V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Pest Management

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	5%		5%	
204	Plant Product Quality and Utility (Preharvest)	5%		5%	
206	Basic Plant Biology	5%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	7%		18%	
212	Pathogens and Nematodes Affecting Plants	8%		5%	
213	Weeds Affecting Plants	6%		5%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants	5%		3%	
215	Biological Control of Pests Affecting Plants	5%		2%	
216	Integrated Pest Management Systems	7%		7%	
311	Animal Diseases	5%		5%	
312	External Parasites and Pests of Animals	5%		5%	
313	Internal Parasites in Animals	5%		5%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	5%		5%	
404	Instrumentation and Control Systems	2%		2%	
721	Insects and Other Pests Affecting Humans	5%		5%	
722	Zoonotic Diseases and Parasites Affecting Humans	5%		5%	
802	Human Development and Family Well-Being	5%		5%	
901	Program and Project Design, and Statistics	5%		3%	
902	Administration of Projects and Programs	5%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	35.0	0.0	69.0	0.0
Actual Paid Professional	42.6	0.0	204.9	0.0
Actual Volunteer	58.7	0.0	0.0	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
1353571	0	2056140	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2435517	0	7774441	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1499876	0	18229036	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research programs during the reporting period covered, among other things, multifaceted activities to develop sustainable, IPM-friendly management programs and monitoring options for brown marmorated stink bug (Halyomorpha halys Stål) (BMSB); testing the prevalence of antibiotic-resistant bacteria on U.S. conventional poultry farms that transitioned to organic practices; discovering learning impairment in honey bees caused by agricultural spray adjuvants; studying slug ecology and management in no-till field crops; exploring potential for novel fungus-based biopesticides for malaria vector control; developing methods for and extension materials for assessment of house fly problems in livestock facilities; identification of thyme oil as effective in controlling verticillium dry bubble disease in commercial button mushrooms; and continuing to support a web-based system to forecast the international aerial movement of Asian soybean rust, which saves growers about $200 million/year in pesticide application costs.

Highlights of Extension activities included dozens of Master Gardener programs, increasing vineyard sustainability, and integrated pest management in orchards and for small fruits and vegetables.

2. Brief description of the target audience

Agricultural Producers/Farmers/Landowners, Agriculture Services/Businesses, Nonprofit Associations/Organizations, Business and Industry, Community Groups, Education, General Public, Government Personnel, Human Service Providers, Special Populations (at-risk and underserved audiences), Students/Youth

3. How was eXtension used?

Penn State Cooperative Extension supports faculty and staff use of eXtension and promotes communities of practice as a way of broadening sources of information and outreach. Penn State Cooperative Extension supports the professional development offered through eXtension.org. Pennsylvania is represented by 152 eXtension members in 47 of the 73 approved CoPs.

eXtension was used as a professional development tool to hone plant diagnostic skills through participation in Introduction to Diagnostics for Master Gardener Volunteers, a 3-hour credit course. The eXtension website is used to search for answers to specific questions from clientele.

Several Horticulture educators serve as a resource for Ask the Expert and answer questions that are assigned to them.

Vegetable team members published two videos on eXtension. They were case studies at Quiet Creek Farm designed to show example systems to help new farmers get started.

One educator worked with eXtension group to produce The Life Cycle of the White Grub.

The eXtension grape community of practice is an important resource and teaching tool for all viticulture extension educators in the U.S. In 2012 an educator wrote 2-3 articles for e-Viticulture, which also has a section for Spanish language visitors. The e-Viticulture website was awarded the eXtension achievement award in 2012.

Two faculty members are involved in e-apples (http://www.extension.org/pages/60760/apples-community-information).

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	301472	4189955	67067	5620

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

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	0	267

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of invention disclosures submitted.
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of people enrolled and/or registered in programs.
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of invention disclosures submitted in support of all programs related to Pest Management

Year	Actual
2012	1

Output #4

Output Measure

- Number of people enrolled and/or registered in all programs related to Pest Management

Year	Actual
2012	79823

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of participants who were evaluated and demonstrated increased knowledge and skills.
2	Number of participants who were evaluated in a follow-up and who implemented/adopted practices.
3	Number of volunteers that helped with program leadership or delivery.
4	Number of decision support tools adopted based upon predictive modeling research.
5	Number of participants in all programs related to Pest Management who were evaluated and demonstrated increased knowledge and skills.
6	Number of participants in all programs related to Pest Management who were evaluated in a follow-up and who implemented/adopted practices.
7	Discovering the basic biology of brown marmorated stink bugs (BMSB) and best methods for immediate (pesticide recommendations) and long-term control
8	Lower prevalence of antibiotic-resistant bacteria on U.S. conventional poultry farms that transitioned to organic practices
9	Discovered learning impairment in honey bees caused by agricultural spray adjuvants
10	Slug ecology and management in no-till field crops
11	Exploring potential for novel fungus-based biopesticides for malaria vector control
12	Annual dollar increase in growers' profits via reduced pesticide application costs enabled by web-based system to forecast the international aerial movement of Asian soybean rust
13	Number of Master Gardeners volunteer hours
14	Percent of growers attending Grape IPM Workshop who expect their vineyard to be more profitable based on the information they learned
15	Average percentage of respondents attending a workshop on integrated pest management in orchards who learned something that has potential to make their business more profitable
16	Total pesticide application costs saved by using data from Penn State's pest monitoring program to make spray decisions for about 600 acres of sweet corn
17	Percentage of participants in the small farm fly control program who adopted 2-3 fly monitoring and control practices discussed

18	Identification of thyme oil as effective in controlling verticillium dry bubble disease in commercial button mushrooms

Outcome #1

1. **Outcome Measures**

Number of participants who were evaluated and demonstrated increased knowledge and skills.

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Number of participants who were evaluated in a follow-up and who implemented/adopted practices.

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Number of volunteers that helped with program leadership or delivery.

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Number of decision support tools adopted based upon predictive modeling research.

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

3a. **Outcome Type:**

Change in Condition Outcome Measure

3b. **Quantitative Outcome**

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
214	Vertebrates, Mollusks, and Other Pests Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
311	Animal Diseases
404	Instrumentation and Control Systems
901	Program and Project Design, and Statistics
902	Administration of Projects and Programs

Outcome #5

1. Outcome Measures

Number of participants in all programs related to Pest Management who were evaluated and demonstrated increased knowledge and skills.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2012 1497

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
214	Vertebrates, Mollusks, and Other Pests Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
311	Animal Diseases
313	Internal Parasites in Animals
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
404	Instrumentation and Control Systems
722	Zoonotic Diseases and Parasites Affecting Humans
802	Human Development and Family Well-Being
901	Program and Project Design, and Statistics
902	Administration of Projects and Programs

Outcome #6

1. Outcome Measures

Number of participants in all programs related to Pest Management who were evaluated in a follow-up and who implemented/adopted practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	550

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
214	Vertebrates, Mollusks, and Other Pests Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
311	Animal Diseases
313	Internal Parasites in Animals
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
404	Instrumentation and Control Systems
722	Zoonotic Diseases and Parasites Affecting Humans
802	Human Development and Family Well-Being
901	Program and Project Design, and Statistics
902	Administration of Projects and Programs

Outcome #7

1. Outcome Measures

Discovering the basic biology of brown marmorated stink bugs (BMSB) and best methods for immediate (pesticide recommendations) and long-term control

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Many of the insecticides currently available to growers have variable effects on resident BMSB populations and little or no residual effects on future invaders into treated fields and orchards. Many insecticides that have been traditionally effective are not available for use on fruit or are discouraged because of harmful effects on natural enemies of BMSB and other beneficial insects.

What has been done
Laboratory and field evaluations of insecticides against BMSB adults and nymphs conducted during the 2012 season tested the effectiveness of multiple insecticide chemistries registered for use on fruit.

Results
Active ingredients belonging mostly to two groups of products--pyrethroids and neonicotinoids--provided the highest mortality of BMSB adults and nymphs. However, the combination of low residual activity of insecticides against BMSBs coupled with their ability for unrestricted movement and continuous reinfestation of orchards creates a challenging situation for pest management. Consequently, only multiple, frequent applications of broad-spectrum insecticides proved effective in managing the pressure from BMSBs. However, the preferred products used for such treatments exhibit highly negative effects on most beneficial organisms in orchards. As a result of the unbalanced needs for insecticide treatments to control BMSBs, some isolated orchards are already experiencing outbreaks of mites, wooly apple aphids, or scale insects, which are normally controlled by natural enemies. Although nonpesticidal control (e.g., biological or cultural methods) is the ultimate goal for BMSB management, the short-term solutions unfortunately still seem to rely mostly on insecticides.

4. Associated Knowledge Areas

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

Outcome #8

1. Outcome Measures

Lower prevalence of antibiotic-resistant bacteria on U.S. conventional poultry farms that transitioned to organic practices

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In U.S. conventional poultry production, antimicrobials are used for therapeutic, prophylactic, and nontherapeutic purposes. Researchers have shown that this can select for antibiotic-resistant commensal and pathogenic bacteria on poultry farms and in poultry-derived products. However, no U.S. studies have investigated on-farm changes in resistance as conventional poultry farms transition to organic practices and cease using antibiotics.

What has been done
Researchers investigated the prevalence of antibiotic-resistant Enterococcus on U.S. conventional poultry farms that transitioned to organic practices. They evaluated the presence of resistant bacteria in poultry by collecting water, feed, and litter samples from 10 newly organic and 10 conventional farms.

Results
Bacterial evaluation showed that concentration of antibiotic-resistant bacteria can be decreased fairly rapidly (3 - 4 years) by changing to an organic-certified growing environment. This can decrease possible environmental contamination of water, litter, and broilers.

4. Associated Knowledge Areas

KA Code	Knowledge Area

313	Internal Parasites in Animals
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #9

1. Outcome Measures

Discovered learning impairment in honey bees caused by agricultural spray adjuvants

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Spray adjuvants are often applied to crops in conjunction with agricultural pesticides to boost the efficacy of the active ingredient(s). The adjuvants are largely assumed to be biologically inert and are therefore subject to minimal scrutiny and toxicological testing by regulatory agencies. Honey bees are exposed to a wide array of pesticides as they conduct normal foraging operations, meaning that they are likely exposed to spray adjuvants. It was previously unknown whether these agrochemicals have any deleterious effects on honey bee behavior.

What has been done
An improved, automated version of the proboscis extension reflex assay with a high degree of reproducibility was used to measure the olfactory learning ability of honey bees treated orally with sublethal doses of the most widely used spray adjuvants on almonds in the Central Valley of California. Three adjuvant classes (nonionic surfactants, crop oil concentrates, and organosilicone surfactants) were investigated.

Results
Researchers demonstrated for the first time that learning was impaired after ingestion of 20 µg organosilicone surfactant, indicating harmful effects on honey bees caused by agrochemicals previously believed to be innocuous. Organosilicones were more active than the nonionic adjuvants, while the crop oil concentrates were inactive. Ingestion was required for the tested adjuvant to have an effect on learning. Exposure via antennal contact only induced no impairment.

Olfactory learning is important for foraging honey bees because it allows them to exploit the most

productive floral resources in an area at any given time. Impairment of this learning ability may have serious implications for foraging efficiency at the colony level, as well as potentially many social interactions. Organosilicone spray adjuvants may therefore contribute to the ongoing global decline in honey bee health.

4. Associated Knowledge Areas

KA Code	Knowledge Area
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals

Outcome #10

1. Outcome Measures

Slug ecology and management in no-till field crops

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As row crops managed with conservation tillage increase, more growers are encountering slugs. Slugs can eat virtually all crops. They inflict most damage during crop establishment and early growth in the spring and fall. This damage tends to be most severe under cool, wet conditions. These mollusks are particularly troublesome within the Chesapeake Bay watershed, where conservation tillage is encouraged to minimize agricultural run-off into waterways. Slugs are challenging to control because of the limited number of management tactics available.

What has been done
Researchers reviewed the species of slugs commonly found in mid-Atlantic field crop production and investigated their natural history, ecology, and some of the factors limiting their populations. The researchers suggested cultural, biological, and chemical management options, particularly for corn production, and suggested elements of a potential integrated management program for slugs.

Results
Tactics that reduce the amount of surface residue, such as shallow disking, decrease slug populations. Natural enemies in no-till fields can be enhanced by increasing crop diversity and using insecticides sparingly. Early planting may give crops a jump on slugs if there is significant growth before many eggs hatch. Growers can further contribute to better early growth by selecting crop varieties that are rated 'excellent' for emergence and seedling vigor.

Many insecticides, like chlorinated hydrocarbons or organophosphates, do not appear to be toxic to slugs, show inconsistent molluscicidal activity, or require a very large dose to have any influence. Carbamate insecticides, however, can have activity against slugs, and some compounds appear to provide control of slug populations in some settings.

It's safe to say that there is not a 'silver bullet' for slug problems in no-till crop fields. Many tactics used provide some relief under certain circumstances. But inconsistencies can be decreased by employing many tactics in concert. Growers should always begin management by scouting for slugs. It may be best to reduce plant residue before planting.

4. Associated Knowledge Areas

KA Code	Knowledge Area
214	Vertebrates, Mollusks, and Other Pests Affecting Plants

Outcome #11

1. Outcome Measures

Exploring potential for novel fungus-based biopesticides for malaria vector control

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Studies suggest that residual treatments of biopesticides comprising certain naturally occurring fungi could play a role in management of adult Anopheles mosquitoes, the major vector of malaria. Isolates belonging to 2 cosmopolitan fungal species have been shown to infect and

significantly reduce Anopheles's longevity, killing them within 14 days. The reduction in mosquito longevity is sufficient to significantly reduce the vectorial capacity. Pre-lethal effects reducing sporozoite formation and feeding propensity increase the potential impact on malaria transmission.

What has been done
Researchers tested the effects of various fungal-based biopesticides on Anopheles mosquitoes. They tested for the co-occurrence of resistance to the major classes of insecticides and fungal biopesticides. They attempted to quantify the efficacy of spray residues of some fungal biopesticides.

Results
Researchers found that the observed pre-lethal reduction in host-feeding propensity could be linked to reduced sensitivity of the olfactory organs (i.e., fungal-infected mosquitoes essentially suffer a 'head cold' and can't smell host odor cues as effectively). Infected mosquitoes also exhibited increased metabolic activity (a metabolic 'fever'), a stress that results in reduced ability to sustain flight.

Resistance to the major classes of insecticides did not confer cross-resistance to fungal pathogens in key African malaria vectors.

Short-term (30 minutes) exposure of adult mosquitoes to a range of realistic substrates treated with fungi was sufficient to cause high levels of infection. Simple spray residues could remain infective for up to 5 months after treatment.

Overall, the combined pre-lethal and lethal effects of fungi, together with resistance-breaking properties, make possible a new paradigm for insecticidal control of malaria: blocking of malaria transmission without fast-acting neurotoxins.

4. Associated Knowledge Areas

KA Code	Knowledge Area
722	Zoonotic Diseases and Parasites Affecting Humans

Outcome #12

1. Outcome Measures

Annual dollar increase in growers' profits via reduced pesticide application costs enabled by web-based system to forecast the international aerial movement of Asian soybean rust

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2000000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Asian soybean rust entered the United States in 2004. The disease causes lesions on the plant that can lead to early defoliation and yield loss.

What has been done
The Integrated Aerobiology Modeling System to forecast the aerial movement of soybean rust, P. pachyrhizi, in the U.S., Mexico, and Canada has been operated with international observation network information as part of the ipmPIPE from 2005 to present. Through the web-based platform, soybean extension specialists, agricultural service companies, independent consultants, producers, and other stakeholders could track the disease from its first day of entry into North America.

Results
Predictions of distribution and timing of disease matched field observations, and soybean rust has not been detected in PA. Smartphone applications have been developed and deployed as a "push" technology to enable Extension specialists to input observations from the field and to reach crop consultants and growers with pest decision support information in a real-time framework. Products include maps created by day, degree, infection, and atmospheric transport models. The site includes a publicly available map with summarized data and products.

The PIPE system has recently achieved sustainability based on a business model by which the corn and soybean industries and grower organizations support monitoring and information dissemination activities of interest to all stakeholders.

The PIPE has had a major impact in reducing sprays applied for Asian soybean rust. PIPE increased producers' profits by between $11 and $299 million in 2005 and ca. $200 million/yr over the subsequent 5 years. It provides benefits to U.S. agencies and producers through a better understanding of the movement of migratory or invasive pests.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

Outcome #13

1. Outcome Measures

Number of Master Gardeners volunteer hours

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	119306

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Master Gardeners (MGs) across PA work in schoolyard gardens, with juvenile offenders, and other community groups, teaching people how to garden. MGs are alert for invasive insect pests and spread the word about environmental concerns and Extension's mission.

What has been done
The Penn State Master Gardeners greatly magnify the reach and ability of Penn State Extension. Through their outreach, Penn State Master Gardener volunteers collaborate with many community groups and increase public visibility of Penn State Extension. They are often the first contact the public has with Extension. They are trained to help in Extension's role of first detector of invasive pests, and they are politically engaged in their communities.

Results
43 counties had 1,989 active MGs. Collectively, they reported 119,306 volunteer hours, with an estimated value of $2,599,677. They made 306,076 direct educational contacts with the public. At least 252 new MGs completed their training during the reporting cycle.

In educational gardens around the state, MGs oversaw the growing of 31,751 lbs. of produce donated to food banks.

In York County, 21 MGs gardened weekly with 30 juvenile offenders, donating 5,634 lbs. of produce to food banks.

211 home gardens were certified as "Pollinator Friendly."

MGs maintained a garden hotline in 39 counties, reporting 17,236 educational public contacts.

Bucks County MGs sold 664 compost bins, 132 rain barrels, 200 compost turners, and 185 kitchen compost buckets. Over 500 lbs. per household of food and yard waste was diverted from landfills, resulting in an estimated diversion of over 60 tons per year.

The first official endowment for a county-based MG program was established in Lehigh and Northampton Counties.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
802	Human Development and Family Well-Being

Outcome #14

1. Outcome Measures

Percent of growers attending Grape IPM Workshop who expect their vineyard to be more profitable based on the information they learned

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	65

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers work hard all year and then watch the crop diminish in quality and size just before harvest. Complications begin with the weather, but are exacerbated by late-season threats, including birds, bees, diseases, and insects. Wine makers need clean and healthy fruit to make fine wines.

What has been done
The annual Grape IPM Workshop gives growers access to the latest scientifically based information to help manage vineyard pests. The Grape IPM workshop is held each spring to review the disease and pest season from the previous year and look ahead to growing defect-free fruit in the next growing season.

Results

65% (N=23) of growers attending Grape IPM Workshop expect their vineyard to be more profitable based on the information they learned; 61% (N=24) of workshop participants surveyed will adopt new disease management practices; 57% (N=22) will adopt new weed management practices; 54% (N=21) will adopt new cultural practices; 48% (N=24) have a high to very high confidence to design a vineyard IPM program; 96% will share the information they learned.

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

Average percentage of respondents attending a workshop on integrated pest management in orchards who learned something that has potential to make their business more profitable

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	93

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers need access to the latest scientifically based information to help them manage fruit pests.

In 2011, there was an outbreak of apple scab in orchards, and producers estimated losses to be $1.9 million.

What has been done
9 full-day Integrated Crop Management Workshops and ten 2-hour meetings/tours around the state. Electronic and print instructional materials (e.g., 2012-13 PA Tree Fruit Production Guide). Timely updates through monthly Fruit Times newsletters, email, and regular updates of appropriate websites.

Extension educators in cooperation with scientists at the Fruit Research and Extension Center responded to the apple scab outbreak immediately by conducting extensive surveys and fungicide resistance trials and by offering in-depth educational programs and regular disease alerts.

Results

Program participants who completed post-program evaluations represented more than 33,000 acres of tree fruit.

88-99% of respondents learned something from the workshop that has potential to make their business more profitable.

95% of respondents reported increased knowledge about Penn State pest management and cultural recommendations for tree fruit crops.

91% use the PA Tree Fruit Production Guide. 81% of that group said it is very useful.

71% use the PA Fruit Times newsletter. 99% of that group said it is moderately to very useful.

164% increase in visits to Fruit Times website after workshops.

60-75% plan to implement changes in stink bug, apple scab, or orchard floor management.

31% are already adopting advanced IPM strategies.

Impact of increased fruit quality: $171-1,584 per acre; impact of increased management efficiency: $245-500 per acre; impact of reduced damage from two major fruit pests: $26 per acre.

Impact analyses demonstrated that incidence of apple scab was reduced by 88% in 2012.

4. Associated Knowledge Areas

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

Outcome #16

1. Outcome Measures

Total pesticide application costs saved by using data from Penn State's pest monitoring program to make spray decisions for about 600 acres of sweet corn

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	16207

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Commercial growers of small fruits and vegetables in Pennsylvania are using research-based information to produce high-quality foods in a manner that protects the environment and meets current market demand.

What has been done
Through participation in vegetable and small fruit production extension programs, commercial growers have learned about and adopted best management practices for, among other things, choosing specialty crops and monitoring and managing pests and beneficial insects.

Results
On post-program evaluations, producers view Penn State as a highly valued source of information and attribute participation in this program with improving their farm's profitability. 66-89% indicated that they have adopted vegetable and small fruit production practices learned through previous Penn State Extension programs, including insect, disease, and weed management; variety selection; and cultural practices.

Sweet corn growers in 13 counties, representing more than 600 acres of production, responded to surveys in 2010 and 2011 on their collaboration in Penn State's pest monitoring program. They reported saving a total of $16,207 in pesticide application costs by using the data to make spray decisions. The same growers reported that the total worth of the crop they protected from insect damage that could potentially have made it unmarketable was $389,000 over two years.

4. Associated Knowledge Areas

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

Outcome #17

1. Outcome Measures

Percentage of participants in the small farm fly control program who adopted 2-3 fly monitoring and control practices discussed

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	98

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Vectors that can transport bacteria from place to place are a concern to animal producers. Measuring such vectors should be part of any integrated pest management program. When coupled with cultural methods to reduce vectors, scouting for vector counts is a method to maintain pests below a critical control point. Fly and pest control is critical in the U.S. Food and Drug Administration's egg rule.

What has been done
Three extension programs were given to assist operators and technicians of large-sized farms dealing with house fly issues. Smaller farms, seeing the success of the larger farm programs, have adopted scouting methods explained in programs given directly to them. The programs train those working with fly issues on farms to understand the identification, life cycle, and integrated controls of flies on the farm.

Results
Of the 33 large-scale farm workshop participants, 80% stated that they learned something new about the house fly and its ecology. 40% stated that they felt comfortable performing farm fly assessments. Control of flies was achieved in all but two instances on poultry farms. Adoption of scouting methods for IPM has begun with larger (50,000 hens+) egg farms. Over 78% of the PA farms scouting are using materials distributed via Extension programs. Egg farms outside of PA are also using the count sheets and other materials. Interest from Europe and Asia was seen this year from web statistics. Due to this higher level of on-farm fly scouting, calls to the PA SWAT fast response fly team have dropped in comparison to previous years. Use of the suggested fly monitoring and control practices helps producers comply with the FDA egg rule.

4. Associated Knowledge Areas

KA Code	Knowledge Area
902	Administration of Projects and Programs

Outcome #18

1. Outcome Measures

Identification of thyme oil as effective in controlling verticillium dry bubble disease in commercial button mushrooms

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The identification and use of environmentally nontoxic biopesticides will reduce the need for chemically based pesticides that can be harmful to the environment.

What has been done
Researchers evaluated essential oils and other biopesticides for the control of several fungal diseases of the commercial button mushroom, Agaricus bisporus.

Results
The application of an essential oil, thyme oil, was found to control the development and symptoms of verticillium dry bubble disease. The higher concentrations of this oil showed some promise as a possible biopesticide, but the economics of the material and application timing need to be investigated. The slow release of thyme oil when added to an adsorbing gel was also effective in reducing the incidence and severity of the disease, so this method of delivery shows some promise. The results of this study suggest that thyme oil could be used as an effective compound to control verticillium dry bubble. Further testing for concentrations and timing of the applications may improve the effectiveness of this biopesticide.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Pathogens and Nematodes Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Competing Programmatic Challenges
- Other (Extramural Funding)

Brief Explanation

Reduced State funding impacted both the research and extension functions of the College of Agricultural Sciences and resulted in retirements and layoffs of key faculty and staff across all areas of the College.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The generation of outcomes from existing programs and the development of new programs require improved evaluation that identifies pre- and post- responses to information and monitoring for long-term behavioral changes that result in improved environmental outcomes. The evaluations conducted thus far provide initial measures of implementation, but long-term monitoring is needed to ensure that the practices are successfully managed over time.

Key Items of Evaluation

See highlights of state-defined outcomes in this planned program.