop – Presque, Isle, ME
2017 Maine Soil Health Workshop – Bangor, ME
2017 Northeast Potato Technology Forum - Fredericton, NB

2017 Maine Grain Conference – Littleton, ME
2017 University of Maine Aroostook Farm Field Day, Presque Isle, ME
2017 McCain Foods Research Field Day – Florenceville, NB
2017 NBSCIA/NBDAAF Cereal Plot Tour – Hartland, NB

Presentations

"Pulse Crop Production in Maine" – 2017 Maine Potato Conference – 250 attendees
"Overview of Maine Potato Board Agronomy Program" – Maine Potato Board Meeting – 25 attendees
"Black Beans – Do They Have a Place in Maine Crop Rotations?" – 2017 Soil and Agronomy Workshop – 60 attendees
Overview of Research Activities

- 2017 University of Maine Aroostook Farm Field Day – 25 attendees
- 2017 Maine Potato Board Legislative Tour – 30 attendees

"Managing Volunteer Potato" – 2017 Potato Pest Conference – TBD – December 2017

Research Projects

"Black Bean Production in Maine" – Littleton, New Limerick, and Limestone, ME
"Eastern Spring Barley Nursery" – in conjunction with University of Maine
"Cover Crop Seeding Rate and Fertility Trial" – Presque Isle, ME
"Italian Ryegrass Planting Date Trial" – Presque Isle, ME
Product trial for private company
"Herbicide Efficacy on Volunteer Potato" – Monticello and Littleton, ME

Collaborative Efforts

Assisted with planning 2017 Maine Grain Conference
Participated in Maine Soil Health Team project planning
Participant in CEI/FocusMaine "Food and Beverage Market Access Collaboration"
Assisted with planning 2018 Maine Potato Conference

Grower Projects

Recommended cover crop blends and seeding rates – 3 growers
Assisted with Potato Bruise Testing Program – 11 growers
Sprayer Calibrations – 4 growers
Technical support for sunflower production – 2 grower
Technical support for sweet corn production – 1 grower
Evaluated barley and oat varieties – 1 grower
Recommended control option of volunteer potato – 3 growers

Goals and Outcomes Achieved

Data from 2016 research projects has been compiled and presented to growers via presentations at field days, industry conferences and workshops. Growers were responsive to the information that was presented and feedback spurred ideas several projects for the 2017 cropping season. 2017 cropping season projects included malting barley evaluations, farm scale dry bean production, cover crop species trials and cover crop seeding rates and dates trials. Results and data from the 2017 projects is being compiled and will presented to growers and industry professionals at winter

workshops held from December 2017 through March 2018. Projects that included a field component were highlighted at a field day held at the University of Maine's Aroostook Research Farm in August and as part of the Maine Potato Board's Legislative Tour in July.

Personal communications with growers and crop services personnel led to research projects regarding controlling volunteer potato, technical support for sunflower production, technical support for sweet corn production, recommendations for cover crop blending and seeding rates, and evaluation of barley and oat varieties.

Beneficiaries

Beneficiaries of this project include the approximately 300 Maine potato growing operations, 65-75 organic and conventional grain growers, 20 industry professionals and crop services representatives, and 20 potato growers who hosted projects and requested services from the CDS.

Lessons Learned

Maintaining and increasing potato yield and quality remains the top priority for growers as they consider alternative and rotation crops. In general potato growers are working toward improving soil health and conservation and are selecting rotation crops with these goals in mind.

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Project 6: Building a Hops Industry in Maine
Final Report 2015-16

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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 2016, 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 2015-2016 growing seasons, establishment of the replicated and randomized trial of hops varieties was completed at Highmoor Farm, the Maine Agricultural and Forest Experiment Station in Monmouth. All of the twelve varieties comprising the trial showed excellent survival. The bines produced a small crop of cones in 2015 and most varieties produced a larger crop in 2016. The plants for the trial were obtained as tissue culture stock from the Cornell University hops propagation program. Over the first two years of the trial the twelve varieties were planted in five-plant plots. Each variety is 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 and 2016 growing seasons two to three bines from each plant were trained to twine suspended from the trellis overhead, and excess bines were removed. Fertilizer was applied to the plants according to Cornell recommendations in late May.

Samples of nine varieties of hops were harvested from the trial in September 2015, and eleven varieties in September 2016. Yield data was not recorded from the trial in 2016, due to poor cone size and development as a result of severe drought conditions during the growing season. However, samples were sent to the Food Chemical Safety Lab at the University of Maine in Orono to further develop protocols to analyze and compare acids and other flavoring components in the cones initiated in 2015. Observations of the varieties suggest that the varieties Newport and Cascade produced the highest yields and largest cones in the trial. The variety Saaz preformed very poorly, and was least tolerant of the dry conditions during the 2016 season. In 2017, detailed data will be collected on plant characteristics, yield and susceptibility to disease, especially downy mildew. His will be the third or fourth growing season for plants and they should be reaching their full yield potential.

A twilight meeting for new and potential hops growers was held on 14 September at the Hop Yard in Gorham. Hosts Ryan Houghton, Geoff Keating and Charlie Hamblen toured attendees through their hops growing operation and demonstrated a hops harvester. University of Maine Cooperative Extension Specialists David Handley and Jim Dill talked about the variety trial at Highmoor Farm, and presented information on pest management in hops. Erin Roche, the University of Maine Risk Management Program Manager discussed business planning for hop yards. Twenty-two people attended the meeting.

Goals and Outcomes Achieved

- The hops variety trial now established at the Maine Agricultural and Forestry Experiment Station in Monmouth, with twelve hops cultivars selected for their potential in this region,.
- 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 September of 2016, approximately 20 growers and potential growers of hops participated in a tour and demonstration of a commercial hop yard in Gorham, organized as part of this project to educate growers on the potential of this crop in Maine.
- As part of the project, we are working with the Maine Vegetable & Small Fruit Growers Association, Maine Hops Growers and the Maine Brewers Guild to develop a hops growing

workshop to be held in conjunction with the Maine Agricultural Trades Show in January, 2017.

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 70 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 have established well. Based on early observations, there are significant differences in bine vigor and cone quality among the varieties, as well as tolerance to drought conditions.
- During the summer of 2016, most of the bines were showing reduced vigor as a result of drought stress. This clearly indicates the need for irrigation systems for hops plantings, in order to maintain consistent plant performance from season to season. We hope to install a simple drip irrigation system to reduce drought stress in the future.
- The trellis constructed to support the bines is not adequate for a mature hops planting. Two of the support posts failed during 2016, and have been replaced. The posts and trellis were adapted from a high apple trellis previously planted at the station. It is fourteen feet tall, and worked adequately for the planting year and second season. However, it is now clear that a taller trellis will be needed accommodate bine growth, and to ease harvest time and labor.
- Enquiries received regarding the trial and interest shown by growers during a summer Twilight meeting 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

We anticipate that this project will continue for three 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.

Hops Trial at Highmoor Farm, July 2016

Newport Hops, Highmoor Farm, 2016

Hops harvester demonstration at hops twilight meeting in Gorham, Maine, September, 2016

Project 7: Evaluating a strategy for enhanced plant growth and pest management in organic vegetable production.

FINAL Report 2017 (funding terminated 9/30/2017).

Prepared and Submitted by: Eleanor Groden, December 15, 2017

PROJECT SUMMARY:

Insect-infecting fungi have been formulated as bioinsecticides and have potential for management of insect pests in vegetable and strawberry production. Two of these fungi, *Metarhizium* species and *Beauveria bassiana*, have been shown to colonize the root zone of plants, providing benefits for pest management and stimulation of plant growth. Field application rates required for consistent pest suppression with these microbials can be high and costly. I investigated potential strategies for *cost effective* inoculation of plants for organic vegetable and strawberry production in Maine. By targeting applications at points in production when the inoculum can be conveniently concentrated in the root zone and applied at a high rate relative to the area being treated, more cost effective crop protection may be achieved. For organic vegetable production, many growers start their crops in a greenhouse and transplant 4-6 week old seedlings into the field. This period of production when plant density is high relative to the area /soil volume needed to be treated. We evaluated whether this would provide an optimal time to inoculate crops with these beneficial fungi. Annual organic strawberry production is initiated with transplanting bare-root plants into the field in July for harvest the following May and June. Treatment of the plant roots prior to planting may also provide successful inoculation with the fungi. I worked with an organic grower to apply commercial formulations of two microbials, *Beauveria bassiana* and *Tricoderma* spp., to seedling cabbages in the greenhouse and bare root strawberries prior to planting and measured the benefits for crop vigor, pest reduction, and yields.

PROJECT APPROACH:

THE GOALS AND OBJECTIVES OF this project were 1) to assess the advantages of beneficial insect-infecting fungi for increased pest suppression, plant vigor, and yields in organic vegetables and strawberries; and 2) to incorporate applications of these materials into existing crop production protocols that add convenience for the grower and increased effectiveness of the product. The approach was as follows.

Vegetable Trial: In collaboration with Six River Farm, we planted three successive plantings of two varieties of cabbage (one green and one red) in the farm's greenhouses between April and early June 2016. For each planting, at five to seven and one day prior to transplanting, subsets of the transplants received one of the following treatments sprayed to saturation: *Beauveria bassiana* (Mycotrol-O), *Trichoderma* spp. (RootShield *PLUS*$^{+}$)* or a control of water alone. The commercial formulations of the beneficial fungi were mixed in water and applied at the highest recommended concentration using a handheld applicator. A fourth subset of the transplants were treated with a soil trench of beneficial fungal treatments in the field 5-7 days after transplanting.

Plants were maintained by Six River Farm and cabbage heads were harvested between August and November, 2016.

I proposed to assess the successful colonization of the root zone (rhizosphere) of transplanted cabbage seedlings following treatment applications. Soils were collected from the root zones of plants at planting, 2.5 weeks after transplanting, and 3) at harvest. All soil samples were sieved and stored in the freezer for processing. I had hoped to use a recently published molecular

technique to determine the levels of the beneficial fungi in the soils that we sampled over time after planting. This technique should have been easier, more accurate, less time consuming, and less costly than plating samples on selective media. However, with successive attempts to utilize molecular probes to detect the fungi in the soil samples, we were not able to extract and amplify sufficient and consistent quantities of DNA in test samples with the fungus added. Complex organic compounds in the soils interfered with the extractions and we ran out of resources and time to pursue this further.

We assessed plant vigor, pest presence and damage, and yields between cabbages inoculated with beneficial fungi during the seedling stage in the greenhouse vs. with the traditional soil trench applied in the field. Plants in each planting were sampled for size, health and vigor at 2.5 weeks post transplanting in the field. Cabbage heads were weighed at each harvest, and roots were inspected for any insect or disease damage at harvest.

Strawberry Trial: Two strategies for inoculating annual strawberries with the beneficial fungi were compared in a field trial initiated in early August 2016. Bare-rooted strawberry plants variety Cavendish were treated just prior to planting by soaking their roots in solutions of

Beauveria bassiana (Mycotrol-O), *Trichoderma* sp. (RootShield *PLUS*$^{+}$*)* or a control of water alone. All plants were planted into beds covered by plastic mulch by the Six River Farm crew using their standard procedures. Immediately after planting, a subset of the plants soaked in water were treated with a direct soil drench of either Mycotrol or Rootshield. These soil drench

treatments were repeated on another subset of water soaked plants seven days post planting when roots would have been established. The crop was maintained by the Six River Farm crew and covered with floating row covers in October to protect them through the winter.

As described above, we had planned to assess successful colonization of the root zone (rhizosphere) of transplanted strawberries following treatment, but molecular protocols did not yield consistent results. The remaining resources for the project were applied to assessing yields of the strawberries rather than quantifying levels of the fungi in the soils.

We assessed plant vigor, pest presence and damage, and yields between strawberries inoculated with beneficial fungi preplanting vs. with the traditional soil trench applied in the field.

Plants were sampled for size, health and vigor, and pest damage at 2.5 weeks post transplanting in the field and again in early October before they were covered for the winter.

During the following May and June, in collaboration with Six River Farm Cooperators, we measured the yields in the plots by total volume of marketable strawberries produced from all plants within each plot.

*I had proposed to assess the impacts of the two entomopathogenic fungi products, *Metarhizium sp., Beauveria bassiana,* on plant growth and yields in organic cabbage and strawberry production. However, as no organically certified commercial *Metarhizium* product was available for use in Maine, I switched to assessing the beneficial effects of another beneficial microorganism, *Trichoderma* sp., which is sold as RootShield *PLUS*$^{+}$ by BioWorks, Inc. (Victor, NY).

GOALS AND OUTCOMES ACHIEVED:

Objective 1) Assess the advantages of beneficial insect-infecting fungi for increased pest suppression, plant vigor, and yields in organic vegetables and strawberries.

Vegetable Trial: For all three plantings of cabbage, there were no measurable effects of Mycotrol or Rootshield treatments on plant quality (measure as average plant height, number of leaves, and missing plants per plot), insect presence, and insect damage measured at 2.5 weeks after planting. There were no difference in application methodology or any interactions between these materials and the application methodology. There were flea beetles present on plants in the 3rd cabbage planting, however, no differences in beetle density or feeding was detected between the treatments.

Similarly, analysis of Mycotrol and Rootshield treatments and application strategies resulted in no measurable effects of treatments on cabbage yields in any of the three plantings. Differences were detected between varieties, with higher yields in the red cabbages vs green in the first planting and higher in the green vs red in the 2nd and 3rd planting. However these differences are related to the grower's decision of when to harvest the crops relative to the growth rate and markets for the cabbages rather than any treatment impacts.

*Strawberry Trial:*In both the plant quality assessments at 2.5 weeks after planting and in the fall prior to plants being covered for the winter, we detected no effects of Mycotrol or Rootshield treatments on plant height, leaf number and number of runners. There was some evidence of tip burn and some insect feeding in the fall assessment. However, there was no detectable effect of these treatments or application strategy on tip burn, feeding holes and overall health ratings that were assigned at sampling.

Similarly, analysis of Mycotrol and Rootshield treatments and application strategies resulted in no measurable effects of treatments on strawberry yields the following summer. The mean strawberry yields in both the Mycotrol and Rootshield were higher than the controls (ca. 22%), however, given the high variability, no significant differences were detected. There were no differences in yields between the different application techniques.

Objective 2) Incorporate applications of these materials into existing crop production protocols that add convenience for the grower and increased effectiveness of the product.

Application of microbials in the greenhouse prior to planting for cabbage seedlings, and dipping strawberry plants at planting required the least amount of additional labor for the grower, compared to applying soil drenches in the field. However, given that the neither the soil trenches nor any of the greenhouse treatments impacted cabbage yields, the more efficient strategy is not important.

The 2016 growing season when this trial was conducted was a particularly dry season and drought conditions were experienced on the farm, particularly in the later part of the growing

season. Although the grower collaborator had access to irrigation and did irrigate the fields, overall, the soils were relatively dry. It may be that in a wetter year there would be more plant pathogen and soil borne insect pressure on the cabbage plants than we observed. Examination of the roots of the cabbage at harvest showed very little sign of either insect damage or root rot. Strawberry yields, although not significantly different between treatments, did exhibit a trend of increased yields across all application techniques with the addition of Mycotrol or Rootshield. More trials under different field conditions may clarify the significance of this trend.

Beneficiaries:

The beneficiaries are the 1,473 vegetable producers and 240 strawberry growers in Maine who can use the information generated in this study to decide whether microbial additives will add cost effective benefits for crop yield and quality. In particular, the number of small vegetable farms (less than 25 acres) in the state increased 79% over the five-year period between 2007 and 2012, with 1,249 small farms (85% of all vegetable farms) reporting sales. Organic sales were reported by 554 farms. The general public will benefit from production practices that allow growers to produce crops at an affordable price and volume so that consumers will be able to afford to eat more healthy fruit and vegetables.

Lessons learned:

My results suggest that there may be a benefit from the application of the microbial additives Mycotrol and Rootshield for use in strawberry production, but not for cabbage. That application strategies of applying the materials as a root dip at planting or as a soil drench after root establishment does not differ in its effect.

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Additional Information:

Dr. Groden is scheduled to present the results of this study to vegetable and fruit growers at the Maine Vegetable and Fruit School in Portland and Bangor, Maine in March 2018.

Project 8: Potential lethal synergism of two commonly used pesticides: Effects on honey bees and bumble bees

SCBG CT 20151021*1586
FINAL Report 2017

PROJECT TITLE: Potential Lethal Synergism of Two Commonly Used Pesticides: Effects on Honey Bees and Bumble Bees

PROJECT SUMMARY: This project was conducted over two years, 2016 and 2017. The neonicotinoid insecticide, acetamiprid and the azole fungicide, propiconazole are commonly used in the spring in wild blueberry production. Because of this there is a high likelihood that pollinating bees may be exposed to these pesticides. Previous laboratory studies with honey bee larvae suggested that simultaneous exposure to these two pesticides resulted in high toxicity to acetamiprid when exposure to acetamiprid alone did not reveal a toxic response. Therefore, we conducted a two-year study to determine if

honey bees and bumble bees are at risk when exposed to both of these pesticides simultaneously in the field. In both years, simultaneous exposure of Assail™ (acetamiprid) and Tilt™ (propiconazole) during bloom to honey bees and bumble bees was evaluated.

2016 - While our experiments suggest that field rate concentrations of Assail and a mixture of Assail and Tilt can result in a few detrimental effects to bumble bee and honey bee colonies, synergy characterized by high levels of mortality (800 times that observed with Assail alone in the laboratory) were not observed in the field. Details of our results are presented in the 2016 annual report.

2017 – In our experiment with honey bees we did not find any evidence that the fungicide Tilt or the combination of the fungicide Tilt and the insecticide Assail had a significant effect on colony health. This was true for all of our colony strength measures. In our experiment with bumble bee colonies we did find some significant effects, but not what we expected. We found that Assail actually enhanced the health of bumble bee colonies relative to the control in three measures. The levels of dysentery due to *Nosema bombi* were lower in colonies exposed to Assail than in the controls. The numbers of eggs and in colonies exposed to Assail were greater than in the controls. It has been shown with some species of insects that sub-lethal exposure to insecticides can stimulate development and metabolism. Overall, we did not see any evidence of a negative synergistic effect of the combination of Assail and Tilt on bumble bee health or survival. Details of our results are presented in the 2017 annual report.

<u>In conclusion</u>, our two years of controlled experiments did not provide any evidence that simultaneous exposure to honey bees and bumble bees coming in contact with residues on wild blueberry flowers resulted in detrimental colony effects in the field. Since application of Assail and Tilt are not recommended during bloom, we suspect that significant detrimental effects to colonies of honey bees and bumble bees will not result when these pesticides are used correctly.

PROJECT APPROACH: This project involved both a research component and an educational component to stakeholders. Our research efforts involved two-years of replicated controlled experiments that measured the effects of natural exposure to both bumble bees and honey bees foraging on pesticide contaminated flowers under field cage conditions. After wild blueberry bloom ended, colonies of honey bees and bumble bees were moved to natural non-

managed landscapes and their responses to the exposure, relative to control non-exposed colonies, were measured over the summer and fall.

Our educational outreach involved providing written reports and oral presentations of our research results to blueberry growers, blueberry researchers and extension professionals, honey bee keepers, and graduate and undergraduate students in a honey bee class offered at the University of Maine.

GOALS AND OUTCOMES ACHIEVED:

All of our research and outreach objectives were met during the period that this project was conducted. Our outreach component involved providing written reports in 2016, 2017, and 2018 (to be distributed in January 2019) to the blueberry grower community.

The reports were distributed to the Maine Wild Blueberry Commission Annual Research Reports[1]. Oral presentations were made to blueberry growers in 2016, 2017, and 2018 grower twilight meetings and at the 2017 Wild Blueberry School. Oral presentations were also given to five local Maine beekeeping chapters and at the 2016 annual Maine State

Beekeepers Association Meeting. In addition, in 2016, 2017, and 2018 more than 60 undergraduate and 3 graduate students learned about pesticide exposure effects on honey bees and specifically about the research results of this study.

BENEFICIARIES: The beneficiaries of this funded project were both directly affected stakeholders such as wild blueberry growers and commercial and hobbyist honey bee keepers. In addition, university blueberry researchers and extension professionals were beneficiaries of this project as were graduate and undergraduate students at the University of Maine who participated in Dr. Drummond's beekeeping class. The total number of beneficiaries are hard to estimate, but I know that over 500 Maine blueberry growers, 118 undergraduate students, and more than 300 beekeepers in Maine (estimate from the Maine State Beekeepers Association). The number of beekeepers from outside of Maine that might be beneficiaries of this research is not possible for me to estimate.

LESSONS LEARNED: Synergy among pesticides and the subsequent effects on exposed pollinators is sparsely researched phenomenon. A few of the studies that have been conducted have shown tremendous lethal potential to honey bees that are simultaneously exposed to multiple pesticides. This is troublesome since the majority of pesticide exposures to honey bees, nationally and in Maine, are multiple simultaneous exposures (Ostiguy in press, Drummond et al. 2018)[2]. Our research shows that not all multiple exposures are synergistic and that not all laboratory experimental results

translate to similar observations under field conditions with commercial honey bee and bumble bee colonies. This is very good news first for the pollinators, but also for the beekeepers who are trying to sustain their colonies and for wild blueberry growers who are trying to grow a crop economically in a high-risk environment due to pest attack. The ultimate lesson that was demonstrated by our research is that all initial findings in the laboratory or under restricted field experiments need to be validated in the field under realistic environmental conditions.

[1] Yarborough, D., J. Cote, S. Annis, F. Drummond, and J. Collins. 2018. 2017 Wild blueberry project reports. Maine Blueberry Commission, 175 pp.
Yarborough, Cote, J., Annis, S., F. Drummond, and J. Collins. 2017. 2016 Wild blueberry project reports. Maine Blueberry Commission, 212 pp.

[2] Drummond, F.A., E. S. Ballman, B. D. Eitzer, B. Du Clos, and J. Dill. 2018. Exposure of honeybee colonies to pesticides in pollen, a statewide survey in Maine. Environ. Entomol. doi: 10.1093/ee/nvy023
Ostiguy, N. , F.A. Drummond, F.A. et al. *In Press.* Honey bee exposure to pesticides: a four-year nationwide study. Insects 9:

CONTACT PERSON:

Dr. Frank Drummond

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ADDITIONAL INFORMATION:

One Master's level graduate student, two research technicians, and three undergraduate research assistants assisted in this project. Dr. Drummond is currently writing a manuscript for publication in a scientific journal in order to communicate the results of this study to the scientific community.

FINAL PERFORMANCE REPORT

PROJECT TITLE

Project 9: Preventing Weed and Disease Resistance: Maine Wild Blueberry Integrated Pest Management (IPM)

PROJECT IMPACT AND FINDINGS

Include a summary of the project results of 250 words or less, suitable for dissemination to the public. A statement of results provides a brief description of your project, its success, and/or lessons learned. A statement of results should:

1. *Include the name of the organization that led and executed the project (State department of agriculture or subrecipient);*
2. *Capture the project's purpose and activities completed;*
3. *Outline the outcomes and indicators achieved, results/important findings and lessons learned; and*
4. *Highlight the target population reached and products developed (including intended use and audience).*

We identified new herbicides and fungicides to prevent resistance and effectively communicated the results to the 510 wild blueberry growers who produce 100 million pounds on 44,000 acres in Maine. We evaluated nine combinations of herbicides on three sites with different soil texture, OM and pH. We determined that Zeus Prime XC herbicide was able to control resistant weeds not controlled by conventional herbicides on sites with heavier soils. This provides a new tool for wild blueberry growers to manage weeds more effectively on heavier soils and alerts them to the need to take site conditions into consideration when choosing herbicide treatments. Growers were provided a new weed resistance prevention fact sheet and a table identifying the correct herbicide for effective control. Fourteen blueberry weather stations were used to provide mummy berry and Botrytis disease reports in a year with very high mummy berry disease pressure. We evaluated three new materials for mummy berry control in crop fields and five new materials for leaf spot control in prune fields, respectively. We found Luna Tranquility and Proline decreased mummy berry incidence and Bravo Ultrex and Proline decreased leaf loss in leaf spot trials. The lower risk and organically acceptable materials did not provide effective control. This weed and disease control information was conveyed at our wild blueberry spring meetings where 86% indicated they learned new information, 83% indicated they would use this information in managing their farm and 71% indicated they would adopt at least one different practice.

BENEFICIARIES

Number of project beneficiaries: 510

ACTIVITIES PERFORMED

OBJECTIVES

#	Objective	Completed?	
		Yes	No*
1	Identify the effectiveness and safety of new herbicides and fungicides with different modes of action to determine the proper rate, timing, weed species controlled and crop safety for wild blueberries.	Y	
2	Use the data generated from these field trials to develop an integrated weed and disease management program and demonstrate results to obtain grower acceptance and use.	Y	
3	Identify the effectiveness and safety of fungicides with different modes of action to control mummy berry and to integrate these new materials into a fungicide rotation plan to decrease the chance of fungicide resistance developing	Y	
4	To evaluate new fungicide materials with different modes of action for their effectiveness in controlling the leaf spot diseases, powdery mildew, leaf rust and Septoria, and to integrate these into an integrated pest management plan to control these diseases and maintain crop safety for wild blueberries.	Y	

ACCOMPLISHMENTS

List your accomplishments for the project's period of performance, including the impact they had on the project's beneficiaries, and indicate how these accomplishments assist in the fulfillment of your project's objective(s), outcome(s), and/or indicator(s).

Accomplishment/Impact	Relevance to Objective, Outcome, and/or Indicator
Evaluated nine combinations of herbicides on three sites with different soil texture, OM and pH. Determined that Zeus Prime XC herbicide was able to control resistant weeds not controlled by conventional herbicides on sites with heavier soils.	This provides s new tool for wild blueberry growers to manage weeds more effectively on heavier soils and alerts them to the need to take site conditions into consideration when choosing herbicide treatments.
Published and distributed new *Weed Resistance Prevention Practices for Wild Blueberries* Fact sheet-257at: https://extension.umaine.edu/blueberries/factsheets/weeds/257- weed-resistance-prevention-practices-for-wild-blueberries/ And what weeds are control by what herbicide table	Provides growers the information they need to choose the most effective herbicide for the weeds they have identified. This results in using the most effective input to provide for more effective control of weeds and higher yields.

Used fourteen internet-connected weather stations to provide mummy berry and Botrytis disease reports from mid-April to end of May (18 reports) on blog, email server list and phone messages	This provides growers with information on suitable timing on when they need to apply fungicides to control mummy berry and Botrytis allowing them to decrease applications and costs.
Evaluated three new materials, including a lower risk material for effective control of mummy berry at two sites. The two effective materials have new chemistries and modes of action to current materials.	Provides growers with new materials for control of mummy berry. New options buffer growers against changes in acceptance of fungicides in foreign markets.
Evaluated five new materials at different rates and combinations for control of leaf spots in a prune field. Four of the materials were lower risk or organically acceptable. Found one new material that was effective in controlling leaf loss in August.	New materials with different modes of action provide growers more options for control and buffer against changes in acceptance in foreign markets.

CHALLENGES

If you experienced any challenges during the project's period of performance, provide a listing of them below. Also, provide the corrective actions you took to address these issues. If you did not attain the approved outcome(s) and indicator(s), provide an explanation in the Corrective Actions column.

Challenge	Corrective Actions

LESSONS LEARNED

We had very different results in herbicide efficacy and weeds controlled depending on site conditions, heavier soils and higher organic matter sites had less control with the conventional herbicides used in the past but the herbicide with a combination of carfentrazone and sulfentrazone (group 14 herbicides) was able to control resistant weeds on these heavier soils. It is important to test herbicides under varied soil conditions to determine which herbicides perform best under the varied conditions.

Continuation and Dissemination of Results. We will continue to discuss results at our spring wild blueberry meetings, ICM scouting sessions, the Annual wild blueberry field day and disseminate new information as it becomes available by newsletter, https://extension.umaine.edu/blueberries/newsletters/ and on the wild blueberry web site at: https://extension.umaine.edu/blueberries/. We are also continuing to evaluate new herbicides and fungicides and will be adding an economic analysis to accompany the results.

OUTCOME(S) AND INDICATOR(S)/SUB-INDICATOR(S)

OUTCOME MEASURE(S)

Select the Outcome Measure(s) that were approved for your project.

- ☐ **Outcome 1**: Enhance the competitiveness of specialty crops through increased sales
- ☐ **Outcome 2**: Enhance the competitiveness of specialty crops through increased consumption
- ☐ **Outcome 3**: Enhance the competitiveness of specialty crops through increased access
- ✓ **Outcome 4**: Enhance the competitiveness of specialty crops though greater capacity of sustainable practices of specialty crop production resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources
- ☐ **Outcome 5**: Enhance the competitiveness of specialty crops through more sustainable, diverse, and resilient specialty crop systems
- ☐ **Outcome 6**: Enhance the competitiveness of specialty crops through increasing the number of viable technologies to improve food safety
- ☐ **Outcome 7**: Enhance the competitiveness of specialty crops through increased understanding of the ecology of threats to food safety from microbial and chemical sources
- ☐ **Outcome 8**: Enhance the competitiveness of specialty crops through enhancing or improving the economy as a result of specialty crop development

OUTCOME INDICATOR(S)

Adoption of best practices and technologies resulting in increased yields, reduced inputs, increased efficiency, increased economic return, and conservation of resources

a. Number of growers/producers indicating adoption of recommended practices 200
b. Number of growers/producers reporting reduction in pesticides, fertilizer, water used/acre 200
c. Number of producers reporting increased dollar returns per acre or reduced costs per acre 200

DATA COLLECTION

In 2017 we distributed a survey at our spring wild blueberry meetings in March in Waldoboro, Ellsworth and Machias. For the Weed and fertilizer management strategies for reduced inputs 97% indicated the quality was excellent or good and 98% indicated the importance excellent or good. For the Wild blueberry disease management strategies 96% indicated the quality was excellent or good and 100% indicated the importance excellent or good. Growers (97%) indicated they understood the understood the need for fertilizer reduction and proper weed control. As a result of the meeting, 86% learned new information, 83% indicated they would use this information in managing their farm and 71% indicated they would adopt at least one different practice next year. These results exceed our outcome indicators at 200/510 growers or 40%

CONTACT PERSON

Contact Person for the Project David Yarborough

Telephone Number 207-581-2923

Email Address davidy@maine.edu

FEDERAL PROJECT EXPENDITURES TO DATE

EXPENDITURES

Cost Category	Amount Approved in Budget	Actual Federal Expenditures (Federal Funds ONLY)
Personnel	$51,579	$51,884
Fringe Benefits	$28,111	$27,406
Travel	$7,800	$6,917
Equipment		
Supplies	$2,000	$2,214
Contractual	$9,110	$6,423
Other		$3,539
Direct Costs Sub-Total		
Indirect Costs		
Total Federal Costs	$98,600	$98,383

PROGRAM INCOME

Source/Nature (i.e., registration fees)	Amount Approved in Budget	Actual Amount Earned
Total Program Income Earned		

ADDITIONAL INFORMATION

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

Project 10: Improving Integrated Pest Management (IPM) Practices to Prevent Weed Resistance for Maine Wild Blueberry Growers

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 pressure for wild blueberry growers in Maine.

Weed Resistance Issue

The wild blueberry crop in Maine prior to 1970 was less than 20 million pounds a year. With the registration and use of new selective herbicides terbacil and hexazinone to control weeds, increased inputs of fertilizer, more hives for pollination and use of irrigation when water was limited, the wild blueberry crop increased to a total of 102 million pounds in 2017. Reliance on the use of these two herbicides without alternatives will reduce efficacy and cause a shift in weed types resulting in less weed control and a loss in production. This process occurs as natural selection pressure in nature, since a small population of any weed will be resistant to any control method and then will be released and build up over time to make the treatments no longer effective. This is not just related to chemical selection pressure since weed seedlings in rice which were hand-weeded over time began to resemble the rice plants and so evaded the hand weeding process. Herbicide resistance has recently become a major issue for wild blueberry growers. Past success was sustained because of the two-year crop cycle that allows herbicide use principally in the non-crop year, and because two herbicides, introduced over 40 years ago, had new chemistry that controlled weeds using the same mode of action. We are now beginning to see resistance to these weed control measures. Fortunately, we can continue to control these resistant weeds if we use new herbicides with different modes of action to maintain weed control and thus prevent a substantial, if not complete, wild blueberry crop loss.

This project is important and timely because wild blueberry growers in Maine have noticed weeds, particularly grasses in their fields that were not responding to current IPM control practices since growers were relying primarily on hexazinone and terbacil. Because custom harvesters move between Canada and Maine, there is also an increased potential for the introduction of weed seeds that are resistant to current control options in Maine wild blueberry fields. Researchers documented weed control resistance in Canada over 20 years ago. In Nova Scotia control options were not available and the province experienced a decrease in their crop over a five-year period. Maine wild blueberry growers will need new herbicide chemistry to control resistant weeds and an education program on how to apply the new control options. The next crucial step is to implement resistance management practice to avoid similar and continuing problems into the future.

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 or combining herbicides with

different groups will prevent weed resistance from developing from similar chemistries 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.
Because the most successful time to manage weeds is during the prune year, IPM scouting practices that detect and determine what weeds are prevalent and are not being controlled by current practices, are critical first step in management. Targeted practices such as scouting with weed identification and mapping, together with use of effective herbicides in combinations or rotations in an IPM system will provide the best option for growers to remain profitable and have financial success in growing the Maine wild blueberry crop. Developing new weed control options and educating growers on weed control resistance management before the problems become widespread will prevent significant crop loss and negative economic impact for Maine's Wild Blueberry growers and processors, and the Maine economy.

This project builds on a previous SCRG project *Improving Integrated Pest Management Practices for the wild blueberry crop in Maine* by providing growers with additional information on newly registered herbicides with modes of action that were not available when the previous project was done and with additional presentations at grower meetings and IPM field scouting sessions. In addition, the *Weed Control Guide* Fact sheet and *Wild Blueberry Pesticide Chart for Herbicides* was updated in 2016 and 2017.

PROJECT APPROACH:

To evaluate herbicides with different modes of action that will effectively control the resistant weed species and to develop and deliver a weed resistance IPM program designed for Maine wild blueberry growers.

Work Plan Activities Performed

Experiments that were conducted to evaluate timing and combinations of herbicides with new modes of action, details of these experiments were provided in the 2016 annual report includes:

Evaluation of spring applications of herbicides targeting red sorrel in wild blueberry fields – crop year 2016 results.

Evaluation of spring applications of herbicides targeting red sorrel in wild blueberry fields,

2016-17.

Single vs split applications of post-emergent herbicides for spreading dogbane (*Apocynum androsaemifolium*) control in wild blueberry fields – 2016 crop year results.
Comparison of multiple post-emergence Callisto applications for spreading dogbane (*Apocynum androsaemifolium*) control in wild blueberry fields, 2016 prune year trial.
RESULTS SUMMARY

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

Wild Blueberry Pest Management Update at the Augusta Trade Show on January 14, 2016 where I discussed new and registered herbicides for red sorrel control and presented the results of a study that compared the effectiveness of Calliso and Matrix herbicides with single vs split applications for dogbane control.

2016 Integrated Crop Management Field Training Sessions held in Warren Tuesday, April 26, May 24 and June 28; in Jonesboro Wednesday, April 27, May 25 and June 29 and in Orland Thursday, Thursday, April 28, May 26 and June 30 where I discussed the different modes of action and how these new herbicides could be combined to control resistant weeds and prevent weed resistance in both pre and post emergence applications.

Wild Blueberry Summer Field Day & Meeting at Blueberry Hill Farm, Jonesboro, Maine Wednesday July 20, 2016. I discussed 2016 weed management research and demonstration plots to illustrate the effectiveness of new herbicides and single vs split application of herbicides for dogbane control.

Weed Control Guide Fact Sheet that indicates the timing, rate and target weeds

https://extension.umaine.edu/blueberries/factsheets/weeds/239-weed-control-guide-for-wild-blueberries/ and the *Wild Blueberry Pesticide Chart for Herbicides* which identifies the mode of action and cautions and restrictions of use

https://extension.umaine.edu/blueberries/wp-content/uploads/sites/56/2010/05/2017-Herbicide-Pesticide-Chart.pdf was updated in 2016 and 2017.

In 2017 produced a new Wild Blueberry Fact Sheet No. 257, *Weed Resistance Prevention Practices for Wild Blueberries* on web at https://extension.umaine.edu/blueberries/factsheets/weeds/257-weed-resistance-prevention-practices-for-wild-blueberries/

GOALS AND OUTCOMES ACHIEVED:

We obtained more information on the effectiveness and injury of the new herbicides and used this to determine the proper timing and what weeds would be effectively controlled. We now have two new additional herbicides; Zeus Prime XC (carfentrazone and sulfentrazone) and Rely that have group 14 and group 10 designations, so these materials will also need to be evaluated to be included in the resistance management fact sheet. The fact sheet will be updated when we have sufficient data to include use patterns for all of the new active ingredients that we now have available, this may take two more field sessions depending on the results obtained. A one year project is not sufficient time to develop the information needed.

Growers are familiar with the concept and principles of preventing weed resistance in wild blueberry fields. Our grower survey from the spring meeting indicated that 85% of the growers thought the resistance management presentations were valuable. In a separate grower survey with a response from 161 growers indicated 84% read the newsletter, 59% accessed internet resources, 64% attended field scouting meetings and 49% attended classroom sessions. Growers will be informed of the results of the ongoing research and fact sheets and pesticide charts updated as reliable information becomes available.

BENIFICIARIES:

Maine's 510 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 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 wild blueberry industry loss is estimated at 50 million pounds annually or a potential loss of about $32 million in farm gate revenue a year to Maine's wild blueberry growers and $64 million in value added economic activity in Maine.

The public will also benefit from production practices that allow growers to produce more 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

New herbicides are continually registered without the field trials necessary to determine the proper rate and timing needed to be most effective. Some of these herbicides, indaziflam and halosulfuron methyl, have been shown to cause injury and reduce yields if not applied properly, so evaluation in fields with different soil types, weed pressures and under different environmental conditions over at least two production cycles are required to determine the fit of these new materials in our wild blueberry weed resistance program.

Improving Integrated pest management practices to prevent weed control resistance for Maine wild blueberry growers CT 01A
20151021 * 1589

SCBG RESEARCH BUDGET IPM Invasive Weeds		EXPENSES	
OBJECT CLASS CATEGORIES	TOTAL BUDGET	Expenses to September	
a. Personnel	$23,288.00	$23,577.45	
b. Fringe Benefits	$12,063	$12,544.07	
c. Travel (in-state)	$4,400.00	$2,623.71	
d. Equipment			
e. Supplies	$1,000.00	$870.25	
f. Contractual			
g. Construction			
h. Other	$6,000.00	$7,135.52	
i. Total Direct Charges(sum of 6a-6h)	$46,751.00		
j. TOTALS(sum of 6i and 6j)	$46,751.00	$46,751.00	
PROGRAM INCOME			

$0.00

CONTACT PERSON

Dr. David Yarborough, Telephone: 207-581-2923 Email: Davidy@Maine.edu

ADDITIONAL INFORMATION

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

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

A Pocket Guide to IPM Scouting in Wild Blueberries that can be downloaded to smart phones is on the wild blueberry web site at:

https://extension.umaine.edu/blueberries/factsheets/integrated-crop-management/ipm-scouting-guide-in-wild-blueberries/