V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger - Integrated 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
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 FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	16.0	0.0
Actual Paid Professional	0.0	0.0	12.5	0.0
Actual Volunteer	0.0	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**
0	0	506640	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	2313827	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	401464	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The main research objectives for this program 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. New 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 providing products and information that will be used by growers and the general public to solve problems. We expect that some of the new advances will eventually benefit food production internationally. 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 informative new findings in science 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 special meetings for stakeholders, (3) experiments will be performed on growers' properties as well as on CAES research farms, (4) 88 cultivars, representing 7 different crops, are currently under evaluation, new cultivars of vegetables (e.g., pak choi) and fruits (e.g., strawberry) will be tested, (5) Methods of controlling powdery mildew and crown gall will be developed, dinofuran (Safari) will be tested as a trunk spray for insect pests of trees, (6) diagnostic services will be provided to stakeholders, (7) training on IPM practices and other methodologies will be provided to stakeholders, (8) staff members will disseminate written information on research findings by presenting scientific displays at agricultural fairs and giving talks and interviews to civic groups, (9) staff members will work with the media and provide information on scientific discoveries, and (10) 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 19,504 stakeholders directly received assistance from these activities in this reporting period. CAES scientists are members or officers in at least 101 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. About 745 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

Diverse target audiences 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.

3. How was eXtension used?

Although The Connecticut Agricultural Experiment Station does not receive extension funding and is not an official institution with eXtension, five CAES staff members in this program are registered with eXtension with the consumer horticulture, youth, pesticide environmental stewardship, bee health, grape, eOrganic, and urban IPM communities of practice. New findings, fact sheets, links to Station material, and answers to questions have occasionally been provided to the national eXtension service (www.extension.org).

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	11659	75124	2684	21014

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	28	28

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Total research papers

Year	Actual
2012	90

Output #2

Output Measure

- # of site visits to conduct research and solve problems

Year	Actual
2012	269

Output #3

Output Measure

- # of talks and interviews given to stakeholders

Year	Actual
2012	745

Output #4

Output Measure

- # of responses to stakeholders' inquiries

Year	Actual
2012	18661

Output #5

Output Measure

- # of diagnostic tests performed

Year	Actual
2012	6691

Output #6

Output Measure

- # of new IPM intervention strategies judged to be effective

Year	Actual

2012 3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	# of homeowners and growers gaining knowledge on insect pests and plant pathogens
2	# of homeowners and growers 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 and growers 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	Actual
2012	15124

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Homeowners and commercial farmers grow grapes for wine production. Although winegrapes and wineries are a relatively new industry in Connecticut, the winegrape industry is one of the most rapidly expanding types of agriculture in the state, with over 40 wineries, comprising approximately 320 acres. The anticipated value of wine produced in Connecticut for 2011 is about $10 million. Several key factors directly contribute to the competiveness of the winegrape crop, one of which is the yearly and ongoing challenge of diseases, particularly fungal diseases. When left unchecked, these diseases can significantly reduce the viticultural and economic value of the crop, as measured by harvestable product (yield) and quality (infected fruit rarely produce high quality wine). One disease of widespread concern in Connecticut and other northeastern states is powdery mildew caused by Erysiphe necator (sy. Uncinula necator (Schw.)). Because this disease can occur every season, numerous applications of fungicides are usually necessary in order to avoid devastating infections and associated losses in quality fruit suitable for winemaking.

What has been done
In collaboration with colleagues in other states and winegrape growers, a network of cell phone-based remote access weather stations were established in vineyards throughout southern New England (Hamden, CT; Windsor, CT; Griswold, CT; New Preston, CT; Colchester, CT; Newport, RI; Deerfield, MA). Each station measures temperature, relative humidity, sunlight, wind speed and direction, rainfall, leaf wetness and soil temperature every 15 minutes. The data are sent back to a central location once per hour where they are accessible via the internet. The resultant data are used to calculate disease risk assessment reports, which are made available to growers and the general public via Internet postings and direct e-mail alerts. On-site weather station data are used to calculate disease risk assessments, which are delivered to the winegrape growers on a weekly basis. Early in the season, disease risk assessments are also used in conjunction with scouting of each vineyard to assess inoculum levels that are critical for primary infections.

Results
Disease-risk information alerts the growers to possible disease problems in their vineyards. Using information about local weather events and inoculum levels to more precisely predict conditions that are favorable for fungus infections, homeowners and commercial winegrape growers are now able to eliminate unneeded fungicide applications, while maintaining the economic value of the crop. The short-term benefits of eliminating one fungicide application can save a grower approximately $55.00 per acre (~$40.00 in cost of fungicide + ~$3.00 in cost of fuel + ~$12.00 in cost of labor per acre). When these cost reductions are multiplied over the season for 320 acres of commercial production, they factor into substantial savings ($17,600) for the winegrape growers. The long-term benefits associated with fewer fungicide applications include minimizing the potential for fungicide resistance to develop in the powdery mildew fungus, more responsible environmental stewardship, and protecting the health of both the vineyard workers and the consumer.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

# of homeowners and growers 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	Actual
2012	1866

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
People living in cities want to grow vegetables in community gardens near their homes. Vacant land, such as previously abandoned industrial sites, are potential garden plots. However, there is concern among residents and municipal officials about the presence of lead, mercury, arsenic, cadmium, and other chemicals in the soil. Homeowners requested assistance on chemical analyses and how to grow vegetables in raised beds.

What has been done

During a 6-year study, 174 soil samples from 25 potential garden plots in 10 cities and towns were analyzed for unwanted chemicals. Scientists at The Connecticut Agricultural Experiment Station taught adults and youth how to grow vegetables in non-contaminated soil or in raised beds when heavy metals were detected in the soil.

Results
Soil samples from 8 garden sites were contaminated with one or more heavy metals. Remedial action consisted of training homeowners on the construction of raised beds containing fresh, uncontaminated topsoil. The concerns about potential food safety issues were addressed. People in Bridgeport, Hartford, New Haven, and Waterbury had bountiful supplies of fresh vegetables. Surplus produce was donated to food banks and soup kitchens to help mitigate hunger. These results had immediate impacts by increasing agricultural output, providing nutritious foods to the needy, and by establishing safe garden plots that can be used for several years. Long-term benefits include a healthy human population and reduced costs for fresh vegetables.

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	Actual
2012	50

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 13 newspaper articles or other news releases on plants and IPM systems covering a wide range of topics, such as specialty crops, honey bee pollination, insect pests, trees, gardening, and homeowner plantings. Station scientists gave 745 talks and interviews. At the summer Plant Science Day event, public television (CTN) recorded talks given by scientists on plant systems and pests and telecasted the presentations to state residents via a cable network.

Results
Reporters learned about the detection of the emerald ash borer in CT, 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 (92%) reporters accurately transferred new findings in written form to stakeholders. For example, a newspaper reporter learned that the mild winter advanced crop growth by about 3 weeks and that strawberries would be available for harvest ahead of normal schedule. Advanced harvesting was also likely to occur for many other crops. Science citations = 24 for the specialty crops 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	Actual
2012	725

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Educating youth, an under-served group, is a major outreach initiative. The goal is to promote science and increase student interest in biology and chemistry. CAES scientists participated as judges in science fairs, showed exhibits and gave demonstrations at agricultural fairs and Plant Science Day. 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 New Haven and invited students to see CAES facilities. During this reporting period, scientists also served as judges in science fairs, displayed exhibits at public events where youth of mixed racial and ethnic backgrounds attended, and gave at least 22 presentations to 371 elementary and high school students and 46 teachers. Students toured 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 farm and were taught good farming practices.

Results

Students of mixed racial/gender makeup and 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 saw live honey bees in a demonstration case and 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

<u>Outcome #5</u>

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	Actual
2012	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Plant-parasitic nematodes, such as the northern root-knot nematode (Meloidogyne hapla), damage roots of vegetable- and fruit-bearing plants and, consequently, negatively impact agricultural production. Methyl bromide and other soil fumigants are now more restricted in use because they deplete the earth's ozone layer. Growers have asked for assistance in finding alternative methods of nematode control.

What has been done
Field studies were conducted with green manure of Brassica species to determine if glucosinolates released from the decaying plant materials can control M. hapla in large-scale agricultural fields where tomatoes are grown.

Results
Bioassay results revealed an 80% mortality rate for M. hapla when sinigrin, a predominant glucosinolate, was present in high concentration. These results had immediate impact because an alternative method of nematode control was identified that can be used in Connecticut and abroad for the production of tomatoes, peppers, and carrots. Compared to the use of conventional biofumigants, $500 to $1,000 per acre can be saved in treatment costs when Brassica species are used as a cover crop and nematicide. For 50 acres of farmland requiring biofumigation in Connecticut, there is a potential savings of about $25,000 to $50,000 if green manure of Brassica species is used. Strawberry and vegetable growers have adopted this integrated pest management program. Long-term benefits include protection of the earth's ozone layer, a boost in global agricultural production, less pesticide exposure for farm workers, and farmland preservation.

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	Actual
2012	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Today, about 11,000 acres on 733 farms in Connecticut are devoted to vegetable production with a cash value of $30.2 million. Vegetable growers responding to a state survey requested that field trials be conducted on personal-sized watermelons.

What has been done
Field tests revealed that the cultivar "Bravo" yielded over 10,000 more watermelons per acre.

Results
At a retail price of $4.99 per fruit, a grower can potentially gross about $50,400 more per acre with "Bravo" than growing another popular cultivar "Vanessa". Ten vegetable growers are including this crop in their farming operations. In addition to increased revenue for farming operations, other benefits include providing a nutritious food for the consumer and preservation of farmland.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems
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 (Staff changes, media influences)

Brief Explanation

The loss of an IPM specialist in a prior reporting period and recent resignation of a scientist hired about 4 years ago adversely affected outcomes because the new knowledge could not be effectively transferred to more growers. This vacancy will not be refilled because of a large state budget deficit and hiring freeze. Nonetheless, the actual quantitative target outcome of 4 growers adopting IPM practices was met because other scientists are working to develop IPM programs in commercial nurseries, orchards, and vegetable fields.

V(I). Planned Program (Evaluation Studies)

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 371 students, whereas "before and after" program on-site evaluations and observations indicated that there were positive outcomes in more effective control of Christmas tree pests. Moreover, a survey of 220 farmers revealed that 77 were growing cultivars of Pak Choi that had been field tested at Experiment Station research farms.

Key Items of Evaluation

The Science Citation Index verified recognition of published articles on plant systems written by 28 scientists. There were 576 citations for this entire planned program. Twelve of 13 published news articles showed that substantial knowledge changes had occurred in reporters. The remaining one news article had minor misquotes of information. Likewise, feedback from 5 teachers verified knowledge changes in youth. On-site observations and evaluations verified success in improved IPM monitoring and control methods.