V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Plant and Integrated Pest Management Systems

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
202	Plant Genetic Resources			20%	
205	Plant Management Systems			25%	
211	Insects, Mites, and Other Arthropods Affecting Plants			15%	
216	Integrated Pest Management Systems			40%	
	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	11.5	0.0
Actual	0.0	0.0	16.7	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	607354	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	2923947	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	219114	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The main research objectives are to develop methods of pest control that require less chemicals and to develop and evaluate plant cultivars that are resistant to insect and plant pathogens and are high yielding. Advances were made on these objectives during the reporting period. Several expected outputs (i.e., activities, services, events, and new crops that reach people) were designed to assist a broad, diverse group of stakeholders by transferring scientific information to stakeholders and solving problems. All activities of this planned research program will ensure that people have equality of service and access to research findings. Direct contacts were tabulated from persons served or those in attendance at meetings, workshops, etc. Numbers of indirect contacts with youth were obtained from teachers, who receive CAES assistance and incorporate informative new findings in educational curricula. The following activities were planned: (1) CAES scientists will partner with stakeholders and participate in their organizations as members or officers, (2) CAES scientists will conduct workshops or meetings for stakeholders, (3) experiments will be performed on stakeholders' properties as well as on CAES research farms, (4) diagnostic services will be provided to stakeholders (5) training on IPM practices and other methodologies will be provided to stakeholders, (6) staff members will disseminate written information on research findings by presenting scientific displays at agricultural fairs and giving talks and interviews to civic groups, (7) staff members will work with the media and provide information on scientific discoveries, and (8) staff members will educate teachers and, thereby, indirectly reach youth. Public service is an important component for all output measures. For example, all state residents were allowed to request direct assistance on diagnosing insect or plant disease problems. About 26,000 stakeholders directly received assistance from these activities annually. CAES scientists are members or officers in at least 140 stakeholder groups. This provides direct opportunities for stakeholder input on the research programs and facilitates reporting of research results. The non-traditional stakeholders were reached at agricultural fairs when they visited or inquired about CAES displays or newspaper, radio, and TV reports. Based on media statistics for viewers or readers, one can estimate indirect contacts with adults and youth who hear or read about new scientific advances made at CAES and reported by the media. Two open houses were held on CAES properties to allow the public to hear oral presentations on research results and to offer comments. Hundreds of talks and interviews were given to civic groups and the media to convey research results and to receive direct public input. Research experiments solved problems or provided information on new crops. Whenever possible, these experiments were conducted on farms or other private properties to encourage stakeholder engagement in the research. Results of these output activities led to specific outcomes, such as reducing pesticide use, controlling insects or plant disease pathogens, development of resistant cultivars, the introduction of new specialty crops, and increased farm income. Scientific publications in peer-reviewed journals or articles written for the general public reached traditional and non-traditional groups of stakeholders.

2. Brief description of the target audience

There are many targeted audiences, which include under-served and under-represented stakeholders. CAES does not receive extension funds but, nonetheless, serves a variety of farmers who grow vegetables, fruits, nursery stock, cattle, and flowers. CAES scientists worked with the University of Connecticut extension specialists in planning growers' meetings. Progress was made in reporting new findings to the national extension service (www.extension.org) to reach stakeholders nationally. Five scientists at CAES are participating as members of communities of practice. The broad goals of the CAES research programs also include work on forestry and environmental problems. Accordingly, target audiences include landscapers, landscape architects, conservation officers, foresters, arborists, beekeepers, maple syrup producers, seed companies, and persons in the wood-products industry. Efforts were also made to reach government and water company officials, horticulturalists, groundskeepers, pest control operators, pesticide manufacturers and retailers, environmental regulators, extension specialists, and municipal officials. Scientists and government officials are also important target audiences for new experimental results. This research program is mainly designed to reach the general public, which includes non-traditional stakeholder groups. Homeowners, who have interests in agriculture and forestry, have access to laboratories and scientific results as well as equality of service. Women, members of minority

organizations, and children are examples of under-represented and under-served groups, important target audiences. Efforts will be made to reach Brazilian, Hispanic, Asian American, African American, and Native American populations as well as elementary and high school students. New scientific information will be transferred to teachers to develop educational curricula, and, thereby, indirectly reach youth.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	30000	90000	2000	20000
Actual	13899	84062	5370	17477

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	9	9

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Total research papers

Year	Target	Actual
2010	70	86

Output #2

Output Measure

- # of site visits to conduct research and solve problems

Year	Target	Actual
2010	350	332

Output #3

Output Measure

- # of talks and interviews given to stakeholders

Year	Target	Actual
2010	650	749

Output #4

Output Measure

- # of responses to stakeholders' inquiries

Year	Target	Actual
2010	15000	15951

Output #5

Output Measure

- # of diagnostic tests performed

Year	Target	Actual
2010	4500	6227

Output #6

Output Measure

- # of new IPM intervention strategies judged to be effective

Year	Target	Actual
2010	7	12

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	# of homeowners gaining knowledge on insect pests and plant pathogens
2	# of homeowners learning practices to control plant and household pests
3	# of media reporters gaining knowledge on research results
4	# of students learning agricultural skills by attending talks, courses, or training sessions
5	# growers adopting IPM practices
6	# of cultivars introduced into farming operations

Outcome #1

1. Outcome Measures

# of homeowners gaining knowledge on insect pests and plant pathogens

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	9000	13329

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Homeowners and farmers requested diagnostic services and sought information on how to solve plant pest problems. Food crops can suffer from a variety of fungal infections, nematode damage, and the adverse effects of insects and mites. People do not want their plants to decline or die prematurely, and they seek remedies from staff members who are knowledgeable. Scientists are likewise interested in the reasons why plants decline because the cause(s) might reflect an emerging pathogen that could negatively impact an important crop system or forests. New emerging pests or pathogens can have negative impacts internationally and cause declines in food supplies.

What has been done
Diagnoses of insect and plant disease problems were performed for 13,329 stakeholders. Results and suggestions for control were provided to these people along with written information on the pest. In about 25% of the inquiries, stakeholders visited the diagnostic laboratories to seek direct assistance from staff members.

Results
During 2009, diagnostic tests of infected tomato and potato plants revealed that Phytophthora infestans, a fungal pathogen, was causing plant mortality. Some people acted quickly and sprayed their crops, thereby saving tomato and potato production (valued at about $4,000,000) in Connecticut and Massachusetts. During 2010, we learned that informing homeowners was important because their treatments prevented the spread of the fungus to nearby commercial fields. Immediate benefits are (1) a well-informed group of farmers and homeowners, who now know the early signs of "late blight" infections and what to do to save their crops and (2) ample supplies of tomatoes and potatoes for consumers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #2

1. Outcome Measures

# of homeowners learning practices to control plant and household pests

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1800	8257

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Homeowners (including farmers) sought information on how to control plant and household pests. Problems that occur on private and commercial properties can sometimes be solved by using biological controls, grafting techniques, insecticidal soap, horticultural oil, or crop rotation. When these alternatives are not available, the least toxic chemicals are used. People want healthy plants, a clean and comfortable indoor or outdoor environment free of pests and chemical pesticides, and high-yielding, quality crops. Crown gall, caused by a bacterium, was identified by homeowners and commercial growers as an important problem of grape vines.

What has been done
In commercial grape operations, scientists visited stakeholders' properties and conducted experiments there. Experiments were conducted with chardonnay (clone 96) budwood grafted onto rootstock (33096) to determine if grafting the vines at different heights could reduce crop losses due to crown gall. Stakeholders participated by contributing to the experimental design and allowed use of their own equipment and materials.

Results
Based on findings obtained over 4 years, high-grafted vines reduced vine losses. The short-term benefits include a savings of about $2,070 plus labor per acre in replacement costs for vines and increased grape production in Connecticut. These advances support the grape-growing industry, valued at $10 million in Connecticut, and have potential to reduce crown gall damage in other countries. The long-term benefits include a profitable and growing fruit juice and wine-producing industry and preservation of agricultural lands at home and abroad.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
216	Integrated Pest Management Systems

Outcome #3

1. Outcome Measures

# of media reporters gaining knowledge on research results

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	35	40

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers and homeowners requested new knowledge on how to grow specialty crops with little or no pesticides. Farmers wanted to reduce pesticide costs and worker exposure to these chemicals and desired to have marketable crops that are in public demand. Media reporters recognized the public's interest in having a cleaner environment and, likewise, sought new knowledge on managing crop systems so that this information can be transferred to a diverse group of stakeholders.

What has been done
Reporters interviewed scientists, saw laboratories, and visited field research plots. There were at least 20 newspaper articles or other news releases on plants and IPM systems covering a wide range of topics, such as specialty crops, honey bee pollination, trees, gardening, and homeowner plantings. Station scientists gave 749 talks and interviews. At the summer Plant Science Day event, public television (CTN) taped talks given by scientists on plant systems and telecasted the presentations to state residents via a cable network.

Results
Reporters learned about a new strawberry cultivar, potential problems with the Emerald ash borer, effects of weather on plant health, effects of neonicotinoid pesticides on honey bees, plant damage caused by deer, and the introduction of new specialty crops. Nearly all (90%) reporters accurately transferred new findings in written form to stakeholders. For example, a newspaper

reporter learned that different personal-sized watermelons are high yielding and could be grown in Connecticut with little or no pesticides. Yields for the cultivar "Bravo" exceeded those of the cultivar "Vanessa" by about 10,600 watermelons per acre. At a retail price of about $4.99 per item, the grower can gross about $53,000 more per acre. Seeds were distributed to commercial growers. These results had impact because some growers are including this crop in their farm operations. The long-term benefits will include greater profits for growers, less pesticide use, farmland preservation, and a source of locally grown, nutritious food for consumers. Science citations = 9 for this specific program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #4

1. Outcome Measures

# of students learning agricultural skills by attending talks, courses, or training sessions

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	375	442

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Educating youth, an under-served group, is a major outreach initiative. CAES scientists participated as judges in science fairs, showed exhibits and gave demonstrations at Farm/City Week and Plant Science Day events. Staff members organized tours of laboratories and experimental plots. Parents want their children to learn about science, including skills of growing crops. Science teachers requested assistance in promoting interests in biology and chemistry and needed material for curricula.

What has been done

Scientists contacted career specialists in high schools in Bloomfield, New Haven, and Waterbury and invited students to see CAES facilities. Scientists also served as judges in science fairs, displayed exhibits at public events where youth of mixed racial and ethnic backgrounds attended, and gave 10 presentations to hundreds of elementary and high school students and 70 teachers. Students toured chemistry and mosquito laboratories and saw demonstrations on the use of analytical equipment. Students from the Sound School in New Haven and from Waterbury, Connecticut learned how to grow vegetables in community gardens. They grew vegetables for their own use at the research farms and were taught good farming practices.

Results
Minority students living in two cities saw experimental field plots and learned how to grow vegetables, to control plant pests by using mulching practices, and how to fertilize and rotate crops. Elementary and high school students learned about the biology and importance of honey bees. High school students learned about research on testing different cultivars and about chemical analyses used to ensure food safety. These efforts to change knowledge in students about agriculture had impact. The students, who learned how to grow vegetables, shared their knowledge with family members and neighbors, who were participating in urban community garden programs. Students learned about food banks and donated surplus produce. Based on feedback from teachers, there was increased interest among students in science. New knowledge on gardening was incorporated in science programs in elementary schools and helped to reach other students (e.g., indirect contacts with youth). The expected long-term benefits are a better educated youth population and increased interests in science.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

growers adopting IPM practices

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	12	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farm costs rise when pesticides are over used. These chemicals can cause toxic effects on users, consumers and beneficial insects, and can pollute soil and surface and ground water. Christmas tree growers requested assistance on how to reduce amounts of pesticides used and exposure to chemicals. The adoption of IPM practices benefits farmers, consumers, golf course managers, landscapers, and the environment. Annual gross revenue for 440,000 harvested Christmas trees, representing 6% of the total 7.7 million trees in Connecticut, is valued at about $9 million. Most growers include food crops on their farms to diversify operations and ensure sufficient income to keep the entire farm financially solvent. Christmas trees are normally grown relatively close together on 6,000 acres in Connecticut. Under these conditions, insect pest problems can emerge and cause immediate economic losses. Armored scales cause discoloration of the tree needles, which decreases market value.

What has been done
Experiments were conducted with the insecticide dinotefuran as a basal trunk spray of Christmas trees 6 feet taller or shorter.

Results
Field tests revealed that dinotefuran effectively suppressed armored scales without negatively impacting biological control. Properly timed treatments avoided losses ranging from $20,000 to $50,000 per acre. These results had impact because growers in Connecticut, Pennsylvania, and Rhode Island have adopted the use of dinotefuran as a trunk spray in IPM programs, and the increased profits from Christmas tree sales helped support the production of fruits and vegetables on these farms.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

of cultivars introduced into farming operations

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}	14

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Growers want cultivars of crops that are resistant to plant pests and are high yielding. Strawberries are grown on about 206 acres in Connecticut. "Pick your own" farm operations are very popular with the public. With average yields of 4,100 pounds per acre and a retail value of $5.00 per pound, there is an overall annual statewide crop value of about $4,223,000. However, pest problems caused by black vine weevil and black root rot can greatly decrease crop yields. Pesticide treatments are required to save crops. Growers requested assistance on trying to find remedies for the pest problems, with minimal use of pesticides.

What has been done
In a breeding program, using conventional-pollination techniques, new strawberry cultivars were produced and evaluated for resistance to black vine weevil and root rot.

Results
A new cultivar has been discovered that has resistance to black vine weevil and root rot. The plant has excellent vigor with high yield, resistance to foliar disease, antifeedent properties to prevent beetle damage, and impressive high quality berries. Patent protection is being sought for future commercialization. This discovery will have immediate impact when the plant is introduced to grower's fields. There will be increased strawberry yields and a savings of about $200 per acre in pesticide costs. Expected long-term benefits will include increased farm income, a quality product for consumers, royalty income to re-invest into research programs, and decreased pesticide exposure to farm workers and the public, thereby reducing human health risks.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges
- Other (Media influences)

Brief Explanation

The loss of an IPM specialist in a prior reporting period and recent resignation of a scientist hired about 2 years ago, adversely affected outcomes because the new knowledge could not be effectively transferred to more growers. It is questionable if this vacancy will be refilled because of a large state budget deficit. Nonetheless, the actual quantitative target outcome for growers adopting IPM practices was met.

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

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- Before-After (before and after program)
- During (during program)

Evaluation Results

Planned evaluation studies were conducted during this reporting period. "After only" evaluations verified that there were knowledge changes in reporters. "During program" evaluations showed that there were knowledge changes in 442 students, whereas "before and after" program on-site evaluations and observations indicated that there were positive outcomes in more effective control of a Christmas tree pest.

Key Items of Evaluation

The Science Citation Index verified recognition of published articles on plant systems written by 20 scientists. There were 453 citations for this entire planned program during this reporting period. Thirty-six of 40 published news articles showed that substantial knowledge changes had occurred in reporters. The remaining 4 news articles had minor misquotes of information. Likewise, feedback from teachers verified knowledge changes in youth. On-site observations and evaluations verified success in improved IPM monitoring and control methods.