2014 Connecticut Agricultural Experiment Station - Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Significant scientific progress continues was made toward meeting the research and outreach objectives set forth in the Connecticut Agricultural Experiment Station's four planned programs: Global Food Security - Plant and Integrated Pest Management (IPM) Systems; Food Safety; Human and Animal Health; and Soil and Water Quality. Cooperation with extension personnel at land grant universities such as the University of Connecticut, University of Massachusetts, and Cornell University, has facilitated the transfer new scientific information to a broad base of interested stakeholders. Professional collaborations exist with scientists in over three dozen states and nearly one dozen countries.

During the current reporting period, restrictions on hiring new staff on state funds were eased. Five new Ph.D. scientists were recently hired; one soil microbiologist, one tree physiologist, two plant pathologists, and one virologist. In the coming years, these additional research scientists will have significant positive impact on three of our planned programs; Global Food Security - Plant and Integrated Pest Management (IPM) Systems; Human and Animal Health; and Soil and Water Quality. In addition, two Postdoctoral Research Scientists were hired on federal grants, and these additional durational staff will positively impact our fourth program; Food Safety. We were also able to shift some scientist year (SY) commitments from state-funded positions to Hatch projects, elevating the SY times beyond those listed in the Plan of Work.

Research on plants and IPM systems has continued. Investigations addressing boxwood blight, a disease caused by the fungus Calonectria pseudonaviculata, have focused on novel detection platforms and control strategies, as well as the deployment of Best Management Practices (BMPs) to nurseries, garden centers, landscapers, and property owners dealing with this disease. The New Crops Program continues to expand; according to the Connecticut Department of Agriculture, there were 143 farmers' markets last year, attended by over 400 farmers compared to 87 markets in 2007. Separate crop cultivar trials included specialty peppers, sweet corn, broccoli, melons and hops. In addition, the Station viticulture program continues to provide information on improved cultural practices and novel disease management strategies to accommodate Connecticut's climate.

In the Food Safety Program, CAES scientists in the Department of Analytical Chemistry continue to assist other state agencies and the US Food and Drug Administration (FDA) in developing more efficient methods and more sensitive platforms to detect toxic chemicals and elements in food. Decisions on violations are based on tolerance levels established by the US Environmental Protection Agency or the FDA. During the last year, Station Analytical Chemists worked directly with the FDA Forensic Chemistry Center (FCC), we well as with state laboratories in California and Florida, to validate new methods to detect mycotoxins and poisons/toxins food. With the assistance of FDA funding, a collaborative risk-based pesticide surveillance program focused on manufactured foods is being brought under ISO 17025 Accreditation.

Findings from our Human and Animal Health Research Program have resulted in significant scientific advances and in changes in behavior. Laboratory tests of a total of 192,172 mosquitoes (13,601 pools) representing 41 species were trapped and tested from over 90 sites. A total of 90 isolations of West Nile virus were made from 6 mosquito species; other mosquito-borne viruses isolated included Eastern Equine Encephalitis (EEE), Highlands J and Jamestown Canyon (JC), among others. A total of 58 isolations of EEE were made from 4 mosquito species. Ongoing discussions with state residents over

several years suggest that 25-40% protect themselves by using repellents or by going indoors when mosquitoes were biting. Research has continued on topics such as population genetics of key mosquito vectors and viruses/microsporidia that may infect important vectors. Additional research and service/outreach activities were focused on bed bugs and integrated management strategies for tick control.

In the Soil and Water Quality Program, research into the spread invasive aquatic weeds, including novel control strategies, has continued. Additional research on the role of biochar in contaminant fate and transport has occurred. Last, projects investigating the mechanisms associated with the degradation of specific contaminants in soil environments have continued.

Outreach remains a high priority across all planned programs. There have been significant direct and indirect contacts with both youth and adults. Staff members gave 782 talks and interviews, made 212 farm visits to solve specific problems, answered approximately 19,189 citizens' inquiries, and conducted 20,185 diagnostic tests. Stakeholders have access to 56 new published peer-reviewed scientific articles and 39 non-peer reviewed fact sheets, CAES Bulletins, newsletter articles, book chapters, and symposia proceedings. Assistance was given to 154 reporters, representing newspapers, television, and radio. The CAES website continues to serve as a powerful and timely method of transferring new information to the public. There were many page views, including visits for publications and visits to the CAES Plant Pest Handbook. A series of videos are available on the website, including a Training Video on Bed Bugs and a video on the hazards of moving firewood as related to the spread of exotic insects. A new section of the website is dedicated to recent Station activities that have been reported in the news.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	31.0	0.0
Actual	0.0	0.0	34.6	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Expert Peer Review
- Other (Internal administrative and scientific review)

2. Brief Explanation

The review process described in our Plan of Work was followed. Hatch grants are subject to both external and internal review prior to submission. All proposals submitted to USDA or other federal agencies likewise received merit and internal peer-review to ensure that the planned research had relevance to stakeholders' needs, met program goals, and had sufficient technical structure and resources for success. In addition to critiques given by scientists in the discipline, Department Heads, the Vice-Director and the Director were involved in the internal review process. The Director gives final approval for all proposals and manuscripts. In addition to meeting residents' needs, the likelihood of success and originality of the work received careful consideration. During the current period, there were 7 Hatch projects (3 were multi-state) reviewed and submitted to USDA/NIFA under Global Food Security: Plant and Integrated Pest Management Systems (4), Food Safety (1), Human Health (1), and Soil and Water Quality (1). Additional expert peer-review was also received when manuscripts were examined by journal editorial boards and reviewers and when proposals submitted for competitive funds were critiqued by grant review panels.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals
- Survey of selected individuals from the general public
- Other (Targeted invitations to legislators and their staff members)

Brief explanation.

Stakeholders actively participated in CAES research programs and public events. Conferences and workshops were held on a number of topics, such as pests of fruit trees and vegetables, bed bugs, specialty crops, controlling Christmas tree pests, as well as three classes for high school students on mosquito testing and research (in conjunction with the Yale Peabody Museum). Information was disseminated to state residents living in widely separated towns and cities in the state. Press releases promoted our annual summer Open House (Plant Science Day); a promotional flyer was delivered to at least 90,000 households via the New Haven Register. Attendance at the August Plant Science Day at Lockwood Farm (1,130 visitors, including 120+ children) was excellent; this year, the Honorable Dannel Malloy, Governor of Connecticut, attended and spoke to the attendees. Connecticut Network (CT-N), a public TV station, taped the main speaker's talk and scientists' presentations at Plant Science Day for statewide telecasting. Extensive media assistance targeted the non-traditional stakeholder groups and individuals. Notices of these public events were mailed or e-mailed to over 190 press contacts and over 5000 state residents on the Station's contact list to inform traditional stakeholder groups and individuals. Station displays of research, presented at several regional or state fairs, and invitations for high school students to tour Station laboratories, provided further opportunities to reach traditional and non-traditional stakeholders. Dozens of students have toured laboratories at the Station's main campus in New Haven or the facilities at Lockwood farm and have heard presentations of Station programs. To encourage stakeholder participation, survey forms were distributed at selected exhibits in statewide agricultural trade shows, as well as at our Plant Science Day, to seek written public comment on research programs. Thousands of citizens saw Station exhibits on agricultural, forestry, and public health topics and had opportunities to bring insect, plant, and soil samples for diagnostic testing. Station staff served on advisory boards and committees of at least 187 agricultural and environmental civic or professional groups. Scientific staff members made 212 visits to farms and other properties where pest problems occurred. In many cases, growers participated in research to find solutions for controlling insect pests and plant diseases. Finally, 14 separate outreach or public events involved direct or indirect participation and interactions with federal, state, or local elected officials.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Open Listening Sessions
- Needs Assessments
- Use Surveys
- Other (Public access to diagnostic laboratories)

Brief explanation.

Stakeholder collected input helps to realign and refocus research programs. There are several mechanisms in place to enable the identification of and interaction with key stakeholders. Evaluation forms, distributed to open house, meeting, and workshop attendees, are used for stakeholder input. Special e-mail messages and letters, written by state residents, are forwarded by Station staff members to Department Heads and the Director and are then addressed after review. The policy is that all citizens receive responses. A complaint requires a response and follow-up contacts by administrators. Active participation of Station staff members on 187 advisory boards of civic or professional groups, representing different agricultural, forestry, environmental or public health interests, is an excellent way to identify users of Station research findings, receive stakeholder input, identify problems that need to be addressed, and to find solutions. Several examples of this process follow. Current research on detecting pesticides and pathogens in honey bees was initiated by requests from beekeepers and fruit growers who were concerned about rising honey bee mortality. In addition, research on removing invasive plants from lakes was initiated when Station scientists attended lake association meetings. Field research on specialty crops was increased at the requests of Hispanic and Asian residents. Members of the microbrewery industry in CT requested research on barley and hops; a research program has resulted that is now active and supported by a well-attended conference at our Valley Laboratory. New cultivars of chestnut trees, grapes, and figs are being evaluated at growers' requests. Station staff members, who are officers of civic groups, recognized the needs of the public and were able to respond. The annual Open House event of the Station and frequent use of displays at public meetings, trade shows, and science fairs provided opportunities to meet stakeholders who are interested in science issues, and to hear about the problems that need attention. Written survey responses obtained at special listening sessions held by CAES scientists during evenings for growers were especially useful in documenting public input. About 782 talks and interviews were given to civic groups and the media. Discussion during question and answer periods following presentations effectively collects input from interested parties. Research priorities on food safety, solving crop pest problems, providing new specialty crops, and mosquitoes and ticks as transmitters of disease organisms were set or modified in part based on public input. Phone inquiries from the public and stakeholder access to diagnostic services also revealed important problems. For example, pest control operators have indicated that controlling bed bugs continues to be very difficult. Further, frequent attendance at agricultural groups' meetings was very helpful in collecting stakeholder input. In addition, the Station website now has links to a Facebook Page and Twitter account; inquiries and comments are forwarded to appropriate staff for response. Finally, Google Scholar was used to identify scientists in other institutions who were recognizing the Station's published works and using new knowledge.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Survey of the general public
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Survey of selected individuals from the general public

Brief explanation.

Written and electronic stakeholder input, including completed surveys, were received during this reporting period, and were effective in collecting public input on research and outreach programs. Giving research reports, providing displays, and attending meetings of traditional stakeholder groups, such as the Connecticut (CT) Tree Protective Association, CT Farm Bureau, CT Nursery and Landscape Association, CT Pomological Society, CT Timber Producers Association, CT Forest and Park Association, Federated Garden Clubs, CT Pest Control Association, CT Academy of Science and Engineering, Christmas Tree Growers, CT Greenhouse Grower Association, CT Urban Forest Council, Northeast Organic Farmers Association, CT Beekeeper Association, Backyard Beekeeper Association, and the Experiment Station Associates, allowed the direct collection of stakeholder input. When scientific staff meets with the public at our annual Open House (advertised to all) and at other events where exhibits were displayed, input was received from traditional and non-traditional stakeholders. Survey or evaluation forms were forwarded to Department Heads and the Director. Staff provide sufficient time following invited talks for questions and discussion, allowing both traditional and non-traditional attendees to provide input. Inviting high school students and teachers to see CAES laboratories to hear brief presentations on research resulted in collecting written stakeholder input. The approximately 20,185 diagnostic tests performed for individuals also yielded stakeholder input. Finally, meeting with specific traditional and non-traditional individuals, such as state or federal legislative leaders or staff, was another effective method of collecting stakeholder input on research results and budgetary matters.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

All stakeholder input received in e-mail messages, letters, survey/evaluation forms, via Facebook/Twitter, or by other means were reviewed by Station staff members and considered by the appropriate Department Head in establishing research priorities or initiating new studies. Within the Department of Plant Pathology and Ecology and the Valley Laboratory, 8,487 inquiries and stakeholder requests were answered. Microbiological and fungal infections of crops and other plants have economic impacts and were reported the National Plant Diagnostic Network (NPDN), which is available to other impacted states. In addition, many other inquiries are addressed in other departments, such as Analytical Chemistry, Entomology and Environmental Science. Hispanic and Asian stakeholders requested assistance on introducing new specialty crops. Subsequently, experiments have been conducted on more than 60 cultivars of 8 specialty crops. Additional detailed examples can be found in the specific program descriptions. Additional topics of stakeholder concern included adulteration foods, forest health, ticks, mosquitoes and viruses, invasive species, indoor mold and insect pests of grass turf and crops. Based on written stakeholder responses, research priorities were re-assessed to address problems of concern. All written comments received by the Director were discussed with appropriate Department Heads, and specific objectives may be included in the managers' performance goal programs.

Brief Explanation of what you learned from your Stakeholders

Our experience has consistently been that stakeholders have extensive knowledge that is of direct benefit to our research programs. Potential environmental, economic, or public health impacts from these interactions have been significant. As a detailed example, public interest and concern over pesticide contamination of tea leaves resulted a targeted study within our Department of Analytical Chemistry. Inspectors from the Department of Consumer Protection were enlisted to collect commercially available tea bag samples. Results showed that 11 of 16 collected samples, including 3 organic products, contained violative pesticide residues. These findings were forwarded to the US Food and Drug Administration or the USDA (organic products) for regulatory response. Additional brief examples or areas where valuable stakeholder knowledge was conveyed to Station staff include the occurrence of spotted wing drosophila, the invasive nature of golden bamboo, pyrethroid resistant bed bugs, new aquatic invasive species infestations and potential techniques to address those invasions, pesticide resistant insects on Christmas trees, the effectiveness of mosquito-control methods in catch basins, and the occurrence of the Asian longhorned beetle and emerald ash borer. In nearly all instances, knowledge gained from stakeholders was used to re-align existing research priorities and establish new research projects.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	988159	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	988159	0
Actual Matching	0	0	4497730	0
Actual All Other	0	0	1490540	0
Total Actual Expended	0	0	6976429	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Local and Global Food Supply and Security - Plant and Integrated Pest Management Systems

☑ 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: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	13.0	0.0
Actual Paid	0.0	0.0	17.4	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	656463	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	2760810	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	894033	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

This program's objectives are to develop pest control methods requiring decreased pesticides, as well as to isolate high yield crop cultivars that are inherently resistant to insect and plant pathogens. Significant progress was made on these objectives during the reporting period. Outputs such as activities/events, services, and new crops assisted a diverse group of stakeholders both domestically and potentially internationally by providing products and information that will be used by growers and the general public to solve problems. All activities are designed to ensure that stakeholders have equality of service and access to research findings. Direct contacts are derived from persons served or those in attendance at meetings, as well as those directly requesting service in our inquiry offices. Indirect contacts with youth were obtained from educators receiving CAES assistance and information that could be incorporated into science curricula. Activities included: (1) CAES scientists conducted workshops or special meetings for stakeholders, (2) CAES scientists partnered with stakeholders and participated as members or officers in over 180 organizations and societies (3) experiments were performed on both CAES research farms and growers' properties, (4) cultivar trials on peppers, sweet corn, broccoli, melons, and hops were completed, (5) composting strategies using oak and maple leaves were investigated, (6) pathogens of tree species were invested, (7) stakeholders received information and training on IPM strategies, (8) written information on research findings was disseminated by scientific displays at agricultural fairs and giving talks and interviews to civic groups, (9) staff members utilized traditional and social media to provide information on scientific discoveries, (10) staff members educated teachers and thereby, indirectly reach youth, and (11) diagnostic services were provided to stakeholders. Field experiments solved problems or provided information on new crops, and where possible, were conducted on stakeholder properties. Collectively, these output activities led to specific outcomes, including reduced pesticide use, greater control of insect or plant disease pathogens, development of resistant cultivars, the introduction of new specialty crops, and increased farm income. Public service is an important component for all output measures. For example, CAES staff directly addressed 19,189 citizens' inquiries and conducted 20,185 diagnostic tests during the current reporting period. CAES staff serve as members or officers in at least 187 stakeholder or professional organizations, which enables stakeholder to directly comment on research and findings. Non-traditional stakeholders were reached at agricultural fairs when they visited or inquired about CAES displays, as well as through traditional and social media. Our annual open house event allowed over 1,130 stakeholders, including nearly 150 children, to hear oral presentations on research results and to offer comments. Approximately 780 talks, including 154 involving the media, were given to stakeholder or professional groups to convey research findings and to receive direct public feedback. Scientific publications in peer-reviewed journals (56) or articles written for the general public (37) 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 does serve a variety of stakeholders that grow vegetables, fruits, nursery stock, cattle/livestock, and flowers. CAES scientists worked with the UConn 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. Several CAES scientists are participating as members of communities of practice. Several broad goals of the CAES research programs include work on forestry and environmental problems. Accordingly, target audiences include landscapers, landscape architects, conservation officers, foresters, arborists, beekeepers, seed companies, and those 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. However, this research program is mainly designed to reach the general public, including non-traditional stakeholder groups. Homeowners with interests in agriculture and forestry have access to research findings and have equality of service. Women, members of minority organizations, and children are examples of under-represented and under-served groups that are important target audiences. Efforts are made to reach Brazilian, Hispanic,

Asian American, African American, and Native American populations, among others, as well as elementary and high school students. New scientific information conveyed to educators will indirectly reach youth.

3. How was eXtension used?

CAES does not receive extension funding and is not an official institution with eXtension. However, several CAES staff members are registered with eXtension with 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

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	22863	9511	938	1902

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	19	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Total research papers

Year	Actual
2014	50

Output #2

Output Measure

- # of site visits to conduct research and solve problems

Year	Actual
2014	1392

Output #3

Output Measure

- # of talks and interviews given to stakeholders

Year	Actual
2014	530

Output #4

Output Measure

- # of responses to stakeholders' inquiries

Year	Actual
2014	8282

Output #5

Output Measure

- # of diagnostic tests performed

Year	Actual
2014	2856

Output #6

Output Measure

- # of new IPM intervention strategies judged to be effective

Year	Actual
2014	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	Number 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
2014	8487

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Phytophthora root rot is a devastating soil-borne disease of Christmas trees. Early and accurate diagnosis of the disease can reduce economic losses by harvesting marketable trees before they completely lose their market value.

What has been done
Researchers at CAES initiated a project to determine if there was a relationship between visible, aboveground symptoms and Phytophthora infection of roots. Ninety fir trees (5-6 years old) from five Christmas tree farms in Connecticut were examined for Phytophthora root rot in 2014. Sampled trees were assessed for symptoms (e.g., flagging/browning of lower branches, stunted growth) in the field and samples of basal bark tissues and roots were brought to the laboratory for testing. These tissues were analyzed using a serology-based method to confirm the presence or absence of Phytophthora in the tree.

Results
We found that trees with symptomatic (flagged) lower branches and stunted new growth were closely associated with the positive confirmations of Phytophthora in the roots. These results led us to develop a simple method to identify Phytophthora-infected Christmas trees without destructive sampling of the trees. This method was communicated to growers to assist them with making decisions to selectively harvest still-marketable trees with early-stage Phytophthora infections as pre-cut Christmas trees rather than leaving them in the field for later harvest. This effectively reduced economic losses caused by this important disease.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

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
2014	981

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Grape growers in Connecticut experienced 40-60% bud kill during the winter of 2013-2014, which was characterized by large swings in temperature before protective snow cover. Temperatures varied from 60 F maximum to -5 F minimum in less than 10 days in December 2013 and again in January 2014. This resulted in considerable loss in fruit yield.

What has been done
To compensate for the winter kill, we modified our pruning techniques in experimental plots by leaving twice as many buds (10 per linear foot of cordon instead of 5).

Results
After bud burst but before flowering (mid-May to mid-June), a second pruning was executed to bring the cordons to the target 5 buds per linear foot. For cane pruned vines (mainly vinifera), there were not enough live buds per linear foot and yield was reduced by 30-50% over previous years. However, for spur pruned cultivars (hybrids) this strategy was successful and fruit yields were maintained in spite of harsh climatic conditions.

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
2014	154

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Stakeholders, including the press, continue to request new knowledge and techniques on how to grow crops with little or no pesticides. Growers want to reduce pesticide costs and worker exposure to these chemicals and seek marketable crops that are in public demand. Both traditional and social media can be used to address the publics interest in having a cleaner and more sustainable environment.

What has been done
Reporters and other stakeholders interviewed scientists, saw laboratories, attended open house events and visited field research plots. Within this program, there were at least 18 interviews and a total of 154 events involving the press. Station scientists gave 782 talks, including 530 within this program. At the August 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 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.

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
2014	938

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Educating youth, an under-served group, is a major program initiative. The goal is to promote science and increase student interest in biology, chemistry, and agriculture. CAES scientists participated as judges in science fairs, showed exhibits and gave demonstrations at agricultural fairs and at our annual open house (Plant Science Day). Staff members organized tours of laboratories and experimental plots. Science teachers requested assistance in promoting interests in biology and chemistry and needed material for curricula.

What has been done
Scientists hosted tours of CAES laboratories and provide discussion of Departmental programs to a number of student groups, including the Sound School in New Haven. During this reporting period, scientists also served as judges in science fairs, displayed exhibits at public events where youth of varied backgrounds attended, and gave presentations that involved direct contact with 938 students. Students toured laboratories and saw demonstrations on the use of analytical equipment. Students from the Sound School learned how to grow crops at our Experimental Farm. At our annual open house, a hands-on science display had scientific staff interacting directly with nearly 150 students.

Results
Students of varied backgrounds from urban areas saw experimental field plots, experienced science in action, learned how to grow crops and control pests by a range of strategies. 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 crop cultivars and

about chemical analyses used to ensure food safety. These efforts to change knowledge in students about agriculture had impact. 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 agriculture and science was incorporated into science programs 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	Actual
2014	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Micronutrients are critical in the defense against crop disease. Many host defense products are synthesized by enzymes that are often activated by micronutrients. One problem is that low element availability in soil often restricts a sufficient supply of micronutrients like Cu, Mn, or Zn. The application of micronutrients to shoot tissues is ineffective since most are not basipetally translocated. The use of nanoscale micronutrients (<100 nanometers) as part of an integrated approach to suppress crop disease and subsequently enhance growth and yield is a novel idea, but large knowledge gaps still exist. Consequently, the use of nanoparticles (NP) of metal oxides Cu, Mn, and Zn as micronutrient formulations may offer a highly effective novel platform for crop disease suppression. Nanotechnology has the potential to play a critical role in global food production.

What has been done

Research at CAES was initiated to explore the role of NP metal oxides Cu, Mn, and Zn for suppression of Verticillium wilt of eggplant caused by Verticillium dahliae. Three to 4 wk.-old eggplant transplants were foliarly treated once with the NP formulations and compared to the bulked equivalent of each metal oxide along with untreated controls. Both greenhouse and field experiments were conducted with eggplant transplants in soil naturally infested with the Verticillium wilt pathogen, Verticillium dahliae, in 2013 and 2014.

Results
Cu oxide nanoparticles increased eggplant growth and yield when compared to controls. In both 2013 and 2014, a 43% and 58% increase in yield, respectively, was observed when compared to the untreated control, and a 17% and 31% increase in yield, respectively, was observed over the bulked equivalent of the micronutrient. These findings suggest the unique size of NP may favor their entry and transport in plants and may have a role in disease management. We estimate that one treatment of NP with CuO would cost less than $45.00, but could potentially increase eggplant yield in infested soil by more than 50 percent.

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 #6

1. Outcome Measures

Number 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
2014	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Today, about 10,000 acres on 952 farms in Connecticut are devoted to vegetable production with a cash value of $36.4 million. Vegetable growers responding to a state survey requested that field

trials be conducted on specialty melons, broccoli, and edamame. These crops are currently being grown by at least 14, 31, and 23 growers, respectively.

What has been done
At our two experimental farms, we have conducted field trials on 11 cultivars each of specialty melons and broccoli, and 12 cultivars of edamame.

Results
Our research has shown that cultivar selection can dramatically increase yields and profits for the grower. For honeydew melons, by growing the cultivar Early Dew instead of Honey Brew, the grower can produce 19,054 more pounds per acre or 7,841 more melons per acre. At a retail price of $2.50 per melon, the grower could potentially gross almost $20,000 more per acre by growing Early Dew instead of Honey Brew. By growing Gypsy broccoli instead of Blue Wind, the grower can produce over 11,400 more pounds per acre or gross about $23,000 more per acre at $1.99 per pound. By growing the edamame cultivar Sunrise instead of the cultivar Beer Friend, the grower can potentially produce almost 13,000 more pounds per acre or gross almost $32,000 more per acre at $2.49 per pound.

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

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

Staff losses in IPM and related programs mentioned in previous annual reports remain unfilled. In addition, a weed scientist position is now open due to a recent staff departure and efforts are underway to refill this weed scientist vacancy. However, additional staff scientists have IPM and related investigations as part of their research and all goals laid out under this planned program were met. In addition, 2 of the 5 new scientists hired this last reporting period (before re-instatement of the hiring freeze) are plant pathologists that will establish lines of research directly under this planned program. As such, meeting and/or exceeding future targeted outcomes is anticipated.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation studies were conducted during this reporting period. "After only" evaluations verified that there were knowledge changes in media and other stakeholders. "During program" evaluations showed that there were knowledge changes in students/children, whereas "before and after" program on-site evaluations and observations indicated that there were positive outcomes in more effective control of tree and other plant pests. Moreover, 212 farm visits enable direct evaluation of acceptance of new crop cultivars, IPM strategies, and cultivation practices.

Key Items of Evaluation

Google Scholar verified recognition of published articles within this program written by CAES staff. There were 1111 citations for this planned program during the current reporting period. Direct contacts within the program approached 24,000, including nearly 1000 with youth. Indirect contacts exceeded 11,000, including 1,900 youth. On-site observations and evaluations verified success in increased use of IPM and new cultivars, as well as control methods.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Food Safety

☑ 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
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources			100%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.5	0.0
Actual Paid	0.0	0.0	4.4	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	38524	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	222713	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	70522	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Work under this program is seeking to develop more efficient and sensitive analytical methods to

detect toxic chemicals and heavy metals in food and other related consumer products, and to determine if these products contain allowable amounts of these constituents. Decisions on whether or not foods are "safe" depends contaminant-specific tolerance levels established by the US Environmental Protection Agency (EPA) or the Food and Drug Administration (FDA). Progress was made on all objectives in this program. The activities, services, and events that reach people are designed to assist a broad, diverse group of stakeholders by disseminating scientific information to the public through the media, publications, and exhibits. People will have equality of service, ease of access to scientific results, and the ability to see laboratories and field plots. The state-generated outputs include numbers of food and consumer product samples tested, scientific publications, and talks and interviews. For example, in the current period the Department of Analytical Chemistry reported out results on more than 2,950 samples, with approximately 80% being food or food-related. The following activities were executed: (1) new analytical chemistry procedures developed and new platforms were evaluated, (2) staff members disseminated new information on analytical test results to visitors at open house events, in scientific displays at agricultural fairs, and in written scientific publications, (3) oral presentations were given to civic groups and professional societies, and (4) laboratories were opened to allow adults and youth to meet staff members and see analytical equipment. Direct interactions with a broad base of stakeholders provide a mechanism for public input on the research program. Non-traditional stakeholders are reached at agricultural fairs and other public venues when they visit Station displays. Results of these activities lead to specific outcomes, such as removing tainted or adulterated food items from the markets and greater public awareness of research on food safety.

2. Brief description of the target audience

A diverse group of targeted audiences includes: state and federal public health officials and regulators, state and federal legislators and their staff members, food producers and importers, managers of supermarkets, educators, extension specialists, researchers in the food sciences, and the general public. Women, members of minority organizations, and children are examples of under-represented and under-served groups who are expected to receive benefits.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1168	34	99	7

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	10	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Total research papers

Year	Actual
2014	11

Output #2

Output Measure

- # of talks and interviews

Year	Actual
2014	45

Output #3

Output Measure

- # of tests performed

Year	Actual
2014	2985

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	# of stakeholders gaining knowledge of food safety
2	# state and federal regulatory agencies making decisions on test results

Outcome #1

1. Outcome Measures

# of stakeholders gaining knowledge of food safety

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1168

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is great concern over the contamination of food and consumer goods with toxic chemicals or heavy metals. Food producers, retail operators, consumers, and consumer advocacy groups want assurances that foods contain safe levels of these constituents. Federal and state regulators request analyses of foods and enforce laws by recalling contaminated products from commerce. These programs include fresh and manufactured foods, as well as animal feeds, including raw and processed products. In some instances, as in the case cited below, products analyzed may occur in direct response to stakeholder concerns.

What has been done
The Department of Analytical Chemistry at The Connecticut Agricultural Experiment Station (CAES) has a market-basket surveillance program where food samples are collected by Department of Consumer Protection Inspectors and submitted for analysis. After solvent extraction, the food samples analyzed for over 1000 pesticides, poisons, and toxins, as well as select heavy metals. The US EPA sets tolerance levels for specific pesticides on food commodities. The USDA National Organic Program has regulatory jurisdiction over organically grown foods. The Organic Foods Production Act of 1990 indicates that a food product may only be sold as certified organic if it contains less than 5% of the allowable tolerance of a pesticide as set by the US EPA.

Results
In response to specific concerns from a consumer advocacy group over pesticide contamination of tea leaves, DCP inspectors were asked to collect a range of samples of tea bags for a targeted study. Results showed that 11 of 16 collected samples, including 3 organic products, contained violative pesticide residues. The neonicotinoid pesticides imidacloprid and acetamaprid were found in 10 and 11 samples, respectively, of the 16 analyzed. These findings were forwarded to the US Food and Drug Administration and the USDA (organic products) for regulatory response.

In addition to facilitating the integrity and safety of the food supply, this work also increases stakeholder knowledge and understanding. In addition, one local tea supplier contacted the laboratory for additional information so as to lower residue presence and improve product quality.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

Outcome #2

1. Outcome Measures

state and federal regulatory agencies making decisions on test results

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Department of Analytical Chemistry at The Connecticut Agricultural Experiment Station (CAES) is asked by other state and federal agencies to analyze consumer products for unwanted chemicals and heavy metals to determine if they are in compliance with labels or safe to use or consume. In some cases, these food and non-food related products are analyzed as part of routine surveillance activities and in others instances, as part of specific investigations.

What has been done
In response to an investigation by the CT Department of Consumer Protection Division of Drug Control, inspectors submitted several samples embargoed from a head shop in Waterbury CT. The concern was that the samples were labelled as having cannabidiols (CBDs). These analytes are DEA schedule one controlled substances and are regulated with tetrahydrocannabinol (THC). A number of samples were submitted, including a skin cream, vapor oils, and oral supplements. The DCP Drug Control inspectors requested analysis for a number of pesticides and heavy metals.

Results
Although the CBDs and THC were not quantified, there presence was confirmed, making these

products illegal in the State of CT. In addition, arsenic was found in 5 of 6 samples, including a level of 450 ug/kg in the oral supplement. The pesticide propamocarb was found at 180 ug/kg in the vapor oil. Although regulatory levels for these constituents do not exist for these commodities, the information supported an investigation involving these illegal and potentially unsafe consumer goods that resulted in the removal of these products from commerce.

4. Associated Knowledge Areas

KA Code	Knowledge Area
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Programmatic Challenges
- Other (Staff changes)

Brief Explanation

All scientist vacancies within this planned program are filled. If state budgetary constraints permit, efforts will be made in the next year to secure an additional food chemist position to work on emerging contaminants of concern in food and consumer products. Separately, two Postdoctoral Research Scientists were hired on a federal grant (US FDA) to assist work under this program. These are critical positions because the discipline requires the testing of toxic organic chemicals and heavy metals in range of products by a number of advanced methods on sophisticated equipment. Other scientists, who were working entirely on state projects with state funds, have been reassigned to part-time status on Hatch-funded programs. Objectives and goals under this planned program were met. However, we do note that competitive federal grant-funded positions are now a critical component of this food safety program.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Information on research and service results was obtained "during the program" by written and oral comments received at public meetings, our annual open house event, guided tours of the laboratory, civic groups' meetings, professional conferences and at Station exhibits. Observations made during interactions with stakeholders revealed positive sentiment about program effectiveness and value.

Key Items of Evaluation

The key items of evaluation and data collection were as follows: stakeholders' written and oral responses concerning food analyses; constructive written feedback from grant peer-reviewers for a competitive USDA and NSF grants; and responses and corrective actions by the State of Connecticut, USDA, and US FDA to remove suspect or adulterated products from commerce. Google Scholar indicated that articles written in previous years by several scientists were recognized and cited by scientists in this field (total citations were exceeded 870 during the reporting period).

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Human Health

☑ 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
722	Zoonotic Diseases and Parasites Affecting Humans			85%	
723	Hazards to Human Health and Safety			15%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	11.5	0.0
Actual Paid	0.0	0.0	6.0	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	164157	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	837952	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	231306	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Program objectives include investigating the mosquito vectors of encephalitis and related viruses, blood meal sources in engorged mosquitoes, if biological control strategies can control arthropod vectors, and which vertebrates serve as reservoirs for arthropod-transmitted pathogens. In addition, the role of invasive plants such as Japanese Barberry as refuges for disease-carrying ticks was investigated, and the impact of deer populations on tick-borne Lyme disease prevalence was evaluated. Last, investigations on bed bug presence and control were continued. Significant progress was made on all objectives, and measured outputs benefitted federal, state, and local public health officials, physicians, veterinarians, and the general public. The primary state-generated outputs include scientific publications, talks and interviews, identifying and testing ticks for the Lyme disease agent, characterizing mosquito species carrying viruses of concern, and numbers of stakeholders served by answering inquiries. Specific activities included (1) investigations on tick and mosquito control, including host/reservoir interactions, (2) dissemination of findings by giving talks and through interactions with traditional and social media, (3) analysis ticks and mosquitoes for pathogens, (4) answering stakeholder inquiries, and (4) coordinating with public health officials on the success of control methods. All program activities strongly emphasize public service to traditional and non-traditional stakeholders. An annual open house event allowed over 1,100 citizens, including nearly 150 children, to view presentations of research findings and to offer direct feedback and comment to CAES staff. These planned activities have and/or will lead to specific measurable outcomes, such as more efficient or environmentally sound methods of control disease carrying arthropods so as to decrease instances of human illness.

2. Brief description of the target audience

Research on human and animal health is of direct benefit to a broad range of stakeholders, including local and national public health officials, elected officials, the regulatory community, and the general public, including both traditional and non-traditional stakeholder groups. The general public was reached by means of agricultural fairs, open house events, and through traditional and social media. Oral presentations were given to public health officials, civic groups, and professional societies. Research findings were published in peer-reviewed journals, directly conveying program results to the broader scientific community. Stakeholders submit ticks through local health departments for identification and if engorged, the organism is analyzed for presence of the Lyme disease agent. Results of this analysis are then returned to public health officials and residents. Fact sheets and other information were posted on the CAES website. Additional efforts continue to be made to reach underserved and under-represented groups. Information on ticks and mosquitoes was printed in Spanish and a fact sheet on bed bugs was printed in Spanish, Chinese, and French. Four Spanish-speaking staff members are available to assist at the public inquiry offices as needed. Displays at agricultural fairs, our annual open house, and at other public venues were designed to interest children as well as adults. Cooperation with the Yale Peabody Museum, which has a $1.3 million Science Education Partnership Award from the National Institutes of Health, has continued to provide information on arthropod disease vectors for the development of middle and high school science curricula. This program is anticipated to reach hundreds of teachers directly and approximately 18,000 students indirectly 2016.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5590	7383	698	1478

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	16	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Total research papers

Year	Actual
2014	19

Output #2

Output Measure

- # of talks and interviews

Year	Actual
2014	167

Output #3

Output Measure

- # of responses to stakeholders' inquiries

Year	Actual

2014	2444

Output #4

Output Measure

- # of ticks identified or tested

Year	Actual
2014	2954

Output #5

Output Measure

- # mosquitoes identified and/or tested

Year	Actual
2014	192172

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	# of residents gaining knowledge of ticks, mosquitoes, bed bugs, and mold
2	# of media reporters gaining knowledge of ticks, mosquitoes, bed bugs, and mold

Outcome #1

1. Outcome Measures

# of residents gaining knowledge of ticks, mosquitoes, bed bugs, and mold

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	3530

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Prevalence of Lyme disease, human granulocytic anaplasmosis (HGA), and human babesiosis cases continue to increase in the United States. There were 36,307 confirmed and probable cases of Lyme disease reported to the Centers for Disease Control and Prevention in 2013. In 2013, the CDC officially acknowledged that the true number of Lyme disease cases was probably around 300,000 human cases per year. Without antibiotic treatment, persons can suffer from dermatologic, joint, cardiac, or neurological disorders. The mean cost per Lyme disease patient is about $1,965 (in year 2000 dollars). We found that there is zoonotic expansion of the human babesiosis in Connecticut and human cases increased 237% from 2011 to 2013. The pathogens for babesiosis attacks red blood cell and the disease can be fatal. The application of pesticides remains one of the primary methods for tick control in the residential landscape, and there is growing interest in biological, natural, and cultural methods in an integrated approach to reduce the risk of tick bite and disease.

What has been done
Field research was initiated in 2013 on an integrated tick management project to determine if an IPM approach could reduce the abundance of the tick Ixodes scapularis and the entomological risk of tick-borne disease (TBD). This tick is the main vector for the Lyme disease, HGA, and human babesiosis agents. The strategies include spraying the entomopathogenic fungus Metarhizium anisopliae, rodent targeted bait boxes, and deer reduction.

Results
Results from the first year of the study showed that natural product application reduced nymphal blacklegged tick populations on residential properties by an average of 75%. Reduced abundance or activity of nymphal ticks is of paramount importance in reducing risk of human infections during May and June in CT. These studies will have impact as guidelines to an effective IPM approach to tick management are needed for residents and communities to respond to the

increasing risk for TBD.

4. Associated Knowledge Areas

KA Code	Knowledge Area
722	Zoonotic Diseases and Parasites Affecting Humans
723	Hazards to Human Health and Safety

Outcome #2

1. Outcome Measures

# of media reporters gaining knowledge of ticks, mosquitoes, bed bugs, and mold

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	24

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Reporters and other members of the media often seek information on mosquitoes, ticks, bed bugs and associated disease causing organisms. There is also interest in information on how arthropod vector densities impact the spread of disease. West Nile, Eastern Equine Encephalitis (EEE), and related viruses constitute ongoing threats to human health by causing severe illness or death. Since its introduction into the United States in 1999, West Nile virus has sickened over tens of thousands of people resulting in nearly 2000 deaths. During this reporting period, there were six human cases of West Nile virus in CT, but no deaths were reported. The first human fatality of EEE virus occurred in CT during 2013 and was identified post-mortem during 2014. Public health officials have requested studies on the ecology of mosquitoes and viruses and biological control of mosquitoes.

What has been done
There were at least 24 reporters who sought information on bed bugs, mosquitoes and encephalitis viruses. Last year more than 192,000 mosquitoes were tested for viruses. Reporters and their viewers/readers gain knowledge about arthropod pests and vectors of disease by interviewing CAES scientists. Stakeholders specifically note concerns over viruses such as West Nile and Eastern Encephalitis that cause human illnesses. Viruses cultured from mosquitoes were identified by advanced molecular techniques. Results were conveyed to the general public via

press releases, social media and through coordinated efforts with the CT Department of Public Health. Tens of thousands of stakeholders were kept informed of recent research findings and the significance of new scientific advances.

Results
Twenty four separate reporters wrote articles on bed bugs, mosquitos and other disease carrying arthropods. The original articles were re-distributed by dozens of additional media venues that ran the original stories and content. These results had impact because mosquito control programs targeted the most important mosquito species and state residents took precautions to avoid mosquito bites. The long-term benefit continues to be healthy human and domestic animal populations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
722	Zoonotic Diseases and Parasites Affecting Humans
723	Hazards to Human Health and Safety

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)

Brief Explanation

A combination of federal and state grant funds were available for this research program, although shifts in scientists' work times from state projects to Hatch projects did occur. There were no delays in re-hiring temporary workers on grant funds, which is critical as traps and other techniques used require technical expertise not present among the general public. There were no changes in public policy, priorities, or research areas that impacted this program. Although a hiring freeze on state-supported positions has been reinstated, one vacant scientist position was filled in late 2014 and investigations conducted by that new staff member will positively impact this program.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As in previous years, "during program" and "after only" evaluations were conducted to assess program effectiveness. Verbal feedback from municipal and public health officials, as well as the general public, indicated significant ongoing interest in work conducted and results generated under this planned program.

Key Items of Evaluation

Data were collected mainly by on-site evaluations conducted following talks to specific civic or professional groups, as well as at our annual open house effect and other public venues. Significant direct interactions with traditional and social media, as well as with stakeholders, continued. Direct interactions exceed 6,000, including nearly 700 youth; there were 75 direct interactions with reporters and the media. During this reporting period, there were a total of 560 citations in Google Scholar for scientists in this program.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Sustainable Use of Natural Resources

☑ 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
112	Watershed Protection and Management			30%	
133	Pollution Prevention and Mitigation			70%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	5.0	0.0
Actual Paid	0.0	0.0	6.8	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	129015	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	676255	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	294679	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The main research objectives are to identify processes and mechanisms that characterize the fate of pollutants in soil and aquatic environments, to develop methods to remediate contaminated soil and water,

and to identify and develop methods to control invasive aquatic plants. Good progress was been made on these objectives. The fate and remediation program covers both fundamental and applied aspects, and deals with pesticides, volatile organic compounds, dyes, hormones and hormone-mimicking compounds, pharmaceuticals, petroleum hydrocarbons, munitions chemicals, and engineered nanomaterials. A special emphasis has been on the chemistry of pollutants at the soil-water interface. The objectives of the Invasive Aquatic Plant Program (IAPP) are to track occurrences of invasive aquatic plants, test novel controls and provide public outreach via talks, workshops and an invasive aquatic plant webpage. The webpage (www.ct.gov/caes/iapp) is an online repository for aquatic vegetation maps, herbarium specimens, and research results. Since 2004 IAPP has surveyed over 200 lakes. The program has found approximately 60 percent contain one or more invasive plant species. IAPP has published numerous research articles, and presented at hundreds of public education events. IAPP boasts one of the largest "Long Term Ecological Research" lake databases in the US. IAPP outputs include; new scientific findings, scientific publications, newsletters, bulletins, talks and interviews. In addition, a large number of state residents are served directly by visitations to infested lakes and ponds, identification of problems, and assistance with management. Participation by members of lake associations in group discussions and workshops are particularly important because these stakeholders need guidance on how to control invasive aquatic plants based on the latest scientific information. Often endangered or threatened species are in areas needing management and IAPP works closely with the CT Department of Energy and Environmental Protection to mitigate damage to non-target species. The outputs were new scientific findings; scientific publications, newsletters, and fact sheets; talks and interviews; and the number of state residents served directly by analyzing soil samples and by identifying and controlling invasive aquatic weeds. These activities, services, or events are designed to provide new information that can be used by the general public and to seek their input on the research program and findings. Information was made available to all stakeholders on the CAES website and other social media, in newsletters and fact sheets, and in displays at the open house events or at agricultural fairs. Articles in the press have been written on the research, thereby enhancing awareness of the problems. Results of these output activities did achieve or will lead to specific outcomes, such as removing pesticides from soil and water, identifying mechanisms by which pollutants behave in soil, clearing lakes and ponds of invasive aquatic plants, and preventing loss of water quality.

2. Brief description of the target audience

Stakeholder groups that directly benefit from this program include: farmers, lake associations, boaters, homeowners, water company officials, environmental organizations, extension specialists, corporate and municipal officials, pesticide producers, and the general public. Additional efforts were made to contact a broad base of under-represented and under-served groups, including members of minority organizations, women, and children.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	553	10	141	10

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	9	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Total research papers

Year	Actual
2014	12

Output #2

Output Measure

- # of talks and interviews given to stakeholders

Year	Actual
2014	43

Output #3

Output Measure

- # of diagnostic tests performed

Year	Actual
2014	11200

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	# of homeowners gaining knowledge on pesticide pollution and invasive aquatic plants
2	# of homeowners gaining knowledge about watershed protection and soil and water quality
3	# of lakes and ponds surveyed and/or cleared of invasive aquatic plants

Outcome #1

1. Outcome Measures

# of homeowners gaining knowledge on pesticide pollution and invasive aquatic plants

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1623

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Pollution affects human safety and health and threatens the vitality of the natural environment. We have addressed broad issues related to understanding the fate and biological accessibility of pollutants in the environment and the development of novel methods for removing pollutants from waste streams and decontaminating water and soil. We have also studied natural photochemical processes in the environment.

What has been done
Projects on fate and remediation of chemical contaminants carried out in 2014 include: the bonding forces controlling adsorption of charged compounds on surfaces of natural organic matter and charred particles; the aggregation of engineered nanoparticles in soil; sunlight-driven reactions of organic compounds and dissolved natural organic matter in marine waters; bioavailability of pollutants in environmental particles in models simulating the human digestive tract; sunlight-driven detoxification of contaminants in waste waters; the potential use of biochar (a charcoal-like product of biomass waste) in environmental remediation and soil fertilization; removal of commodity fumigants in vent streams; remediation of crude oil spills on land and sea; and emission of climate-warming gases from soil. Studies were initiated to investigate the role of charred biomass in emissions of nitrous oxide from fertilizer in soil.

Results
Compounds with pKa values close to those of carboxyl/hydroxyl groups on carbonaceous surfaces have been shown to adsorb by very strong hydrogen bonds. Biochar particles have been shown to aggregate irreversibly with engineered nanoparticles such as nano-CeO2. Through sunlight-driven photochemical reactions, organic compounds and dissolved natural organic matter in marine waters can become degraded and can incorporate halogen from bromide and iodide in seawater. The bioavailability of polycyclic aromatic hydrocarbons was tested in a laboratory model simulating the human digestive tract. Studies were done on optimizing conditions leading

to photooxidation of pharmaceuticals and hormones in brackish wastewaters using oxidants such as hydrogen peroxide and persulfate. Methods were developed to remove a commodity fumigant (methyl bromide) in fumigation chamber vent streams. Progress was made on using biochar as an absorbent for remediating crude oil spills on land and at sea. Studies were initiated to investigate the role of charred biomass in emissions of nitrous oxide from fertilizer in soil.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

Outcome #2

1. Outcome Measures

# of homeowners gaining knowledge about watershed protection and soil and water quality

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	11293

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers, landscapers, homeowners, and golf course managers frequently use commercially available fertilizers on specific areas of land. By law, all fertilizers are to contain a minimum or maximum of the guaranteed nutrient value as expressed on the label. In fact, the purity and label accuracy of these products is often critical to their successful use, as well as to efforts to minimize contamination of valuable soil and water resources. Notably, CAES was founded in 1875 for this very purpose. At the May 1, 1876 meeting of the Committee of the Trustees of Wesleyan University, the Preliminary Report of The Connecticut Agricultural Experiment Station stated that - the need for a fertilizer control system was so pressing and so vital to the interests of a considerable portion of the farmers of the State that it seemed absolutely necessary to turn the first efforts in this direction. Accordingly, analyses of fertilizers sold in the state were undertaken.- And so began a 140-year old product safety program for determining the composition and label accuracy of commercial fertilizers in the State of Connecticut.

What has been done
At the request of the CT Department of Agriculture, 93 commercially available fertilizer formulations were submitted to the CAES Department of Analytical Chemistry for analysis during

the current period. The analytes of interest are varied and include moisture, sand, organic content, ash, various forms of phosphorus and nitrogen, and select micronutrients. Current samples are analyzed by methods and guidelines described in the Official Methods of Analysis and the Association of American Plant Food Control Officials, respectively.

Results
Of the submitted samples analyzed during the current period, 36% were found to be deficient in one or more requested analytes. Findings are reported back to CT Department of Agriculture inspectors, who then initiate a regulatory response and investigation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #3

1. Outcome Measures

# of lakes and ponds surveyed and/or cleared of invasive aquatic plants

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	15

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Extensive growths of invasive aquatic weeds, such as Eurasian watermilfoil (Myriophyllum spicatum) and curly leaf pondweed (Potamogeton crispus) can significantly reduce water quality and alternative aquatic habitats. Stakeholders requested assistance with determining the species of aquatic vegetation and on integrated weed control.

What has been done
Staff mapped native and invasive aquatic vegetation in 6 new and 9 previously surveyed water bodies. The effects of eight years of winter drawdown on invasive plants were quantified in the States largest lake. Tests on controlling a new introduction in the state -Brazilian waterweed (Egeria densa) in Fence Rock Lake with bottom placement of herbicide were successfully completed.

Results

After eight years of surveillance, 60 percent of Connecticut lakes and ponds have been shown to contain invasive plants. These plants cover approximately 10 percent of the combined area of all Connecticut lakes and the problem is increasing. The coverage of Eurasian watermilfoil shows a negative relationship to drawdown depth and duration in Candlewood Lake. After no decrease in curly leaf pondweed in Grannis Lake in 2008 and 2009, grass carp were found to reduce the plants abundance in each year thereafter. We have largely restored Bashan Lake to preinfestation conditions after years of selective fall herbicide applications. Long-term benefits of this work will be the protection of native lake ecosytems and prevention of associated economic losses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Other (Staff changes)

Brief Explanation

There were no external factors that negatively affected outcomes during this reporting period. However, the current economy, changes in state or federal appropriations, and resulting staff changes remain the primary external factors that could affect outcomes. Although a state hiring freeze has been reinstated, one new scientist was hired during this reporting period and the resulting research being initiated will positively impact this program.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

"Before and after" and "during" evaluations were initiated to measure increased knowledge of aquatic plants and select other program issues. "During" evaluations were used to assess advances in stakeholder knowledge on soil and water quality issues. Direct stakeholder participation in the aquatic weed abatement programs, workshops and town meetings remains a value venue for results evaluation.

Key Items of Evaluation

Written information on evaluation forms following workshops, held in different towns, was an important information collection method for program assessments. During this reporting period, there were 1050 citations (Google Scholar) for scientific articles written by several scientists for the planned program. These citations indicate that knowledge was gained by scientists and used in their studies.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
0	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.