V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Plant Protection

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
123	Management and Sustainability of Forest Resources			1%	
136	Conservation of Biological Diversity			3%	
202	Plant Genetic Resources			7%	
204	Plant Product Quality and Utility (Preharvest)			1%	
205	Plant Management Systems			14%	
206	Basic Plant Biology			1%	
211	Insects, Mites, and Other Arthropods Affecting Plants			8%	
212	Pathogens and Nematodes Affecting Plants			16%	
213	Weeds Affecting Plants			22%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants			1%	
215	Biological Control of Pests Affecting Plants			2%	
216	Integrated Pest Management Systems			8%	
311	Animal Diseases			7%	
605	Natural Resource and Environmental Economics			1%	
701	Nutrient Composition of Food			1%	
721	Insects and Other Pests Affecting Humans			7%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	4.9	0.0
Actual	0.0	0.0	5.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	410655	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	630298	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research new ways to control diseases of potato and blueberry. Research new soil management techniques to control weeds. Research biological control of pests of potato, blueberry, other crops, and invasive ant species. Publish peer-reviewed journal articles and other publications concerning research. Present findings at professional meetings and at field days for growers and other venues.

2. Brief description of the target audience

Scientists, extension specialists, pest management professionals, potato, blueberry, and other crop producers in Maine

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010
Plan: 0
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	10	
Actual	0	18	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- # of other types of publications

Year	Target	Actual
2010	8	14

Output #2

Output Measure

- # of papers presented at professional meetings

Year	Target	Actual
2010	30	41

Output #3

Output Measure

- # of research projects completed on ways to protect valuable plant/crop species

Year	Target	Actual
2010	3	2

Output #4

Output Measure

- # of mummy berry forecast systems (MBFS)

Year	Target	Actual
2010	{No Data Entered}	1

Output #5

Output Measure

- # of videos produced on new tools for weed control on organic farms: (1) Prologue: Weedmaster...Why?; (2) Weedmaster Field Trial: Peacemeal Farm; (3) Weedmaster Field Trial: Fisher Farm; and (4) Weedmaster Field Trial: Fail Better Farm.

Year	Target	Actual
2010	{No Data Entered}	4

Output #6

Output Measure

- # of research blogs (see gallandt.wordpress.com),

Year	Target	Actual
2010	{No Data Entered}	1

Output #7

Output Measure

- Maine Invasive Species Network was established following a one-day workshop involving professionals from four universities, several state and federal government agencies, one national park and two non-government agencies.

Year	Target	Actual
2010	{No Data Entered}	0

Output #8

Output Measure

- A survey of the landscape and nursery industry was conducted to identify industry views on invasive plant issues, attitudes towards potential regulation, and to estimate the potential economic costs of banning the sale of specific invasive plant species in Maine.

Year	Target	Actual
2010	{No Data Entered}	1

Output #9

Output Measure

- Website to facilitate future Maine Invasive Species Network projects http://umaine.edu/invasivespecies

Year	Target	Actual
2010	{No Data Entered}	1

Output #10

Output Measure

- Amount of extramural funding awarded to faculty working in this program area during university fiscal year 2010

Year	Target	Actual
2010	{No Data Entered}	1520471

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	% of potato growers familiar with effects of soil management on populations of insect
2	Average density of germinable weed seedbank found by Maine growers adopting ecologically based weed management practices (# of germinable seeds per square meter, 10 cm deep). Weed populations surviving cultivation will not reduce crop yield or quality and
3	Wild blueberry growers in Maine will be able to improve production by proper management of weed and disease pests
4	Wild blueberry growers in Maine will be able to properly identify and respond appropriately to weeds and diseases
5	Wild blueberry growers will make better management decisions on fertilizer and weed control
6	Increase in number of organic potato growers using biocontrol and mutualistic microorganisms to improve disease management, enhance crop yields, and increase soil fertility
7	Number of wild blueberry acres in Maine being treated with control measures for leaf drop diseases
8	Decrease in use of fungicides to control mummy berry disease of wild blueberry in Maine
9	Number of Maine blueberry growers increasing their understanding of mummy berry forecast system (MBFS) to control mummy berry blight in lowbush
10	Number of Maine blueberry growers increasing their understanding of the efficacy of lower risk fungicides to control mummy berry blight
11	Better understanding of the control of late blight in potatoes
12	Maine blueberry growers will increase their awareness of Valdensinia leaf-spot disease
13	Increase in use of commercial bumble bees as pollinators for lowbush blueberry
14	Reduced reliance on insecticides for controlling Colorado potato beetle in Maine potato fields
15	Number of people improving their understanding about how to manage weed seed rain
16	Improved methods for controlling the invasive European fire ant
17	Number of people in Maine trained to identify invasive plants, conduct a field siting and publish their sitings in the VitalSigns system

18	Number of possible biological control agents identified for control of Japanese barberry
19	Number of participants who completed the full-day training session of the Invasive Plant Atlas of New England

Outcome #1

1. Outcome Measures

% of potato growers familiar with effects of soil management on populations of insect

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	25	25

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

Average density of germinable weed seedbank found by Maine growers adopting ecologically based weed management practices (# of germinable seeds per square meter, 10 cm deep). Weed populations surviving cultivation will not reduce crop yield or quality and

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Wild blueberry growers in Maine will be able to improve production by proper management of weed and disease pests

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Wild blueberry growers in Maine will be able to properly identify and respond appropriately to weeds and diseases

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Wild blueberry growers will make better management decisions on fertilizer and weed control

2. **Associated Institution Types**

- 1862 Research

3a. **Outcome Type:**

Change in Action Outcome Measure

3b. **Quantitative Outcome**

Year	Quantitative Target	Actual
2010	100	0

3c. **Qualitative Outcome or Impact Statement**

Issue (Who cares and Why)
Weeds, diseases and vertebrate depredation reduce the yield and quality of wild blueberries. Furthermore, hexazinone, a commonly used herbicide in wild blueberry production, is a known and pervasive groundwater contaminant, due to its high water solubility.

What has been done

MAFES scientists conducted a study to assess the effects of pre-emergence herbicides on wild blueberry cover, phytotoxicity and broadleaf and grass weed cover in spring/summer 2010 using an RCBD design with 6 replications: a check, hexazinone, hexazinone + surfactant, indaziflam, terbacil WP, terbacil WDG, terbacil WDG + mesotrione, pendimethalin and rimsulfuron. Plots were evaluated at one, two, four and eight weeks post-treatment and were analyzed using a nonparametric median two-sample exact test PR<0.05. Treatments were compared individually to the check, to the standard hexazinone and to each other where relevant.

Results
This study illustrated there are several viable options to Velpar, both currently registered and in development, that may be used in rotation to effectively control weeds without significant injury to wild blueberries.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
214	Vertebrates, Mollusks, and Other Pests Affecting Plants

Outcome #6

1. Outcome Measures

Increase in number of organic potato growers using biocontrol and mutualistic microorganisms to improve disease management, enhance crop yields, and increase soil fertility

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Number of wild blueberry acres in Maine being treated with control measures for leaf drop diseases

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Decrease in use of fungicides to control mummy berry disease of wild blueberry in Maine

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

Number of Maine blueberry growers increasing their understanding of mummy berry forecast system (MBFS) to control mummy berry blight in lowbush

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	250

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #10

1. Outcome Measures

Number of Maine blueberry growers increasing their understanding of the efficacy of lower risk fungicides to control mummy berry blight

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	200

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #11

1. Outcome Measures

Better understanding of the control of late blight in potatoes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The combination of the bottleneck requirement of winter survival in diseased potatoes, stricter enforcement of cull pile disposal, and pathogen strains virulent enough to limit viability of fall-infected seed, late blight has the potential for eradication in most U.S. and Canadian growing

regions. Essential to this is the prevention of disease spread in seed prior to planting.

What has been done
MAFES researchers evaluated fungicides for their potential as additives to potato seed treatments, which lack materials effective against late blight. Seven oomycete-specific fungicides were compared with the two fungicides currently labeled for seed treatment, mancozeb and cymoxanil. The fungicides were evaluated for their ability to suppress superficial mycelium and spore production by infected seed pieces, to prevent infection by spores, to prevent infection by mycelium, to not stimulate bacterial development, and to be used at amounts that were economic and not affect shoot emergence.

Results
The scientists found that when applied to seed at 1/10 the amount labeled for the equivalent foliage produced, Forum, Presidio, Reason, Revus Top and Zampro all provided good to excellent suppression of mycelial growth, as did mancozeb. Previcure Flex and cymoxanil did not. All of the materials tested, including commercial mancozeb/bark formulations, prevented infection by spores. However, direct infection by tuber-to-tuber contact was much less sensitive. The researchers believe that recent trends toward lack of adequate seed treatments can be reversed by inclusion of small, inexpensive amounts of systemic oomycete-specific fungicides in or with standard seed protectants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #12

1. Outcome Measures

Maine blueberry growers will increase their awareness of Valdensinia leaf-spot disease

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Valdensinia leaf spot (caused by Valdensinia heterodoxa) causes early leaf drop in lowbush blueberries and in pruned fields can cause complete leaf drop so that no flower buds are produced by infected stems. By June 2009, Valdensinia leaf spot had caused complete defoliation in approximately 40 crop and prune fields in Nova Scotia, and had been found in Quebec and New Brunswick fields. By July 15, 2009, this fungus had been found in Maine wild blueberry fields and garden plantings. This emerging pant disease is new to Maine, so Maine wild blueberry producers need resources and training to spot and deal with the disease.

What has been done
MAFES scientists held grower meetings in 2010 to educate blueberry growers about the differences between Septoria, "false Valdensinia," and Valdensinia leaf spots and their control measures.

Results
There has been an increase in the awareness and knowledge of Valdensinia leaf spot throughout the blueberry growing areas of the state. Due to the identification of Valdensinia leaf spot, growers became more aware of the disease and its effects on lowbush blueberry. Researchers and some blueberry growers are enacting methods to limit the spread of this disease by screening for contamination of equipment and personnel before moving between fields.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
212	Pathogens and Nematodes Affecting Plants
216	Integrated Pest Management Systems

Outcome #13

1. Outcome Measures

Increase in use of commercial bumble bees as pollinators for lowbush blueberry

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Pollination is one of the largest production costs in lowbush blueberry. Maine blueberry growers currently rent more than 75,000 honey bee colonies each year. The recommended honey bee stocking density for lowbush blueberry is 4 hives/acre, although the numbers of colonies rented suggest an actual stocking density of 2.3 hives/acre, but some growers in Washington County, ME, deploy 8 to 10 hives/acre. Given the problems facing honey bees, many blueberry growers are concerned that the current supply of colonies may not continue.

What has been done
To address these concerns, MAFES entomologists are developing and refining recommendations for managing commercial bumble bees as blueberry pollinators.

Results
: Although the project is in its early stages, the researchers have found that Maine lowbush blueberry growers are already increasing the number of commercial bumble bees hives that they use each year. Based on a survey, the scientists found that organic growers rely upon bumble bees the most (31%), comparable to their investment in honey bees (38%). Conventional and no-spray growers use bumble bees at a low rate (8% and 0%, respectively) compared to a relatively high investment in honey bees (75% and 50%, respectively. Twenty-seven percent of IPM growers invest in bumble bees whereas 88% of them rent honey bees.

4. Associated Knowledge Areas

KA Code	Knowledge Area
136	Conservation of Biological Diversity
205	Plant Management Systems

Outcome #14

1. Outcome Measures

Reduced reliance on insecticides for controlling Colorado potato beetle in Maine potato fields

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Colorado potato beetle is an important and costly pest of potatoes. Potato growers need new, environmentally friendly methods to limit damage from these insects.

What has been done
MAFES entomologists are attempting to determine individual- and population-level processes responsible for the decrease in the Colorado potato beetle populations on potato plants grown in manure-amended soils.

Results
Their results provide a tangible incentive for commercial potato growers to use organic soil amendments. Potato plants grown on organically amended soils are less favorable hosts to Colorado potato beetles compared to synthetically fertilized plants, as evidenced by slower beetle development, and, in some cases, increased larval mortality. Adult beetles do not avoid such plants; indeed their recruitment and oviposition might be higher on amended plants early in the season because such plants emerge earlier and have a more vigorous stand. This puts subsequently hatching larvae at a disadvantage, however. As a result, larval populations are commonly lower on amended plots later in the season, while potato yields are higher. Although the observed effects are not sufficiently strong to ensure plant protection without additional insect control measures, they demonstrate an additional benefit of using organic soil amendments.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #15

1. Outcome Measures

Number of people improving their understanding about how to manage weed seed rain

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	200

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
213	Weeds Affecting Plants

Outcome #16

1. Outcome Measures

Improved methods for controlling the invasive European fire ant

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The European fire ant is a stinging, invasive ant that attains extremely high densities in infested properties in Maine, and many people have complained that they are unable to use their gardens, and children and pets can no longer frequent their yards. These ants can be particularly problematic in parks, schoolyards and other suburban landscapes along the coast, because of the issue of human and environmental exposure to pesticides.

What has been done
? MAFES entomologists regularly collected colonies of Mymrica rubra from infested sites in coastal Maine, holding them for several weeks to observe for mortality. They dissected dying and dead ants and observed them microscopically or surface sterilized and incubated them for emergence of nematode or fungal pathogens. The scientists assessed pathogenicity when possible with reinfection assays. They also explored the culture and production of pathogens on artificial media and in vivo, and looked at methods for facilitating infection.

Results

The researchers found that a number of natural enemies infect the European fire ant in Maine. They are exploring the potential of these natural enemies to infect various life stages of the ants and how they may impact the behavior of colonies. The scientists have found that the ants do not avoid soil treated with inoculum of pathogenic fungi. Worker ants readily crossed and tunneled through fungal treated soil in order to acquire food, and colonies exposed to the treated soil experienced significantly higher mortality than controls. They also found that deployment of food bait stations placed in the center of - m diameter area treated with B. bassiana experienced reductions in ant activity at 8 weeks post treatment. This management approach could result in lower densities and fewer problems associated with these ants.

4. Associated Knowledge Areas

KA Code	Knowledge Area
721	Insects and Other Pests Affecting Humans

Outcome #17

1. Outcome Measures

Number of people in Maine trained to identify invasive plants, conduct a field siting and publish their sitings in the VitalSigns system

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	32

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity

202	Plant Genetic Resources
205	Plant Management Systems
206	Basic Plant Biology
605	Natural Resource and Environmental Economics

Outcome #18

1. Outcome Measures

Number of possible biological control agents identified for control of Japanese barberry

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results
Experiments to identify symbionts associated with invasive populations of Japanese barberry in Acadia National Park led to the identification of a fruit fly, Rhagoletis meigenii, in the barberry fruits. This is being explored as a possible biological control agent.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
202	Plant Genetic Resources
205	Plant Management Systems
206	Basic Plant Biology
605	Natural Resource and Environmental Economics

Outcome #19

1. Outcome Measures

Number of participants who completed the full-day training session of the Invasive Plant Atlas of New England

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	11

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results
The session included training in plant identification, mapping protocol and the process for submitting information to IPANE. All participants established passwords and entered the IPANE website to identify a piece of land to map. In the 5 months since the training, they have vouchered some samples into IPANE, but the intensive process often requires years to completely map parcels of land. Ultimately, these volunteers' data will support research about invasive plants in Maine.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
202	Plant Genetic Resources
205	Plant Management Systems
206	Basic Plant Biology
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (new insect pests or diseases)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- During (during program)
- Comparison between locales where the program operates and sites without program intervention

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}