2014 Connecticut Agricultural Experiment Station - Research Plan of Work

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I. Plan Overview

1. Brief Summary about Plan Of Work

Executive Summary

Field and laboratory experiments, coupled with strong public outreach programs, are planned for the period 2014-2018 for the Connecticut (CT) Agricultural Experiment Station (CAES). There are ongoing and new research projects established in four major programs: Local and Global Food Supply and Security - Plant and Integrated Pest Management Systems; Food Safety; Human Health; and Sustainable Use of Natural Resources. In most cases, research is ongoing, and with replication of field trials, multiple years of work are required to fully meet objectives. There are 20 integrated, multistate projects planned that include scientists and extension specialists in land grant universities representing at least 40 states. International collaborations with scientists in 12 countries exist as well. For example, scientists in Joydebpur, Bangladesh have been trained in plant pathology, and a molecular diagnostic laboratory will be fully established to increase food production. Some shifting of scientist years' times from one program area to another is expected each year.

The majority of financial and human resources will be dedicated to local and global food supply and security. A major emphasis will be placed on implementing integrated pest management programs to increase crop production with less pesticide use. The latter also connects with sustainable use of natural resources initiatives. It is important to protect honey bees from pesticide contamination and to provide healthy flowering ornamental and other plants as food sources for these pollinators. About one-third of our food supply is linked to honey bee pollination. Growers need revenue to keep farms operating. Nutritious specialty crops, such as calabaza (squash), pak choi, daikon radish, edamame, leeks, and vegetable amaranth will be field tested so that new crops can be released for farm operations and to meet public demands. Ongoing studies include evaluations of 88 cultivars of 7 different crops for yield and resistance to destructive insects and plant pathogens. Biological, cultural, and chemical control methods will be developed to manage insect pests and plant pathogens. For example, grafting experiments on grapes will be continued to control crown gall and reduce winter injury losses. New surveillance and research will be conducted on the brown marmorated stink bug (Halyomorpha halys) and the spotted winged drosophila (Drosophila suzukii). Of Asian origin, both insects have destroyed crops, such as corn, grapes, stone fruits, and peppers, in eastern states. There will be CAES participation in multistate project NE-580, which was formed to study the stink bug. Moreover, there will be new investigations on determining the phytotoxic effects of nano- materials, such as pesticides and fertilizers, on squash plants and other selected food crops.

Research on food safety will be conducted in cooperation with the following state and federal agencies: CT Department of Consumer Protection, CT Department of Public Health (DPH), CT Department of Energy and Environmental Protection, Civil Support Team of the CT National Guard, US Food and Drug Administration (FDA), US Environmental Protection Agency, and the Federal Bureau of Investigation. More sensitive and specific methods of detecting toxic chemicals in foods, beverages, and other consumer products will be developed. Proficiency testing will be done in concert with the US FDA as a part of a counter-terrorism program in the Food Emergency Response Network. Ongoing market basket surveys will be conducted on domestic and foreign produce to assess pesticide residue levels. A new initiative, started in the previous reporting period, will be continued. In addition to analyzing foods for toxic chemicals at the CAES, there will be testing for microbial pathogens at CT DPH. Food samples will be divided for analyses, and results will be reported to all appropriate federal agency partners for product recalls or other regulatory actions.

Several arthropods of public health importance will be investigated to monitor human pathogens, detect emerging disease organisms, and to develop control methods. Molecular methods will be used to monitor the Lyme disease agent in ticks, to assess prevalence of a subtype of Powassan virus in ticks, and to identify encephalitis viruses in mosquitoes. Antibody tests will be developed to determine prevalence of different bacteria that cause Lyme disease (Borrelia burgdorferi) and granulocytic anaplasmosis (Anaplasma phagocytophilum) infections in white-footed mice, white-tailed deer, cottontail rabbits, or other wildlife species that could be serving as important reservoirs. Highly specific recombinant fusion proteins representing key immunogenic outer surface proteins of pathogens, will be incorporated in enzyme-linked immunosorbent assays for analyses. Studies on biological control of ticks, mosquitoes, and bed bugs will be conducted. The latter have become a serious problem in human dwellings and will be given high priority for control.

Sustainable use of natural resources programs are important for food production, drinking water, and recreation. Studies will be continued to reduce pesticide contaminants and fertilizers in soil and water, survey and control invasive aquatic and terrestrial plants, and to develop methods of enhancing soil quality by the addition of biochar or compost. New experiments will be conducted on the use of woodchips for composting in vegetable production. Studies will also be conducted on finding ways of removing pesticide contaminants from soil by phytoremediation.

Results of field and laboratory investigations will be transferred to the public by giving talks to civic groups, serving on advisory boards of civic organizations, conducting interviews with the media, posting information on an enhanced CAES website, and by publishing in peer-reviewed journals, book chapters, conference proceedings, and newsletters. Interactions with stakeholders at growers' meetings and providing diagnostic test results on insect pests and plant diseases provide opportunities for discussion and input on new problems. There will also be at least one major open house event where the public can meet scientists, tour research facilities, hear oral presentations, and provide written comments on evaluations. There will be increased cooperation with the Yale Peabody Museum in developing public-health related science curricula to educate K-12 students with the goal of reaching 18,000 students by 2016.

All research programs will be held to high ethical standards to ensure accurate and trustworthy findings. All newly hired scientists and technicians will be trained, as past researchers have been educated, on research integrity and provided instructions on proper record keeping, rules for authorship, and procedures on reporting scientific misconduct. Written policies exist on defining scientific misconduct, specific methods of investigating alleged misconduct, appeal rights, and final resolution of problems. There is "whistleblower" protection for those who report possible or actual scientific misconduct. These guidelines were first established in 2001 to comply with policies enacted by the US Public Health Service.

Overview

Pursuant to the Agricultural Research, Extension, and Educational Reform Act (AREERA) of 1998, USDA guidance, and other regulations, this updated Plan of Work is submitted for the period FY 2014-2018. Written stakeholder input received at meetings, workshops, open house events, and from correspondence has helped to identify the critical short-term, intermediate, and long-term agricultural and environmental issues in Connecticut (CT). The CT Agricultural Experiment Station, hereafter referred to as the "Station" or "CAES" is the oldest state agricultural experiment station in the United States. Founded in 1875, the institution remains a separate state agency unaffiliated with a university. The Station, however, has numerous collaborations with scientists, extension agents, and educators in at least 40 states and 12 countries, including joint research projects with scientists at the University of Connecticut (UCONN), Cornell University, University of Massachusetts, and Pennsylvania State University. Joint research exists with scientists in Bangladesh, Canada, Chile, China, Malaysia, Czech Republic, Israel, Peru, Great Britain, the Netherlands, Australia, and Turkey. Federal Hatch and McIntire-Stennis funds are received for research, but no federal funds are received for education or extension. Without teaching and extension responsibilities, Station scientists and technicians have time to do extensive outreach and research. Station scientists participate in 20 integrated, multistate projects and disseminate new findings to professionals in academia and extension. Five Station scientists contribute to the national eXtension

website (www.extension.org) as a part of Communities of Practice on bee health, consumer horticulture, eOrganic, pesticide environmental stewardship, grapes, and sustainable energy. This updated Plan of Work has a major commitment for integrated activities. Brief descriptions of research goals and information on joint projects are given as examples to show how research and extension are coordinated. This document and accomplishment reports are written for laypersons, including legislators and their staff members. Accordingly, an effort was made to minimize the use of jargon and highly technical terminology whenever possible.

Connecticut is a small state with several physiographic regions, extensive forests, and a population of over 3,500,000 people. Station scientists conduct research on agriculture, forestry, public health, and natural resources, such as soil and water, in areas characterized by urban sprawl, where quality of life is often defined by relatively small tracts of farmland, forests, and parks in an otherwise urban/suburban setting. Larger farms and rural areas still exist, however. Public drinking water is drawn extensively from protected surface and ground water supplies and aquifers. Protecting watershed areas is a high priority. Nearly 60% of the state is forested, and residential subdivisions have numerous trees. The Connecticut River Valley is highly fertile and has productive agricultural soils with low erosion potential. There are about 4,700 farms consisting of at least 400,000 acres. This includes about 200 commercial greenhouses on 180 acres. Agriculture employs about 20,000 persons and contributes about $3.5 billion annually to the state's economy. Connecticut is among the nation's top producers of fruits, such as blueberries, pears, and apples.Apples are exported to Israel. Connecticut has about 170 farms in maple syrup production. The nursery and bedding plant industries are major components of agriculture, valued annually at about $400 million. Annual gross revenue for Christmas trees is about $9.0 million. Moreover, the wood-products industry, which exports premium lumber, is valued at about $500 million annually. Clearly, Connecticut's farms and related businesses are not only important to its residents but also provide food for large human populations in New York City and Boston.

The CAES research programs are designed to advance knowledge of science, improve crop production and greenhouse irrigation systems, boost US agricultural production, ensure safe foods, protect the environment, and to enhance human health and well being. Although most projects have basic as well as applied components, a major goal is to solve agricultural problems. Future pilot research projects are now being considered to investigate climate change (eg., long-term monitoring of rainfall and temperature and the corresponding introduction of exotic invasive plants and insects). Work also is being planned on sustainable energy and enhancing international food security, all of which are priority areas for the National Institute of Food and Agriculture. Forward movement on new initiatives will depend on the availability of financial and human resources. The Station also has a strong commitment to public health; scientists conduct research studies on mosquitoes and encephalitis viruses, ticks and associated pathogens, and on the rising problem of bed bugs in human dwellings.

Developed with input from stakeholders, the Station's 5-year strategic plan includes broad goals to increase competitiveness of US agriculture in global and domestic markets, meet the challenges facing new farmers as they enter agriculture, train farmers on new methods, promote conservation and environmental stewardship, enhance rural economic growth, and create opportunities to expand agricultural products, markets, and research. Multistate projects are an important component of the Station's strategic plan because they encourage the blending of scientific expertise and, thus, more efficiently utilize scarce resources over broad regions to address common problems. The Station's portfolio of research projects is consistent with the mission of the Medium Term Strategic Plan for State Agricultural Experiment Station System and addresses national issues.

The logic model system has been used in this Plan of Work. There are 4 major research programs planned: (1) Local and Global Food Supply and Security - Plant and Integrated Pest Management Systems; (2) Food Safety; (3) Human Health; and (4) Sustainable Use of Natural Resources. All four programs have a balance of basic and applied research enhanced by a strong outreach effort, which transfers new findings to stakeholders. The first two programs are consistent with USDA priorities. It should be noted that financial resources and amounts of scientist years (SY) dedicated to each active program are recorded and verified by the scientists. In some cases, a given scientist's time may be divided among different programs. For example, a chemist working on food safety is also working

on soil quality. Therefore, the appropriate fractions of an SY unit (0.5 SY, etc.) are assigned to each respective program areas.

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

The Station's overall research effort is weighted heavily towards this program. The main goals are to apply new methods to improve crop systems and to boost agricultural production. Developing and implementing IPM programs to achieve more efficient farming practices; identifying microbial pathogens and nematodes, which affect plant health and yields; evaluating new cultivars of grapes, other fruits, and vegetables; controlling insects and mites on plants; and sustaining healthy honey bee populations are high priorities. One third of the US food supply is linked to pollination of honey bees; IPM programs protect these and other pollinator species. Basic and applied research on IPM, a major core program, is accomplished in concert with the Station's statutory responsibilities to annually inspect nurseries, survey forests, and to implement programs in nurseries and other agricultural settings. Crop yields increase when pest problems are controlled. It is important to protect flowering nursery stock, bedding plants, and trees, such as maple and willow, because they help to sustain honey bee populations. There are ongoing studies on the use of bacteriophages to control a bacterial pathogen infecting peach.

The control of insects, nematodes, and fungi that cause damage to crops has traditionally relied heavily on the use of chemical pesticides. This approach has caused environmental pollution, which threatens watersheds and insect pollinator species; encourages rising farm costs; and can cause increased health risks for persons who apply the pesticides or who enter treated areas. Moreover, the recent removal of or restrictions on the use of certain organophosphate insecticides on farms has motivated growers to consider alternative methods of pest control. As a part of ongoing studies, researchers will identify the efficient uses of biological controls, develop more accurate monitoring systems for pest populations, and identify the next generation of alternative strategies, such as using rapeseed as a cover crop and for the control of certain nematode species. Glucosinolates released from decomposing rapeseed vegetation can suppress Northern root knot nematodes (*Meloidogyne hapla*). Genetic traits of *Brassica juncea* are being investigated to find a cultivar that releases the most sinigrin, a predominant glucosinolate. Another objective is to build a knowledge base on IPM and train growers, including those who visit from foreign countries, on how to implement new monitoring systems and methods of pest control. In a new collaboration effort with scientists at the University of Massachusetts and the University of New Hampshire, a CAES plant pathologist is assisting 10 scientists at the Bangladesh Agricultural Research Institute to establish a diagnostic laboratory with state-of-the-art molecular tools. A workshop has been held to train scientists, but further efforts are planned to make these facilities fully operational. It is expected that findings from initial research investigations on controlling certain pests will lead to further studies on different pests, thereby, broadening the overall IPM effort and having global impact. The expected long-term outcomes will be increased agricultural production, more food for vulnerable human populations, a cleaner environment with improved watersheds, reduced farm costs, increased acreage in IPM, protection of crop systems and insect pollinators, and reduced health risks to humans. There are stakeholder requests to improve trellis systems and introduce new cultivars of table and wine grapes. Winter injury of grape plants and crown gall are serious problems for growers. Growers want to expand production with different grapes, but need research results on grape yields, sugar content, winter hardiness, and bacterial and fungus control. Station scientists are working collaboratively with investigators at Cornell, UConn (including extension), the University of Massachusetts, and the University of Rhode Island and were awarded a Northeast IPM grant to find ways to reduce amounts of fungicides in vineyards. To meet the needs of vegetable growers and under-represented and under-served groups (i.e., Hispanic, Brazilian, Black, and Asian populations) in CT, at least 88 cultivars of the following crops are being field tested: calabaza (squash), leeks, personal-sized watermelons, beach plums, edamame, garlic, Chinese cabbage, sweet potatoes, vegetable amaranth, pak choi, and daikon radish. With 11,000 acres of vegetable production and at least 114 farmers' markets in CT, there is an annual cash value of about $25 million for all vegetable crops. The Brown Marmorated Stink bug (Halyomorpha halys) and the spotted wing drosophila (Drosophila suzukii) have entered CT. Of Asian origin, both insects have caused

significant crop losses in the US. Methods of control are needed to protect fruits and vegetables.

Food Safety

This planned research program addresses public concerns. There have been numerous national news stories and government recalls of contaminated food and other products. Station scientists collaborate with personnel in the CT Department of Agriculture, CT Department of Energy and Environmental Protection, CT Department of Consumer Protection, CT Department of Health, CT National Guard, Federal Bureau of Investigation, US Environmental Protection Agency (EPA), and the US Food and Drug Administration (FDA). In the latter, the Station is an integral part of the Food Emergency Response Network (FERN) and receives federal funding to develop more sensitive and specific chemical detection systems, test foods and other consumer products for the FDA, and to be a back-up laboratory for federal and state laboratories in an emergency. During this reporting period, Station scientists continued to assist the FDA by developing new analytical procedures to test foods for toxic chemicals. State statutes mandate that the Station shall assist other state agencies in the testing of products for any unwanted chemicals, such as pesticide residues, lead, mercury, arsenic and other heavy metals, as well as industrial compounds (e.g., melamine). A new study has been initiated on nanoparticle contamination of agricultural crops with an emphasis on pesticide and fertilizer uses. A new USDA competitive grant was awarded to CAES to define the impact of nanoparticles on food crops with a focus on the risk posed to humans from exposure to these contaminated plants. Hatch funds will be used in this research. Monitoring pesticides in fruits and vegetables addresses important food safety issues to meet short-term critical needs. Connecticut is the only state in New England that has continuously monitored its food supply for pesticide residues. Numerous product recalls, some of which have occurred nationally, are an outcome of these efforts. Chemists will continue to work on improving analytical procedures, such as evaluating a new liquid chromatography/mass spectrometry protocol for the detection of pesticide residues in food. A novel Hydrophobic Interaction Liquid Chromatography (HILIC) stationary phase-based chromatographic column will be evaluated. The combination of HILIC with semi-aqueous mobile phase improves the performance of mass spectrometry. Chemists will also test honey bees, flowers, nectar, and pollen for neonicotinoid pesticides. This ongoing project, an example of how Station scientists work on problems in different planned programs, has 20 collaborators, including extension agents, from 15 institutions.

Human Health

The "Human and Animal Health" research program mainly consists of basic and applied projects on medically important arthropods, such as mosquitoes and ticks, and the viral, bacterial, and protozoan disease agents they transmit to people, domesticated animals, and wildlife (i.e., birds, deer, and rodents). Work will also be dedicated to research on controlling bed bugs in homes and hotels. This program was added because these insects have become very abundant and resistant to pyrethroid pesticides; new pesticides and monitoring traps will be evaluated.

During 1999, the West Nile encephalitis virus emerged for the first time in New York City and southwestern CT, resulting in dozens of human deaths. However, other encephalitis viruses also circulate in mosquito populations. For example, the LaCrosse virus and Eastern Equine Encephalitis (EEE) virus can cause severe human illnesses or death. Jamestown Canyon virus, prevalent in white-tailed deer (Odocoileus virginianus), can cause flu-like illness in people. The EEE agent has a 30% fatality rate in people. The first culture of the West Nile virus in North America was made at the CAES. This accomplishment had great impact because live virus cultures were made available to scientists at the Centers for Disease Control and Prevention, Yale University, and other institutions and companies. This discovery facilitated current research on vaccine development and molecular-based diagnostic tests at Yale University. Other important expected outcomes include the development of interferon treatment of viral infections. Ongoing research focuses on determining if two exotic mosquito species, Ochlerotatus japonicus and Aedes albopictus, carry encephalitis viruses. In Asia, both species are important vectors. To identify newly emerging viruses from other continents, RNA of viruses is being sought to build a reference collection. The mosquito research program at the CAES is combined with statewide surveillance of encephalitis viruses. Research objectives will focus on identifying blood meals in mosquitoes by using cytochrome b gene molecular analyses, detecting new viruses present in the state, sequencing the RNA of viruses to determine strain and virulence differences, and identifying which of the 50 mosquito species

present in the state are epidemiologically most important. Once identified, these key species will be targeted in control programs. Efforts will be made to control mosquitoes with biological (Bacillus species) agents, particularly in catch basins. The mosquito/virus surveillance program is an early warning system. When viruses become prevalent, press releases issued on a weekly basis will inform the public about the risks and how to prevent mosquito bites. The main goal of this program is to prevent human illnesses and deaths.

Lyme disease, human babesiosis, and human granulocytic anaplasmosis are common in CT and other states where *Ixodes scapularis* ticks are abundant. Tens of thousands of human cases have been reported nationally. The research program is divided into three major components: improving antibody detection assays for wildlife studies, detecting the DNA of the Lyme disease agent in ticks using polymerase chain reaction methods, and control of the tick vector. Highly specific recombinant fusion proteins are currently being evaluated as antigens in enzyme-linked immunosorbent assays to detect antibodies in deer, white-footed mice, and cottontail rabbits. The objective is to determine the role of selected wildlife species as sources of infectious agents or as monitoring systems in studies on the ecology and epidemiology of tick-borne infections. The DNA analyses add further information on the prevalence of the Lyme disease organism in CT. It is also important to find effective and safer methods of tick control, including deer management, for treatment in small areas, such as homeowners' backyards. In addition to using acaricides, nootkatone (a component of the essential oil from the heartwood of Alaska yellow cedar and an extract of grapefruit) and *Metarhizium anisopliae* Strain 52 and Bauveria bassiana are being evaluated in field and laboratory experiments. It appears that Powassan virus, which infects ticks and domesticated animals, is another emerging public health problem. The main goal of this planned program is to find ways of reducing tick-borne infections and human illnesses.

Sustainable Use of Natural Resources

This program is strongly focused on research to suppress or eradicate invasive plants and to prevent the overuse of fertilizers. Agricultural systems require ample supplies of clean water. Excessive use of fertilizers pollutes ground and surface waters and can cause damage to watersheds. In terrestrial habitats, Japanese barberry and Mile-a-Minute vine are invasive plants that have great potential to disturb forested settings and thereby negatively affect watershed areas. Extensive growths of Japanese barberry are also linked to increased tick abundance and human risk for Lyme disease because mice, an important host for *I. scapularis* larvae and nymphs, are protected from predators. Studies will be conducted to reduce Japanese barberry from the forest understory and reduce risk of Lyme disease. A beetle (Rhinoncomimus latipes) is being released to control the Mile-a-Minute weed. A milfoil weevil was released in Candlewood Lake, the largest lake in CT, to control Eurasian water-milfoil. Field experiments on the use of herbicides 2,4D, diquat, and fluoridone to control Variable water-milfoil and Eurasian water-milfoil in lakes have been completed with success. Experiments will continue on drawdown of lake water to control Eurasian water-milfoil. In addition, to track changes in aquatic species abundance and distribution over time, global positions system-based (GPS) bathymetric vegetation maps will be created and digitized along with text-based narratives; GPS-derived transects will be established within each treated lake or pond. About 10,000 soil samples, submitted by stakeholders, will be analyzed annually for acidity, and mineral and organic matter content to determine if fertilizer is needed in the farms, gardens, or lawns. The objective is to provide accurate laboratory results, and if fertilizers are not needed, to educate the public to avoid the excessive use of fertilizers.

To be useful, new scientific knowledge will be transferred to stakeholders in a timely manner. A strong outreach program operates to accomplish this. The Station has an extensive program designed to reach a broad audience of persons of all ages and racial and ethnic backgrounds in the state and nation. All Station scientists are required to participate in outreach activities. Technicians contribute to this effort on a more limited basis. Many new research projects have been initiated at the requests of stakeholders. For example, fruit growers have asked us to monitor the brown marmorated stink bug, an Asian insect pest that threatens a wide range of crops, such as corn, fruits, and peppers. When research objectives have been met, activities are terminated. The Station's website (www.ct.gov/caes) will be enhanced to include a Plant Pest Handbook, numerous fact sheets, publications, and databases. It is not uncommon to have 2.6 million page views annually; the average visit duration is about 14 minutes. A 30-

second video was produced to describe some core Station research programs and to pique public interest. The video will be shown at talks and is posted on the agency's website. Station scientists have good rapport with the media; hundreds of news stories are written for newspapers and television to reach stakeholders. Station administrators will transfer new scientific information to Members of Congress and state legislators as well. The public will be invited to tour Station facilities and to attend at least one major CAES open house to meet scientists, see laboratories and experimental plots, hear presentations, and to submit written comments on research programs. In addition, state residents will receive direct services when diagnostic tests are conducted, soil samples are analyzed, ticks are tested for the Lyme disease agent, or when people see Station displays at agricultural fairs. Information on plant diseases will be submitted from the Station's Plant Diagnostic Information Office to the National Plant Diagnostic Network (NPDN), extension offices at universities, and to the national extension website. However, not all of the Station's findings, such as tick analysis and insect identification, are reported to the NPDN. Results of food and product analyses will be reported to state agencies and the US FDA and US EPA. Under-served and under-represented populations will be reached mainly through the specialty crops program and distribution of fact sheets written in Spanish and Chinese on home-related insect problems. Moreover, adults and youngsters will hear hundreds of presentations given by Station staff members at meetings, workshops, and in schools. Youngsters will be served as a part of mentorship programs. Teachers educated on new scientific findings will incorporate the information in elementary or high school curricula. For example, CAES scientists will submit information on insect or tick-associated diseases to the Yale Peabody Museum. The information is used to develop science curricula for middle and high school students. The new teaching units are expected to impact 18,000 students by 2016. These outreach activities are very effective means of the Station indirectly contacting youth. In addition, lesson plans will be available on the American Phytopathology Society website. Direct and indirect contacts with adults and youth will be recorded. Finally, there will be publication of scientific articles in peer-reviewed journals to reach a very broad international scientific community. Those scientists who are primarily devoted to routine diagnostic testing, however, will write technical reports and fact sheets for the public even though they might not yet have publishable data for a peer-reviewed article.

Estimated Number of Professional FTEs/SYs total in the State.

Year	Extension		Research	
	1862	1890	1862	1890
2014	0.0	0.0	31.0	0.0
2015	0.0	0.0	31.0	0.0
2016	0.0	0.0	31.0	0.0
2017	0.0	0.0	31.0	0.0
2018	0.0	0.0	31.0	0.0

II. Merit Review Process

1. The Merit Review Process that will be Employed during the 5-Year POW Cycle

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

2. Brief Explanation

An external review process, with at least one outside reviewer, will be followed during this reporting period to evaluate project outlines for Hatch grants and other federal funds. As before, all scientific proposals for the Station will be subjected to merit and peer review following federal register guidelines and the National Science Foundation model (http://www.eng.nsf.gov/pet/review-2.htm). Merit reviews for proposals follow criteria proposed by the National Science Foundation (NSF-99-172). All scientific proposals and experimental findings of the Station will continue to be subject to the merit and peer-review process by persons who are qualified to critique the proposed studies. The distinction between merit review (project evaluation whereby the quality and relevance to state program goals are assessed) and scientific peer review (that performed by experts with scientific knowledge and technical skills to conduct the proposed work encompassed within the program) is recognized. Research priorities will be based on stakeholder input and state needs. Our priorities normally parallel national research priorities recognized by the Joint Council on Food and Agricultural Sciences, the Experiment Station Committee on Organization and Policy, and the United States Department of Agriculture. The proposed research will be of relevance sufficient for an organizational representative to make an informed decision as to whether the work is appropriate for federal and state support. Project outlines for Hatch, McIntire-Stennis, or multistate research funds will be prepared by scientists after consultation with the respective Department Head and will be independently reviewed by other qualified scientists within or outside the Station. In most cases, the reviewers are chosen by Department Heads. In addition, the project outline will be reviewed by the Department Head, who supervises the scientist, and by at least two other Department Heads (Chief Scientists) within the Station before the Vice Director or Director of the Station review the proposals and give final approval. The review process adheres to ethical standards on research integrity. All scientists and technicians have received training on scientific integrity. All new employees will be trained. Written policies are in place to review allegations of scientific misconduct; there were no complaints during this reporting period. The merit of the proposed scientific work will be evaluated to ensure that the planned research addresses established priorities that are consistent with stakeholders' needs, meets state and national USDA program criteria and goals, has sufficient funding, and has a reasonable likelihood of success with measurable outputs (e.g., peer-reviewed publications). Scientific peer review of research proposals (including grant funding) focuses on the suitability and validity of methods to be used (technical quality), originality of the study, and value of the work to the scientific community and the public. Proposals for all multistate research projects will be reviewed by at least three scientists outside the Station as well as those in the Station. The names of outside reviewers are not disclosed so that candid comments can be received. Station scientists are encouraged to publish their results in peer-reviewed journals that have national and international audiences and to also write reports for the general public. Scientific work is held to high technical standards. Although emphasis is placed on peer-reviewed journals as the main forum for reporting scientific advancements, persons who do not have scientific backgrounds will not be excluded from receiving information. They will have access to non-technical summaries, regional reports, and fact sheets prepared by Scientists and other staff in the Departments of Analytical Chemistry, Entomology, Environmental Science, Forestry and Horticulture, and Plant Pathology and Ecology. Fact sheets, pest management guides, and the Station's Record of the Year, which contains research findings will also be made available on the CAES website.

III. Evaluation of Multis & Joint Activities

1. How will the planned programs address the critical issues of strategic importance, including those identified by the stakeholders?

During federal fiscal year 2012, there were 29 Hatch research projects at The Connecticut Agricultural Experiment Station (CAES). Of these, 25 (86%) projects were multistate collaborations with scientists in at least 40 states, while 20 (69%) of these projects included jointly planned integrated activities. There are extensive external and internal linkages in staff and other resources, such as in the participation in the US FDA's Food Emergency Response Network (FERN) and National Plant Diagnostic Network (NPDN). Stakeholders participate by allowing experiments to be conducted on their properties and have identified the following main critical issues that need attention in the planned programs: (1) development of IPM programs to reduce amounts of pesticides used and to decrease farm costs; (2) effective immediate control of insect and plant pathogens; (3) development of efficient plant management systems that include specialty crops; (4) more efficient detection of human pathogens transmitted by ticks and mosquitoes and the transfer of new information to stakeholders; (5) ensuring that food products are free of harmful chemicals; (6) mitigation of pollution problems such as indoor mold and invasive aquatic weeds; and (7) expanded outreach programs to report new scientific findings. In some instances, immediate solutions can be found, such as finding ways of controlling insect and plant pathogen pests to reduce crop damage and preparing more fact sheets on scientific results. However, most critical issues are complex and will require long-term research efforts in replicated field studies. Although analyses of food items for chemicals are almost entirely laboratory-based, this critical issue is considered intermediate because in some instances, analytical methods will need to be modified to improve accuracy and reduce the amount of time needed to obtain results. For example, the US FDA requested assistance on evaluating new analytical methods to detect ricin in meat as part of excercises in proficiency testing. The FERN initiative links several states with federal laboratories in a counter-terrorism program. The multistate and integrated programs offer many advantages and enhance efforts to achieve goals. Scientists, who have different educational backgrounds in multiple disciplines, will work together in designing experiments and evaluating results. Equipment and human resources will be pooled across state lines, experiments will be conducted in different settings, and key reagents will be shared. This regional or national approach, with unique capacities of the participants, is the most efficient way of addressing all of the above-stated critical issues of strategic importance. The extension component with Cornell, the University of Connecticut, and other universities will be a key mechanism for transferring information and technological advances to a broad base of stakeholders. Participation in the national extension website as a part of Communities of Practice adds to this effort. The analyses of food products for unwanted chemicals is an example of how the food safety critical issue will be addressed using state and national resources. The Department of Analytical Chemistry receives sample food products from other Connecticut state agencies for analyses per state statute and also receives samples as a part of FERN. Scientists in this department will also collaborate with Federal Bureau of Investigation agents, personnel in the Civil Support Team of the CT National Guard, researchers in other states, and with federal scientists and officials in the US EPA. Under FDA guidance, CAES scientists are formally participating in the FERN and can officially test potentially contaminated foods and other products from other states in the event of a bioterrorist attack or other emergencies. Conversely, scientists in other states can test samples from Connecticut if necessary. Standardized equipment and reagents will be shared among collaborators.

2. How will the planned programs address the needs of under-served and under-represented populations of the State(s)?

The planned multistate and integrated programs will address the needs of under-served and under-represented populations in Connecticut. Since these research initiatives are very broad-based in approach, all persons will benefit by having (1) a cleaner environment with pesticide use reduced; (2) healthy plants and forests; (3) locally grown produce; (4) a decrease in human disease, such as Lyme disease and West Nile encephalitis; (5) safer foods to eat; and (6) by having less pollution problems due to indoor mold, invasive plants, and overuse of fertilizers. There are specific research initiatives planned to assist the under-served and under-represented individuals in Connecticut. Over the past decade, there has been a notable increase in the Hispanic and Asian populations in the state. Accordingly, there have been requests from these stakeholders to evaluate selected plant cultivars to ultimately introduce the following specialty crops: calabaza (squash), jilo (African eggplant), edamame, vegetable amaranth, beach plums, personal-sized watermelons, and artichokes. Blacks and Asians have requested that leeks, pak choi, daikon radish, Chinese cabbage, garlic, okra, and sweet potatoes be grown and introduced to Connecticut farmers so that these produce items can be sold in local markets. These studies are in progress. In addition, assistance will continue to be given as needed to two Native American tribes (Mohegan and Pequot) in Connecticut on more efficient forest management practices. The Station has a strong outreach program, which transfers research findings and services to under-served and under-represented individuals. This is being accomplished mainly by distributing written information in Spanish and Chinese and by educating high school teachers and students who visit and tour the Station's facilities. Minority applicants and women are sought and trained for Postdoctoral Research Scientist and summer worker positions. The latter are recruited from inner city and suburban high schools and colleges and universities and are located by advertising in newspapers, contacting school officials, and meeting students at science fairs. Minority applicants, with an advanced or basic knowledge of science and mentoring from scientists, perform well and contribute greatly to the research programs. Spanish-speaking stakeholders need assistance to improve English proficiency. Efforts will be made to have one scientist, who speaks Spanish, assist stakeholders who wish to obtain arborist certification for employment with tree companies. Results from two multistate and integrated programs (tick management and mosquito/virus studies) are printed in Spanish to reach stakeholders. A fact sheet on bed bugs has been written in Spanish, French, and Chinese. Another fact sheet on boxwood blight was written in Spanish. Children have been identified as an under-served group. Staff members at the Station will cooperate with school officials and teachers statewide and will participate in Farm/City Week to encourage hundreds of youngsters to see experimental plots and learn about science. Other children, their families, and teachers will be invited to a Station open house (Plant Science Day) in August to meet scientists and learn about research findings. Also, at harvest time, there are about 21 tons of produce available at the conclusion of experiments. Based on US Census American Community Survey, poverty has increased in Connecticut since 2007; 320,554 people now have incomes under the federal poverty level ($20,050) for a two-parent household with two children. According to the Connecticut Food Bank, the state is listed among the "Top 10" states with the highest increase of children who are food insecure. It is estimated that about 280,000 state residents in 50,000 households or shelters are hungry each day in Connecticut. Surplus fruits and vegetables will be donated to charities and food banks for the needy. Finally, scientists who conduct studies on crop systems assist inner city residents in the Bridgeport, Hartford, New Haven and Waterbury community garden programs. A program on testing soils from community gardens in Connecticut cities and towns for heavy metals and pesticides is being jointly planned among Station scientists and an extension specialist at the University of Connecticut. Most of these gardens are located in urban areas. Raised beds were installed in areas where soil was contaminated with heavy

metals (lead, mercury, cadmium, etc.). Results of multistate and integrated research programs are and will be applied in managing these and other crop systems.

3. How will the planned programs describe the expected outcomes and impacts?

Outcomes reflect changes in knowledge, actions, or conditions that stakeholders accept based upon new knowledge, while impacts occur when a societal, economic, or an environmental condition is improved based on actions taken as a result of joint research activities and outputs. Station scientists will collaborate extensively with colleagues at many US and foreign universities as well as state and federal agencies to enhance research expertise and support, disseminate information, or take actions, including regulatory actions, based on findings and the needs identified by stakeholders. The Station has no formal extension responsibility. Therefore, the extension component is mainly linked to the University of Connecticut, University of Massachusetts, and Cornell University. One of the Station's mandated statutory functions is to disseminate IPM research results to Cooperative Extension at the University of Connecticut. In addition, the Station's diagnostic services assist the University of Connecticut and are linked to Cornell University through the National Plant Diagnostic Network. Multistate, integrated programs will: (1) secure economic benefits for farmers and other stakeholders, (2) convince stakeholders to use IPM practices, thereby reducing human exposure to pesticides and environmental contamination and solve certain pest problems, and (3) inform residents about human diseases associated with ticks and mosquitoes to help mitigate risk. The development of more efficient farming programs in nurseries, greenhouses, vineyards, orchards, and vegetable plots is a high priority and a major component of 14 integrated multistate projects. In nurseries, for example, it is expected that the implementation of monitoring systems for pests and effective use of biological controls will provide opportunities to show growers economic benefits associated with reduced costs for chemical treatment, resulting in less human exposure to pesticides, and reduced amounts of chemicals leaching into watersheds. Similarly, new cultural, biological, and other control options for managing weevil species will help reduce economic and environmental costs associated with pesticides currently used. It is expected that research will identify more efficient uses of nutrients in greenhouses and in the field and determine what new specialty crops will result in increased profits for farmers. Outreach efforts will inform under-served and under-represented residents that progress has been made on providing quality produce of interest to these stakeholders. Encephalitis and tick-associated diseases affect numerous stakeholders nationally. Our human health planned program will monitor changes in encephalitis virus infection rates in mosquitoes, develop more sensitive and specific diagnostic antibody assays for humans and wildlife (e.g., mice, deer, etc.) by using recombinant fusion proteins as antigens, and will identify methods, particularly alternatives to the use of area-wide chemical pesticides, for reducing ticks on homeowners' properties or mosquitoes on municipal properties (e.g., catch basins). Long-term experiments will be conducted to reduce ticks by decreasing deer herds. A trap-monitoring device will be evaluated for bed bug detection in treated and untreated human dwellings. The expected outcomes will be improved, higher yielding crop systems, reduced farm costs, and healthy human and domestic animal populations.

4. How will the planned programs result in improved program effectiveness and/or

The planned multistate and integrated programs are designed to have interdependency and will result in improved program effectiveness and efficiency. Declining financial and human resources and rising costs for research have made it difficult for a given scientist to achieve goals without collaborators and federal grant funding. Multistate funds can leverage other grant funds to boost resources. Collaborating scientists, who also have extension appointments at Cornell, the University of Massachusetts, or the University of Connecticut, offer added expertise and will improve program efficiency by disseminating research results to a broader

base of stakeholders. As examples, the following planned projects are briefly discussed to more specifically describe how there will be improved efficiency. (1) Multistate project NE-1020 focuses on grape cultivars. Some of these cultivars are developed at Cornell University and are evaluated for plant disease resistance, yield, and winter hardiness by researchers in Connecticut and other states. Plant breeders are not employed at every experiment station, and a thorough evaluation of a particular cultivar must be performed and replicated in widely separated sites with different climates, soil types, insect populations, etc. The high transportation costs make it difficult for Cornell scientists to travel to field plots in New England. Accordingly, plant breeders at Cornell will work with horticulturists, plant pathologists, and IPM specialists in Connecticut to identify cultivars that grow best in southern New England. There are similar collaborations with scientists at the University of Connecticut, the University of Massachusetts, and at the University of Rhode Island on testing more than 20 grape cultivars, monitoring for fungal infections caused by excessive rainfall, and testing grafting procedures and different trellis systems. (2) Tick-borne and mosquito-transmitted infections affect people throughout the US. Not all scientists have the laboratory facilities or access to key reagents to test ticks and mosquitoes for pathogens or to detect antibodies in serum samples. Scientists at Yale University can produce molecular-based reagents but do not have certain pathogens or reference antisera (stored at the Station) to perform specialized tests. Scientists (pathobiologists) at the University of Connecticut can perform diagnostic tests not available at the Station. A collaborator at the University of New Mexico has expertise in the molecular detection of Powassan virus in ticks. Scientists from different institutions will blend their expertise and share reagents and knowledge to determine how prevalent Powassan virus is in deer, dogs, or horses. Plaque reduction neutralization tests will be used. Since Yale and the Station do not have an extension system, collaboration with a veterinarian in the University of Connecticut extension program will be used to help inform stakeholders. (3) Plant nematodes are destructive to several crops throughout the US. Strawberries and vegetable crops are affected in northern states, while peanut and other crops are damaged in the South. Multistate project (NE-1040) has 13 plant pathologists, molecular biologists, plant breeders, and extension personnel working together to find biological and cultural methods to manage nematode populations. An assay developed by biochemists and molecular biologists in Florida will be used to test for a biological control agent in soil samples from northern states, where plant pathologists are performing field studies. Finally, 19 scientists at eastern and mid-western states will collaborate to determine the cause(s) of colony collapse disorder in honey bees in a multistate project (NC-1173). A Station scientist will test pollen and honey bees for neonicotinoid and other pesticides, while scientists in other states will investigate viral and bacterial pathogens. Beekeepers will participate by providing samples of honey bees for analysis. A new multistate project (NE-580) will address control options for the Brown Marmorated stink bug.

IV. Stakeholder Input

1. Actions taken to seek stakeholder input that encourages 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.

During these times of diminishing state funds and the threat of federal cutbacks, public support for research programs will be critical. Public input and participation are encouraged directly by inviting representatives of numerous traditional stakeholder organizations as well as the general public (non-traditional groups) to attend open houses in the spring and summer (Plant Science Day) to tour Station facilities, to meet scientists, and see experimental plots and laboratories. Participation in public meetings, giving oral presentations to citizens' groups, use of the media to announce Station meetings and report research findings, responding to public inquiries, and serving on advisory boards of stakeholder organizations are also effective open and fair processes for scientists to target traditional and non-traditional stakeholders, foster customer satisfaction, and to invite citizen input and participation. Following talks, question and answer periods are particularly useful in receiving stakeholder input on justifications for research and relevance of research findings. Written comments will help in adjusting research priorities. Insect and plant disease problems need immediate attention, and all residents of Connecticut have ease of access to diagnostic services, including the NPDN. More than 20,000 stakeholders, representing traditional and non-traditional groups benefited directly from CAES programs annually. This figure is derived from the total number of letters, e-mail messages, and visitations to Station facilities; requests for diagnostic tests; persons served by staff lectures to civic groups; and media requests for information. Agricultural, public health, and environmental problems generate considerable stakeholder interest and, under these circumstances, it is relatively easy to encourage the public's participation in research. For example, many farmers allow Station scientists to perform their experiments in their fields or greenhouses and, thus, collaborate with scientists in designing experiments, obtaining data, evaluating results, and seeing progress made. For example, a new strawberry cultivar (called Rubicon), which is resistant to the black-vine weevil and a fungus that causes root rot, is being evaluated in growers' fields. A patent application has been submitted for this plant. Several experiments on grapes will be conducted in growers' vineyards. Daily contact with growers allows for frank dialogue, and encourages interest and exchange of information. Direct public input benefits research programs. Local health department staff work closely with mosquito biologists in developing mosquito control programs and controlling bed bugs. Veterinarians will provide serum specimens from domestic animals for research. Nursery growers will donate plants for studies and closely follow research progress. Special contacts will be made with farm groups, civic organizations, commodity associations, and government agencies to reach under-served and under-represented groups. In the past, these actions have stimulated interest among Blacks, Hispanics and Asians and resulted in requests for us to grow vegetables of interest to these persons. For example, persons of Asian decent have requested evaluations of pak choi and edamame as possible new crops for local markets. Station scientists considered the economic value of growing specialty crops and, in field tests, identified cultivars of calabaza, leeks, garlic, okra, jilo, artichokes, pak choi, sweet potatoes, edamame, and Chinese cabbage that grew well in Connecticut. Evaluation forms will be designed by scientists to seek written stakeholder input and participation at statewide public meetings, open houses, and workshops. Tens of thousands of people see Station exhibits annually at major events, such as the Hartford Flower Show, Woodstock Fair, and Eastern States Exposition. Scientists and other Station staff will stand by their exhibits during normal work hours and discuss research results. Attendance at flower shows is particularly effective in attracting interest from people not in the farming community. Members of the Experiment Station Associates (ESA) will promote the scientific activities of the Station and publish a newsletter

describing scientific studies and findings. This publication will be made available to members of the ESA, state legislators, and to the general public. Moreover, Station scientists will give research reports at an annual public meeting of ESA. Comments and questions will be encouraged from stakeholders following the talks. The Director or Vice Director of the Station will also continue to give research reports to the ESA Board of Directors at bi-monthly meetings and to seek input.

2(A). A brief statement of the process that will be 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.

Several methods will be used to identify individuals and groups who are stakeholders and to collect input from them. Stakeholders are defined as persons who have the opportunity to use or conduct agricultural or public health research and benefit from outreach activities in the state or nation. Experiment Station staff members are available to give talks to agricultural and forestry groups, other civic groups, and students at all levels of education. Those persons interested in hearing about and using scientific results are stakeholders. In addition, farmers and other people who visit Experiment Station displays at agricultural fairs and other events, attend public meetings and listening sessions at Station facilities, and who request information and assistance by phone, written communication, or by visiting Station laboratories and field plots are identified as stakeholders. Although advisory committees, listening sessions, and needs assessments are important processes of identifying individuals and receiving input, the use of surveys/evaluations at public meetings and workshops will be relied on more heavily to receive stakeholder input. The CAES is committed to facilitating equality of service and ease of access to all research, service, and outreach activities, including information generated by experimental work. Although this policy allows for multiple mechanisms to reach and identify non-traditional and traditional stakeholders, we have found that direct contact with people is most effective.

2(B). A brief statement of the process that will be 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.

In most instances, research objectives for Hatch and McIntire-Stennis programs are established as a direct result of stakeholder input and participation. The Station utilizes different methods to identify stakeholders (i.e., end users of agricultural and public health research) and receive their input on past achievements, identifying problems, and on planning research so that critical issues in Connecticut can be appropriately addressed. In a broad sense, stakeholders are those persons who are interested in and benefit directly or indirectly from agricultural research, including forestry. The Science Citation Index identifies scientists in other institutions who use the Station's published works. Scientists, legislators and their staff members, business owners, municipal officials, administrators, forestry officials, landscapers, groundskeepers, industry personnel, state and federal workers, students, and consumers of agricultural products are stakeholders. Some of these persons have opportunities to use or conduct research activities. Growers, who implement IPM programs or other more cost-effective farming practices, are examples of primary beneficiaries because farm costs and human exposure to pesticides will be reduced. Multiple processes will be used to identify individuals and groups who are stakeholders. Open house events and more formal meetings on special issues will be held to allow people to hear presentations and provide written comments. Those who attend will be considered stakeholders. Open listening sessions will be held to meet with more specialized groups (e.g., those who grow apples or Christmas trees). Individuals who visit the Station and directly use diagnostic services are stakeholders. This group represents a broad base of residents and includes many people outside agricultural communities. In addition, persons who visit Station exhibits at agricultural fairs and who request information on agricultural issues are stakeholders. A variety of methods will be relied on to collect stakeholder input. Survey or evaluation forms will be used at public meetings, open houses, and at workshops to receive voluntary written input. These methods are effective tools for gathering information and will be an adjunct procedure used along with summarizing verbal suggestions from traditional and non-traditional individuals. Verbal comments are logged into computer databases (separate from the NPDN national repository) for later consideration and possible shifts in program activities. When scientists attend growers' meetings, they will invite these people to participate in research programs and to provide input on experimental design. For example, 14 multistate research projects (supported by Hatch funds) are designed to investigate a variety of agricultural problems. Stakeholders are participants in these research efforts. Many other experiments will continue to be conducted on growers' farms or in greenhouses so that these people can be directly involved with the research, including the planning process, and can receive immediate results. Station scientists will also collect stakeholder input by serving as members or officers of board of directors for more than 100 civic organizations. This activity will provide additional opportunities for people to learn about Station research and to comment on the programs. This effort will be continued to receive input and to increase contacts.

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.

Stakeholders' input must be considered in different ways to be effective. Comments from the public will help identify immediate problems and facilitate the setting of research priorities. However, because of financial and staff limitations, requests for assistance or new projects are prioritized for human health, food safety, food production, and water quality. If research support remains after these commitments, other projects will be included. Experimental design is sometimes revised after receiving feedback from growers that field studies or trials are not progressing well. For example, control work on a sap beetle that attacks strawberries has been ineffective. This line of research was terminated in a prior reporting period, but some new ideas on chemical control have arisen. Therefore, work on this pest will be resumed. Alternative methods of insect or plant pest control sometimes need to be implemented to make good progress. In other instances, major shifts in the direction of the research program are required to properly address problems. Summarized below are some examples that describe how stakeholder input was considered in making programmatic decisions. Connecticut residents reported to Station scientists on salt marsh dieback. The cause(s) is unknown. Research was started to determine the factors responsible for dying grasses. Stakeholder concerns about Ramorum Blight (Sudden Oak Death) led to a special request for emergency state funds to renovate and equip a new laboratory to increase the capacity for diagnostic testing. This was later strengthened when the Station participated in the National Plant Diagnostic Network. Bed bugs have become widespread in distribution and very abundant in hotels, homes, apartments, retail centers, schools, and theaters. Pest control operators and citizens requested information and research on control. Workshops were conducted to educate attendees on control of these insects. Research on bed bug monitoring and biological control has started. Based on stakeholder input, studies were initiated to control invasive aquatic plants. The discovery of an exotic insect pest, the small Japanese cedar longhorned beetle in Connecticut, was a direct result of stakeholder input. A person brought a dying branch from an ornamental plant into the Station's diagnostic laboratory for examination. The insect was later found to be infesting red cedar trees in coastal areas of Connecticut and other northeastern states. An urgent emerging issue was identified and an emergency action plan was implemented. Infested nursery stock then needed pesticide treatment before certain plants could be shipped to other states. In a special public meeting held with over 40 nursery growers, it became clear that research on chemical treatment was required. Studies were conducted, and a solution was found. Plants worth hundreds of thousands of dollars were shipped rather than being destroyed under quarantine regulations. Fruit growers asked for assistance on monitoring and control of the brown marmorated stink bug, a significant agricultural pest. Similarly, grape growers have recently asked that studies be initiated on the spotted wing drosophila. Beekeepers requested a state action plan for Africanized honey bees and wanted studies conducted on the cause(s) of colony collapse disorder. The plan was developed, and first responders (i.e., town and city emergency personnel) were trained on how to depopulate a honey bee colony or swarm. Stakeholder attendance and participation in open house events and public meetings is essential to obtain valuable guidance on problems. Stakeholder suggestions on topics to be covered at these meetings will identify relevant issues, help improve communication, and make these events more

meaningful for everyone. Judgment on accountability of how well state and federal funds are used for research ultimately rests with the stakeholders. Therefore, the opinions and perceptions held by these people will be considered by scientists and administrators in all aspects of research program development, execution, and the distribution of results. Once written input is received, summaries of the comments will be transferred to the respective Department Heads and the Director for consideration. The Director of the Station will then discuss the issues at regular administrative meetings with department heads or other staff members.

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

2. Brief summary about Planned Program

Development of more efficient farming practices, based on IPM, can have positive impacts locally and globally. Increased agricultural productions in the US and foreign countries can greatly aid efforts to meet the growing demand for food. Training foreign scientists and establishing a plant diagnostic laboratory in Joydebpur, Bangladesh will greatly benefit food production there. Methods need to be developed to reduce pesticide and fertilizer use and to prevent human and honey bee exposure to insecticides and other pesticides. For example, increased agricultural production depends on having healthy honey bee and other pollinator species. Trees, such as maples and willow, and flowering bedding plants and nursery stock help to sustain insect pollinator populations. Apples are exported from Connecticut to Israel each year. About one third of the US food production depends on pollination by honey bees. Reintroduction of hybrid chestnut trees, good sources of nutritious nuts, relies on early detection and control of insect pests and plant diseases. Some forest insect pests attack fruit trees. Therefore, forests located near fruit orchards need to be healthy. Screening cultivars of grapes and vegetables for resistance to insects and plant pathogens is a major research initiative. Studies on evaluating soybean and rapeseed as cover crops, to prevent soil erosion, and on testing rapeseed to control parasitic plant nematodes of fruit trees and vegetable plants demonstrate a multistate and multidisiplinary effort with an IPM component. Experiments will be conducted on glucosinolate releases (sinigrin being an important ingredient) from decomposing rapeseed to control Meloidogyne hapla. A grant proposal for IPM in vineyards, which includes extension personnel at the University of Connecticut, has now ended. Initial studies have been completed. The focus of this research was to develop a predictive model, based on rainfall and temperature, for fungal infections of grapes. The goal was to specifically determine risk of infection and the most efficient time for the application of fungicides. Model systems are operational and will be under continued evaluation. Station research includes the following core areas: (1) investigations of plants and their pests; (2) development and implementation of IPM systems; and (3) enhancement of agricultural production by introducing new crops that require little or no pesticide treatments and better management practices, such as improving grape trellis systems and introducing pest-resistant cultivars, such as strawberry. The Station's website, published reports of research findings in newspapers and scientific journals, scientists' presentations to and interactions with the public, and open house events are most effective in disseminating findings to stakeholders and provide evidence of the research program's success. Laboratory and field experiments will be designed to control insect pests and plant diseases and increase crop yield; increase farm efficiency and income; and to protect agricultural workers and residents from pesticide exposure. Moreover, forest plots will be monitored annually by ground and aerial surveys to detect emerging insect, plant disease, and invasive plant problems, such as Japanese barberry and Mile-a-Minute weed. The Station is the official state plant regulatory agency, which is responsible for monitoring forest health, detecting exotic pests, and registering and inspecting the state's nurseries and honey bee colonies. Finally, new crops will be evaluated for quality and yield to provide vegetables and fruits that are desired by under-represented groups. The current IPM research program has existed for about 8 years, and the expected future program duration is planned as long-term (more than 5 years). Although some results are obtained and goals are met in the short term, replicated field experiments will take several years to complete. Replicated trials will be required in different years and on different plots to obtain statistically valid data on varying growing conditions. Shifts in priorities within each core area are anticipated as new agricultural concerns arise, such as the brown marmorated stink bug and spotted wing drosophila, and as solutions are found for existing problems.

3. Program existence : Mature (More then five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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 (Situation and Scope)

1. Situation and priorities

Based on stakeholder input, there are 4 important issues identified for high priority research: development of IPM programs, promptly solving emerging pest problems by using chemical or alternative control methods, growing crops for prevention of soil erosion, and introduction of specialty crops. Development of IPM programs is particularly important because of broad-based public concern and perceptions that pesticides are over used and beliefs that these chemicals cause cancer and other diseases as well as polluting ground and surface water. Moreover, with rising food prices, there is increased interest in home gardening. People do not want to use pesticides on the foods they will consume. Growers want more efficient methods of pest control to reduce farm costs and to lessen liability due to workers' exposure to pesticides. Current work indicates that less toxic chemical pesticides can be used to solve immediate, emerging pest problems and that implementation of IPM practices over the long term can indeed be successful in decreasing pesticide use, human health risks, and farm costs. Also, there is interest among consumers and farmers for specialty crops, such as calabaza, artichokes, edamame, leeks, sweet potatoes, vegetable amaranth, pak choi, daikon radish, garlic, and Chinese cabbage. A major goal is to have locally grown, fresh produce consumed by students in school systems. Protecting honey bees and other insect pollinators is a high priority. Economic development is needed in rural areas. Several factors and criteria were considered in determining research priorities. First, the problem or issue must be of state and national relevance. Whenever possible, research results also must ultimately have measurable economic, environmental, or health impacts. Moreover, there must be adequate financial and experienced human resources to conduct the research. Laboratories must be suitably equipped to perform the required analyses. Finally, there must be existing collaborations with scientists in US and foreign institutions to increase the likelihood of efficiently solving the problems or completing research objectives. It is important to boost US agricultural production, improve global capacity to meet the growing food demand, and to fight hunger at home and abroad. A sufficient amount of preliminary research has been completed by scientists in the Northeast on all of the above-mentioned problems or issues. Moreover, there is a foundation of published information available. Successful IPM

programs developed at Cornell University and elsewhere will be used as models. Once emerging insects or plant pathogens have been detected in crops or trees, remedies will be developed for immediate control. Because of its potential significant effect on crops, the brown marmorated stink bug and spotted wing drosophila (present in Connecticut) will be closely monitored and pest managment programs will be developed. Recent success in introducing some specialty (ethnic) crops in Connecticut has heightened enthusiasm among growers and consumers. There are firm collaborations between Station scientists and researchers in universities and the USDA.

2. Scope of the Program

- In-State Research
- Multistate Research
- Integrated Research and Extension
- Multistate Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

There are several beliefs about the research initiatives and the people involved to anticipate how the program will work for each of the major priority issues discussed below. Science-based assumptions are mainly linked to past evaluations of research findings and stakeholder input. There is a stable, skilled workforce and sufficient finances currently available to perform field and laboratory studies. There are extensive multistate and international collaborations to enhance research efforts. It is expected that IPM practices on farms will result in grower acceptance of new methods, high quality plants and foods for consumers, reduced health risks to the users of pesticides, and less pollution of watersheds. Cost effectiveness and adoption of IPM practices go together. Effective IPM programs have been in place for at least 15 years in Connecticut. Information gained at the University of Connecticut has been shared with Station scientists. Results of Station research are given to the university's extension specialists. A new joint project for both institutions will continue to evaluate our ebb and flow system of irrigation in greenhouses to determine if this new, more efficient irrigation system will reduce the distribution of certain plant pathogens. Jointly planned research on the use of bacteriophages (viruses) to counter bacterial infections of peaches and other stone fruits will continue. Station scientists have access to a substantial knowledge base and new results from other states. Farmers allow experiments to be performed on their properties. The number of acres in IPM will increase in time because stakeholders have generally accepted this approach. Annual surveillance of crops and forests for emerging pest problems allows for early detection. Scientists and other staff members will work with stakeholders and are trained to diagnose problems and find solutions. Early detection of pest problems will lead to the development of efficient control practices to reduce economic losses. Based on past experience in growing specialty crops, such as jilo, pak choi, and calabaza, there is interest among farmers and consumers for new crops. Research in growing other crops will result in increased farm income in rural areas. The scientists performing these studies have experience in performing field trials and have contacts with several growers. It is assumed that Hatch funds will continue to leverage other financial resources.

2. Ultimate goal(s) of this Program

The ultimate goals of the global food security and IPM research program are to identify and address emerging pest problems, such as the brown marmorated stick bug and the spotted wing drosophila, including the use of molecular-based detection methods when appropriate, develop and implement IPM systems, encourage growers to accept insect and disease resistant crops, and to boost agricultural and forestry production or efficiency. It is expected that this program will develop new management options,

decrease chemical pesticide use and farm costs, diversify our local food supply, and increase income options for farmers. Moreover, a database of diagnostic records will be produced on plant pests and a Plant Pest Handbook (available on the Station's website) will be revised for public electronic access. A web-based system for stakeholders to diagnose their pest problems is being developed.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2014	0.0	0.0	13.0	0.0
2015	0.0	0.0	13.0	0.0
2016	0.0	0.0	13.0	0.0
2017	0.0	0.0	13.0	0.0
2018	0.0	0.0	13.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research activities will focus on developing biological control agents such as bacteriophages and nematode parasites of beetle larvae in soil; developing trapping methods to more accurately monitor pests; the use of mulching techniques to control weeds; on developing cultivars of grapes, plums, and vegetables for quality and yield, and on assessing plant resistance to pests. Service and research activities are designed to assist a broad, diverse group of stakeholders by 1) conducting research of relevance to stakeholders, 2) conducting surveillance for major pests, and 3) dissemination of research findings. Public service is an important component for all output measures. For example, all state residents are allowed to enter Station facilities and request direct assistance on diagnosing insect or plant disease problems. In this approach, at least 21,000 stakeholders are expected to benefit from these activities annually. Research experiments are designed to solve problems or to enhance agricultural production and forestry practices. Training on IPM practices and other methodologies will be provided to stakeholders, including those in other countries. In addition to Station research farms, these experiments are conducted on stakeholders' farms or other private properties to encourage public engagement in the research. Results of these output activities will lead to specific outcomes, such as developing new management options, reducing pesticide use, detecting and controlling insects or plant disease pathogens, controlling invasive plants by herbicide treatment, and the introduction of new crops or cultivars, thereby increasing farm income. Grower acceptance of IPM methods and of insect and disease-resistant plants are important outcomes, which will be monitored by the number of acres affected and cost savings to growers. Many of the new crops are of interest to minority groups and are sold at about 114 farmers' markets to diversify agricultural production and make nutritious, fresh foods available to stakeholders, including under-served groups. It is estimated that 210,000 residents in 50,000 Connecticut households are hungry each day. Efforts will be made to continue the donation of surplus fruits and vegetables, grown on Station farms, to food banks and soup kitchens. The Station is the state plant regulatory agency, which carries responsibilities for exotic plant pest detection, forest health monitoring, and nursery and apiary registration and inspection. Honey bees and pollen will be tested for pesticides. Surveillance for existing and potential new pests of our crops and forests permits early detection and appropriate regulatory or control activities. Ground and aerial surveys of forests will be conducted by Station inspectors to assess defoliation in cooperation with USDA/APHIS

Plant Protection and Quarantine and USDA Forest Service. The plant disease and insect diagnostic laboratories are part of the National Plant Diagnostic Network (NPDN). Samples submitted by staff at the University of Connecticut will continue to be examined at the Station. Hundreds of plant inspections each year and phytosanitary certificates assure a quality product and facilitates commerce. Scientific publications in peer-reviewed journals, articles written for the general public, and updating of a Plant Pest Handbook on the Station's website reach traditional and non-traditional groups of stakeholders. Station scientists are members or officers in more than 100 stakeholders' groups. This provides opportunities for stakeholder input on the research program and facilitates reporting of research results. The non-traditional stakeholders will be reached at agricultural fairs when they visit and inquire about Station displays. At least one major open house will be scheduled annually on Station properties to allow the public to hear oral presentations on research results and to offer comments. Hundreds of talks and interviews will be given to civic groups and the media to convey research results and to receive public input. To enhance the dissemination of research and surveillance results, Station scientists will: (1) partner with stakeholders and participate in their organizations as members or officers, (2) conduct workshops or meetings for teachers and other stakeholders, (3) disseminate research findings in scientific displays at agricultural fairs and by giving talks and interviews to students and civic groups, and (4) cooperate with the media and provide information on scientific discoveries. These efforts will encourage direct and indirect contacts with adults and youth. Educating teachers indirectly reaches youth and under-served groups. The average number of students per high school teacher is about 130. News stories on Station research findings will also indirectly inform stakeholders. For example, an article published in the New Haven Register reaches about 400,000 people. We will use very conservative rates of 0.05% and 0.01% for estimating the number of indirect contacts with adults and youth, respectively, who learn about new scientific findings. Collaborations with scientists in other countries, such as Australia, Bangladesh, Canada, China, Czech Republic, Chile, Israel, and Peru, will improve crop systems or diagnostic services for plant diseases.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Workshop	● Newsletters
● Group Discussion	● TV Media Programs
● One-on-One Intervention	● Web sites other than eXtension
● Demonstrations	● Other 1 (Radio programs)
● Other 1 (Diagnostic services)	● Other 2 (Youth via teachers)

3. Description of targeted audience

To be effective, there should be a diverse group of targeted audiences, which include under-served and under-represented stakeholders. The Station serves a broad, diverse group of farmers who keep honey bees or grow vegetables, fruits, bedding plants, and nursery stock (including fruit trees). However, the broad goals of this research program also include work on forestry and environmental problems. Connecticut farms must be diversified to survive. For example, 170 (3.6% of 4,700) farms include maple syrup production to raise revenue. Healthy forests are needed to sustain honey bee populations. These insects are attracted to the flowers of maple and willow trees as well as flowering ornamental plants. Accordingly, target audiences include landscapers, landscape architects, food bank personnel, conservation officers, foresters, arborists, beekeepers, maple syrup producers, seed companies, and persons in the wood-products industry. Organized environmental and conservation groups, such as The Nature Conservancy, Audubon Society, Connecticut Forest and Park Association, Connecticut Beekeepers Association, and Backyard Beekeepers Association, are important target audiences. Efforts

will also be made to reach 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 targeted audiences for reporting new experimental results, primarily by publishing articles in peer-reviewed journals. This research program on increasing food production is designed to reach the general public, which includes non-traditional stakeholder groups. State residents, who have interests in agriculture and forestry, have ease of access to experimental farm plots, laboratories, scientific results, as well as equality of service. Women, members of minority organizations, and children are examples of under-represented and under-served groups, all of which are important target audiences. Special efforts will be made to reach Brazilian, Hispanic (including Puerto Rican), Asian American, African American, and Native American populations as well as elementary and high school teachers and students. New scientific information will be transferred to teachers to develop educational curricula and, therefore, indirectly reach youth. Data on public contacts are also derived from interviews with the media to facilitate widespread dissemination of research findings in newspapers, radio, and TV. Indirect contacts with adults and youth are computed by multiplying a newspaper subscription rate or other media audience figure times 0.05% for adults and 0.01% for youth. These are very conservative rates, far less than what the media have determined as being the population reached by release of news stories. Information on direct contacts is based on records of past contacts with the public (e.g., answering phone and e-mail inquiries, serving civic groups by giving talks, and by providing diagnostic testing services). Past records serve as a guide in determining estimates of public contact.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Total research papers
- # of site visits to conduct research and solve problems
- # of talks and interviews given to stakeholders
- # of responses to stakeholders' inquiries
- # of diagnostic tests performed
- # of new IPM intervention strategies judged to be effective

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

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

Outcome # 1

1. Outcome Target

# of homeowners and growers gaining knowledge on insect pests and plant pathogens

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 211 - Insects, Mites, and Other Arthropods Affecting Plants

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

# of homeowners and growers learning practices to control plant and household pests

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 205 - Plant Management Systems
- 216 - Integrated Pest Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

# of media reporters gaining knowledge on research results

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources
- 205 - Plant Management Systems
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 216 - Integrated Pest Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 4

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 205 - Plant Management Systems
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 216 - Integrated Pest Management Systems

4. Associated Institute Type(s)

- 1862 Research

Outcome # 5

1. Outcome Target

growers adopting IPM practices

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 202 - Plant Genetic Resources
- 211 - Insects, Mites, and Other Arthropods Affecting Plants
- 216 - Integrated Pest Management Systems

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

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

Description

There are several external factors that will likely directly affect outcomes, but financial stability, staff turnover, and inclement weather are the most important risk elements. The state's economy continues to struggle because of lost tax revenue due to high unemployment rates, slumping real estate values, less consumer spending, and budget cutbacks in government and industry. Job growth, another important economic component, has seriously lagged in Connecticut. Public concerns about a weak economy and corresponding declines in certain business sectors (e.g., financial systems and the mortgage and housing market) have caused deepening deficits in state budgets, thereby resulting in recissions for The Connecticut Agricultural Experiment Station. The decline in financial resources is negatively impacting field studies on basic plant research, which normally leads to peer-reviewed papers. The lack of technical help, in particular, is a critical factor. Coupled with essentially flat Hatch and McIntire-Stennis funds over several years, it is expected that there will be insufficient funds for supplies and automobiles to do some field studies and for technicians to assist in laboratory and field work. Without stable resources, some program goals may be difficult to achieve. Moreover, weather conditions are unpredictable. Hail, wind, excessive rainfall or drought can be destructive to plants. Deer feedings, insect damage and plant diseases can adversely affect experimental field plots and be major setbacks for research. Competing public priorities and programmatic challenges can also negatively impact outcomes. Research programs take time to design, and years may be required to properly complete experiments. Even when conditions for research are optimal, it can take years for stakeholders to accept change. When new issues arise, such as the brown marmorated stink bug and spotted wing drosophila, research resources must be allocated immediately to address stakeholder concerns and to implement emergency control programs. This process can divert important funds and human resources from other existing research studies. An early retirement program resulted in 7 staff vacancies, 6 of which remained unfilled. Goals of competitive grant programs also can quickly change based on federal priorities and affect alternative funds that are needed to complete research studies. Moreover, competition for limited federal grants has increased in recent years, thereby decreasing the success rate for a given principal investigator to win awards. If this trend continues, it will become increasingly difficult to meet long-term research objectives.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

Several different forms of evaluation are planned to judge the effectiveness of research programs and the outreach efforts to inform stakeholders. Since research objectives are diverse in their design to solve problems, the following methods of evaluation seem most practical depending on the research objective: after only (post-program), retrospective (post-program), before-after (before and after program), and during the program. The method of evaluation selected depends on the specific research project. For example, studies on testing new strawberry and specialty crop cultivars and research on nutrient solutions in greenhouses will be evaluated after harvest. Retrospective evaluations of outcomes will be applied to studies that showed adoption of IPM practices and more cost-effective measures to control insect pests on fruit trees and vegetables. For example, research revealed that fewer amounts of

a less toxic insecticide (bifenthrin) could control a variety of insects. It is important to determine if fruit growers have continued to adopt the new management practices and what the overall economic benefits are. Before and after program evaluations are appropriate for effectiveness of IPM programs on farms. Once again, the number of acres in IPM programs and economic benefits need to be determined to show impacts. An example of during program evaluations is the field testing of alternative crops to assess plant growth problems with and without mulch. Also, apiary inspections will help determine the health of honey bee populations. Long-term evaluations will be required to determine success or failure of pest management practices. Surveys of stakeholders to determine direct benefits to these people, communities, or organizations would require post program or post services evaluations. This approach would permit assessments of short-term learning changes following public meetings or direct one-on-one services, such as the identification of insect problems and diagnosing plant diseases.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Food Safety

2. Brief summary about Planned Program

Pursuant to state statutes, the Station is mandated to analyze foods and other products for label compliance and unwanted chemicals at the request of other state agencies. This responsibility now includes federal partners, such as the FERN of the FDA, Civil Support Team of the CT National Guard, and the Federal Bureau of Investigation. The number of samples analyzed annually will range between 700 and 1,000. In some cases, complicated time-consuming procedures will be required before samples are tested. Development of new methods can lead to peer-reviewed publications, but in general, conventional analytical methods are relied on. The Station was originally one of 8 state laboratories selected to be funded as part of a cooperative agreement with the US FDA. The FERN program is designed to respond to bioterrorist activities or other emergencies. During this reporting period, the US FDA requested Station assistance on evaluating methods of detecting ricin in meat. Liquid chromatography with a fluorescence detection system will be further evaluated in collaboration with chemists in the Minnesota Department of Agriculture and FDA scientists at their forensic chemistry laboratories in Cincinnati, Ohio to test seafood for petroleum chemicals associated with the Deepwater Horizon oil spill in the Gulf of Mexico. These methods have been published in a peer-reviewed journal. Food items will also be selected by the Connecticut Department of Consumer Protection as a part of market basket surveys. Local produce and imported foods will be included in routine analyses for unwanted chemicals. For example, analyses at CAES revealed illegal pesticide residues in foods. Tolerance levels for pesticides or other chemicals in foods or beverages are established by the US EPA or US FDA. Findings sometimes result in recalls of contaminated products. The Station has modern equipment and expertise to develop new techniques and perform scientific studies to detect chemicals in foods, soil and water. Honey bees, flowers, nectar, and pollen will be tested for neonicotinoid pesticides. Chemists will continue validating new procedures, such as Hydrophobic Interacting Liquid Chromatography and phased-based chromatographic column testing for insecticides. New liquid chromatography and mass spectometry methods will be used to detect paraquat and diquat in water. A new initiative will include the testing of nanoparticles, such as pesticides, on phytotoxicity of vegetable crops. People benefit from the research program by knowing that foods and other materials are safe and that tainted or adulterated products have been removed from commerce. Most results are obtained and research objectives will be met in the short term.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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 (Situation and Scope)

1. Situation and priorities

Based on stakeholder input, food safety is a high priority for research. In view of several cases of contaminated foods, people have become very concerned about unwanted microbes and chemicals in food, beverages, and other products. There are perceived feelings that the consumption of pesticides or their breakdown products can cause cancer and that poisons (e.g., arsenic or ricin) can be deliberately introduced into the food system. Therefore, a food monitoring program and research on developing more sensitive and specific methods of chemical detection are warranted. The FERN program, in particular, allows states to participate along with federal partners in training exercises on technology in a system designed for mutual assistance in the event of bioterrorism or other emergencies. Immediate responses are of paramount importance in preventing illnesses. Scientists are well trained, there are extensive collaborations with personnel in federal and state laboratories and universities, and state-of-the-art equipment is available. Instruments can measure chemicals in parts per trillion.

2. Scope of the Program

- In-State Research
- Multistate Research

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

There are several beliefs about the research initiative and the people involved to anticipate how the program will work. Currrently, there is a relatively stable workforce, and with a 5-year, $2,000,000 grant from the US FDA, key personnel remained employed. Also, FDA officials have purchased analytical equipment and have standardized testing procedures among states. Proficiency testing is an ongoing activity. There are currently sufficient state and federal funds available to perform all of the planned work. Collaborations with state and federal scientists have strengthened the monitoring and research program. Experienced scientists and technicians have access to a substantial knowledge base and use of precision instruments. It is expected that analyses of foods and beverages will result in the prompt identification of pesticides and other unwanted chemicals and in the recall of tainted or adulterated products from the market. Test results will re-assure stakeholders that foods are safe to consume and that other products, such as toys, are free from lead and cadmium.

2. Ultimate goal(s) of this Program

The ultimate goals are to have safe foods and other products by analyzing produce and other items for harmful chemicals and to develop more sensitive and specific test methods to detect chemicals,

including residues from agricultural and other sources. It is particularly important to improve analytical methods to enhance cost-effectiveness by reducing the amount of time to perform tests.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2014	0.0	0.0	1.5	0.0
2015	0.0	0.0	1.5	0.0
2016	0.0	0.0	1.5	0.0
2017	0.0	0.0	1.5	0.0
2018	0.0	0.0	1.5	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research activities will include development of more efficient methods of detecting chemicals in foods, beverages, and other products. The expected outputs (i.e., activities, services, and research results) are designed to assist a broad, diverse group of stakeholders by mainly disseminating test results to the public and state and federal regulatory agencies and by providing scientific information to scientists and other stakeholders. People will have equality of service and ease of access to scientific results. The state-generated outputs include numbers of food samples tested, scientific publications, and talks and interviews. The following activities are planned: (1) staff members will disseminate written information on test results and research findings to the media upon request, at open house events, and in scientific displays at agricultural fairs and (2) oral presentations will be given to civic groups. Direct interactions with stakeholders will provide a mechanism for public input on the research program. Non-traditional stakeholders are reached at flower shows and agricultural fairs when they visit Station displays. At least one open house event will be scheduled annually on Station properties to allow the public to hear oral presentations on research results and to offer written comments. Tours of laboratories will be given. Notification of state and federal agencies, which have pesticide, food, and health regulatory responsibilities (i.e., Department of Consumer Protection, Department of Environmental Protection, Department of Agriculture, Department of Public Health, and US FDA), of test results will lead to specific outcomes, such as removing tainted or adulterated food items from commerce and having safer consumer products. A new collaboration with the CT Department of Public Health (DPH) will examine fruits and vegetables for toxic chemicals and harmful microbials conducted respectively by CAES and DPH. Public access to new scientific findings will be another important outcome. The expected impact is that there will be no public health event because of tainted food or hazardous products.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods

● Group Discussion ● One-on-One Intervention ● Demonstrations ● Other 1 (Presentations to civic groups)	● Web sites other than eXtension ● Other 1 (Newsletters) ● Other 2 (Youth via teachers)

3. Description of targeted audience

A diverse group of targeted audiences includes: state and federal public health officials and regulators, food producers, educators, extension specialists, and the general public. Women, members of minority organizations, and children are examples of under-represented and under-served groups.Data on direct contacts are derived mainly from talks given to civic groups and one-on-one interventions regarding analytical testing, whereas indirect contacts are based on (1) providing new scientific findings to elementary and high school teachers and college professors who incorporate results into their educational curricula and (2) calculating the estimated number of persons contacted via media activities (e.g., newspapers, radio shows, etc.). Rates of 0.05% and 0.01% will be multiplied times media audiences to estimate respective numbers of adults and youth reached concerning Station research findings . Past records serve as a guide in estimating public contacts.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Total research papers
- # of talks and interviews
- # of tests performed

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

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 Target

# of stakeholders gaining knowledge of food safety

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

state and federal regulatory agencies making decisions on test results

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 711 - Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

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

Description

The most important external factors that may directly affect outcomes are financial resources and competing programmatic challenges. If extensive budget cuts continue, there could be negative impacts on program activities. The state's economy is currently sluggish. Future budget deficits would have a direct impact because technical help could be laid off. Hatch funds, which are being used to purchase

supplies for analyses and research, have been essentially flat for many years. Moreover, if US FDA shifts its priorities away from the chemical concerns of food safety, there could be a loss of grant funds. This might result in the release of one scientist and a technician. The collective loss of research capacity would result in decreased output measures and outcomes.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

The most suitable form of evaluation is "during the program". Since the research effort is considered short term based on current needs and is prone to rapid shifts in priorities depending on immediate food safety issues, it is most appropriate to plan evaluations for "during the program" to assess effectiveness. Stakeholders will offer written input on how well they think the research and services are producing relevant findings and direct benefits. This approach provides assessment of short-term learning changes following public meetings or direct one-on-one services. Also, the Science Citation Index will be used to assess recognition of published articles by the scientific community for specific projects as well as the entire program. National or state recalls of tainted foods or other products will be an excellent measure of during program actions.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Human Health

2. Brief summary about Planned Program

This research program focuses on (1) using DNA or RNA analyses to test ticks and mosquitoes for bacterial or viral pathogens that could cause diseases in human beings, domesticated animals, and wildlife, (2) reducing localized populations of medically important arthropods, and (3) controlling indoor mold (fungi) problems in greenhouses and other buildings. Lyme disease, tularemia, human granulocytic anaplasmosis, monocytic ehrlichiosis, human babesiosis, West Nile encephalitis, and Eastern Equine Encephalitis are national problems. Tens of thousands of people are infected with the agents that cause Lyme disease and West Nile encephalitis virus annually in the United States. Stakeholders are very concerned about ticks and mosquitoes and how these arthropods affect their health by causing acute and chronic illnesses, which can result in emotional and financial burdens on families. Declining health in domesticated animals can also cause economic losses. New research has been initiated on chemical control of bed bugs and developing a monitoring, trapping system. Research on indoor mold problems, requested by public school officials, will be conducted in public buildings. Allergic reactions to mold spores have been documented for people who live or work in mold-infested work places. All Station scientists receive state and federal funding to support ongoing research on sampling arthropods, developing tests with highly specific recombinant fusion proteins to detect pathogens or antibodies to disease agents; testing blood-engorged mosquitoes (collected in carbon dioxide baited or oviposition traps) to identify the source of blood by using cytochrome b gene molecular analysis; and on developing chemical and biological methods of pest control. Multiple methods will be used to disseminate research findings: scientific publications, media reports, the Station's website, talks to civic groups, and open house events. Extensive field studies will be conducted to monitor pathogens in arthropods and vertebrate reservoirs and for the introduction of new arthropod vectors due to climate change. The main objectives are to identify the main mosquito vectors of encephalitis viruses, determine if ticks transmit a subtype of the Powassan virus, develop more effective methods of arthropod and mold control, and to disseminate experimental findings to stakeholders.

3. Program existence : Intermediate (One to five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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 (Situation and Scope)

1. Situation and priorities

Wildlife biologists have requested research to develop more sensitive and specific antibody tests for arthropod-transmitted pathogens, to more efficiently monitor pathogen activity in reservoir hosts, and to reduce populations of ticks, bed bugs, and mosquitoes. Finding solutions to indoor mold problems is another high priority. The transition of farmland to forest ecosystems has resulted in increased tick populations, primarily because white-tailed deer are the chief hosts for adult Ixodes scapularis ticks. The sharp rise in deer populations is directly correlated with increased populations of this tick, which transmits at least three different pathogens to humans, domesticated animals, and wildlife. Japanese barberry, an invasive plant in forested settings, provides protection for white-footed mice and other rodents against predators. Mice are hosts for immature ticks and reservoirs for the etiologic agents of Lyme disease and human babesiosis. Mosquitoes breed in stagnant water and are known to transmit West Nile, Eastern Equine, Jamestown Canyon, and LaCrosse encephalitis viruses to humans and other vertebrate hosts. Two exotic mosquitoes of Asian origin (Ochlerotatus japonicus and Aedes albopictus) have been detected in Connecticut. The feeding and breeding habits of these species will be studied. With warming global temperatures, it is possible that exotic mosquito species could negatively impact public health. For example, Aedes albopictus was documented in northeastern CT at a commercial tire recycling plant, but the species failed to overwinter and complete its entire lifecycle in CT. This mosquito is firmly established in New Jersey and Long Island, NY. The situation could change in CT if winter temperatures rise. Research on bed bugs, ticks, mosquitoes, and pathogens benefit a wide range of stakeholders, such as physicians, veterinarians, epidemiologists, and the general public. Advances in laboratory diagnosis, surveillance programs, and control will help to prevent mammalian infections, lead to effective treatment, and can, thereby, reduce medical costs. Research results on landscape, biological, and chemical control of ticks are included in a revised Tick Management Handbook for homeowners. This output will help homeowners apply appropriate least-toxic methods for tick control on their properties and will decrease the risk of tick-associated diseases. Research will continue on nootkatone and fungi (Metarhizium anisopliae and Beauveria bassiana) for tick control. The outcome of having better diagnostic tests and effective control of medically important arthropods will be healthy human populations. New laboratory methods and information will also benefit the health of domestic animals. This will be monitored by receiving input from physicians and veterinarians. There are well established collaborations among Station scientists and researchers at universities, state and local health departments, and the Centers for Disease Control and Prevention (CDC). Some mosquito trap sites are located on private properties. Controlling mosquitoes in catch basins will be done in collaboration with municipal public health officials. Field tests on tick control will be conducted on homeowner's properties, which encourage direct stakeholder involvement in the research. Laboratories are well-equipped to isolate and identify pathogens. For example, the first isolate of West Nile encephalitis virus in North America was cultured in Station laboratories, and serologic antibody tests for Lyme disease and human granulocytic anaplasmosis were among the first developed in the United States. Efforts have been made to obtain reference RNA of the chickungunya virus, which is

present in Asia and Africa, to facilitate identification if this virus enters the US.

2. Scope of the Program

- In-State Research
- Multistate Research
- Integrated Research and Extension

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

There are several assumptions or beliefs about the research program to anticipate continued success. Strong public concern about mold in buildings, bed bugs, ticks, and mosquitoes encourages further investigations by justifying objectives and financial support to state and federal legislators. With adequate grant funding, skilled technicians can be hired. The current staff and resources available for studies on these arthropods and the pathogens they transmit are adequate. State and federal funding has been sufficient to conduct field and laboratory studies, and laboratories are well equipped to complete the planned tasks. Numerous research collaborations exist among veteran scientists in the CDC, universities (including the University of Connecticut), the Connecticut Department of Public Health, the New York State Health Department, municipal public health officials, and a biotech company. Collaborations speed research progress. For more than two decades, manuscripts have been published in quality, peer-reviewed journals; the scientific knowledge base is extensive. The scientists are experienced, highly motivated, and open to developing or applying new methods. Staff members can solve technical problems. It is, therefore, expected that continued research on the detection of arthropod-transmitted pathogens will result in a better understanding of Lyme disease, granulocytic anaplasmosis, human babesiosis, and encephalitis and that the collaborative work will facilitate laboratory diagnosis and result in prompt and more effective treatment of people and domesticated animals.

2. Ultimate goal(s) of this Program

The ultimate goals of this research and surveillance program are to increase public awareness of arthropod-related diseases and risks associated with ticks, mosquitoes, and mold; improve diagnostic tests for cottontail rabbits, deer, and mice to conduct ecological studies; and to develop effective methods of controlling medically important arthropods and mold in buildings. It is also important to identify new (i.e., previously undiagnosed) pathogens, such as subtypes of the Powassan virus, that may be causing disease in humans, domesticated animals, and wildlife species.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2014	0.0	0.0	11.5	0.0
2015	0.0	0.0	11.5	0.0
2016	0.0	0.0	11.5	0.0

Year	Extension		Research	
	1862	1890	1862	1890
2017	0.0	0.0	11.5	0.0
2018	0.0	0.0	11.5	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research activities will include identifying molds occuring in buildings by culturing, molecular diagnosis, or microscopic examination procedures and finding solutions for corrective action; evaluations of the use of highly specific recombinant or peptide fusion antigens to detect antibodies in cottontail rabbits, mice, and deer to anaplasmosis, or Lyme disease agents; use of polymerase chain reaction methods to detect the DNA of the Lyme disease agent in ticks; and the use of molecular analyses and genotyping of viral RNA to identify encephalitis viruses. Also, mosquitoes will be tested for exotic viruses that may enter northeastern states in commerce. A new trap will be evaluated to detect and monitor bed bugs in buildings. Field experiments will be conducted on evaluating two fungi (Metarhizium anisopliae and Beauveria bassiana) and nootkatone to control ticks. Biological controls (Bacillus species) will be tested to manage mosquito larvae in catch basins. The expected outputs are designed to benefit a broad base of stakeholders, such as public health officials, greenhouse growers, school administrators, veterinarians, and the general public. State-generated outputs mainly include scientific publications; talks and interviews; identifying and testing ticks for the Lyme disease agent; reports on the prevalence of ticks and mosquitoes infected with pathogens; and numbers of state residents served directly by answering inquiries. Staff members will (1) disseminate information on research findings by giving talks and media interviews, (2) analyze ticks and mosquitoes for pathogens by molecular analyses or culturing methods, (3) answer public inquiries, (4) train public health officials on sanitation methods of remedying indoor mold problems and on arthropod control methods, and (5) develop more sensitive and specific antibody tests and enhance website access for stakeholders. A Tick Management Handbook and Mosquito Identification Guide will be used to train public health officials. All activities strongly emphasize research and public service and include traditional and non-traditional stakeholders. The main outcome will be a well-informed public on arthropods of public health importance. At least one major open house event will be conducted annually on Station properties to allow the public to hear oral presentations on research findings and to offer comments. It is expected that results of these activities will lead to specific outcomes, such as reducing the number of tick and mosquito bites and having mold-free work places. Surveys will be conducted annually to determine if stakeholders are following advice given by public health officials on reducing mosquito and tick bites. These surveys will measure if the public is better educated on arthropods and associated diseases.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Group Discussion ● One-on-One Intervention ● Demonstrations ● Other 1 (TV media programs)	● Web sites other than eXtension ● Other 1 (Diagnostic services) ● Other 2 (Youth via teachers)

3. Description of targeted audience

A diverse group of stakeholders will benefit as target audiences. Research findings will be directly transferred to scientists via peer-reviewed journals and conferences. The general public will be reached directly or indirectly by means of presenting new research findings via flower shows, agricultural fairs, open house events, TV, radio, and newspaper articles. Media reporters frequently request information for stories. Indirect contacts with adults and youth will be calculated by determining the number of students taught by teachers who have implemented Station findings in curricula and by estimating the audience reached by the media. Rates of 0.05% and 0.01% will be multiplied by newspaper readership to estimate numbers of adults and youth, respectively, reached when a news story is published on Station findings. Oral presentations will be given to public health officials in meetings and, as requested, to civic groups. Also, state residents will be allowed to submit ticks through local health departments for identification and analysis for the Lyme disease agent. Results will be reported to public health officials who will then inform the residents or physicians. General information on tick-related research will also be provided. Fact sheets and other reports will be posted on the Station's website, and the number of page views will be recorded. Although these communication venues allow for extensive contacts with the public, special efforts will be made to reach under-served and under-represented groups by disseminating new findings to high school teachers and students. There will be increased cooperation with the Yale Peabody Museum in providing information on mosquitoes and ticks to be used in developing science curricula for middle and high school students. We have found that when teachers include our new scientific information in updating curricula, youth are served. Extensive media interviews will result in newspaper stories, which indirectly reach adults and some youth. Data on direct contacts are derived from one-on-one responses to stakeholders in answering inquiries, group discussions at meetings and workshops, providing diagnostic testing services, and by giving talks to civic groups. Past records serve as a guide in estimating public contacts. Information on bed bugs, ticks, and mosquitoes is printed in Spanish, and displays at agricultural fairs and open houses are created to attract childrens' interest. Participation in agricultural fairs is particularly effective in reaching non-traditional stakeholder groups.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Total research papers
- # of talks and interviews
- # of responses to stakeholders' inquiries
- # of ticks identified or tested
- # mosquitoes identified and/or tested

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

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 Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 722 - Zoonotic Diseases and Parasites Affecting Humans
- 723 - Hazards to Human Health and Safety

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 722 - Zoonotic Diseases and Parasites Affecting Humans
- 723 - Hazards to Human Health and Safety

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

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

Description

Unexpected changes in state appropriations or federal funds, staff reductions, extreme weather conditions, amount of cooperation from collaborators, and competing public priorities are the most important risk factors. Cuts in the state budget, layoffs of technicians, and reduced federal and grant funds related to state and federal deficits or priorities can greatly reduce capacity and immediately affect outcomes. The research program includes laboratory studies, but is strongly oriented toward field work. These investigations, which require vehicles and extra technical help, have high costs. The availabilitiy of state vehicles is a critical factor. Laboratory testing is also expensive. Therefore, reduced funding and the loss of personnel and vehicles can greatly impede research progress. Drought can significantly reduce numbers of mosquitoes and ticks and, consequently, greatly affect the outcomes of field research. Moreover, even though tick and mosquito research activities currently have high priority, new unrelated problems can emerge and cause important funds to be diverted to start new work.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

Depending on the research project, different forms of evaluation will be used. Post-program evaluations are planned to assess the impacts that new diagnostic (antibody) tests have. In tick, mosquito, and mold control research, before and after program evaluations seem appropriate. Assessments of tick abundance at sites before control measures and after treatments will be used to determine if certain management practices with a biological control agent (Metarhizium anisopliae and Beauveria bassiana) are effective. During-program evaluations will be relied on to determine if mosquito/encephalitis virus surveillance programs and public notification activities are reducing risk of infection. Effectiveness will be measured by surveying stakeholders' responses in heeding public health advisories on reducing tick and mosquito bites. In each case, public input will be considered in the evaluation process to determine if there are direct benefits to stakeholders and if there have been short-term learning changes.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Sustainable Use of Natural Resources

2. Brief summary about Planned Program

Stakeholders have expressed that soil and water quality is important, especially in improving or protecting watershed conditions. Farmers need good soil for optimal crop production, and homeowners want non-contaminated soil for gardens. Water quality ranks very high, along with food safety and public health. The presence of heavy metals (eg., arsenic, lead, and mercury) or pesticides in soil and water, in particular, has reduced the value of natural resources and has raised concerns about human and domesticated animal health. The presence of heavy metals and persistent organic pesticides (e.g., chlordane, DDT and DDE) in soil and water has led to intensive field and laboratory research. The use of certain plants (phytoremediation) show promise in removing some pesticides from soil. In a new initiative, nanotechnoloy (i.e., measuring very small amounts of a chemical) will be used as a research tool to measure phytotoxicity. Moreover, surveys of lakes and ponds for invasive weeds (considered pollutants) are being conducted throughout the state to determine presence of invasive plants and the water conditions which favor their establishment. Changes in aquatic species abundance and distribution will be recorded by using global positions system (GPS)-based bathymetric vegetation mapping procedures. For each treated lake or pond, GPS-derived transects will be utilized. In addition, surveys are being conducted to detect exotic invasive plants. Consistent with stakeholders' requests, pollution prevention and mitigation and watershed protection and management are the primary focus areas for research in this planned program. The current research program on invasive aquatic plants is heavily field oriented, has existed for about 9 years, and is expected to extend for more than 5 years. The project on detecting persistant organic pollutants in curcurbits is nearly completed.

3. Program existence : Mature (More then five years)

4. Program duration : Long-Term (More than five years)

5. Expending formula funds or state-matching funds : Yes

6. Expending other than formula funds or state-matching funds : Yes

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			50%	
133	Pollution Prevention and Mitigation			50%	
	Total			100%	

V(C). Planned Program (Situation and Scope)

1. Situation and priorities

Persistent organic pollutants or their degradation products and heavy metals have been found in many ecosystems. The problem is extensive in the United States. Chlorinated hydrocarbons, such as DDT and chlordane, were banned many years ago but continue to persist in the soil, herbicides (e.g., atrazine) have entered groundwater systems, heavy metals are present at industrial sites, and invasive aquatic plants are spreading and choking lakes and ponds. There is potential for the introduction of new exotic, invasive plants. Since residual chlorinated hydrocarbon pesticides in soil can accumulate in animal tissues, this issue is a concern for many stakeholders. Skin contact with or accidental consumption of these chemicals may have public health importance by being linked to cancer and other diseases. Therefore, detection and removal of pollutants (including invasive plants) from soil and water is a high priority for research. Cucurbits (zucchini and pumpkins) have been found to remove chlordane and other persistent organic pesticides from soil; phytoremediation methods have been effective in improving soil quality. Moreover, chemical methods have been developed to speed the decomposition of certain pesticides in well water. Experiments will be conducted to find ways of minimizing amounts of herbicides, such as 2,4-D and diquat, used to control aquatic weeds and to develop biological controls of invasive aquatic plants, such as using plant-eating beetles. Future work is urgently needed to increase the efficiency of removing pollutants from the environment, reduce amounts of fertilizer used to protect watershed areas, develop more sensitive detection methods for unwanted chemicals, and to determine the sources of heavy metal and other forms of contamination. It is expected that results of this research program will improve soil and water quality in different ecosystems, may also help reclaim contaminated, industrial sites as well as agricultural fields, and prevent the movement of pollutants into crops and eventually into human foods. Collaborations with scientists in other states and countries (Czech Republic and Turkey) and past successes increase the likelihood of future progress. There is also an excellent knowledge base on published information and state-of-the-art instrumentation available to support the research program. State and federal funds are currently in place to continue the research, but declining state revenues may have a negative impact on conducting field studies.

2. Scope of the Program

- In-State Research
- Multistate Research

V(D). Planned Program (Assumptions and Goals)

1. Assumptions made for the Program

There are several assumptions about the program and the people involved to predict how the program will work. Stakeholders believe that the research initiatives are important, are of national relevance, and should be supported by state and federal funds. There currently is a stable workforce of experienced scientists and technicians and strong collaborations with experts in universities. Past successes indicate that the research approaches are valid, and published findings by other scientists support the overall research strategies. Moreover, the practices being followed by our research team are being used by other scientists. It is expected that continued studies of lakes and ponds, using current chemical methods, will be as effective in detecting and removing invasive aquatic plants to improve water quality. Per aqueous liquid chromatography will be used to analyze water samples after treatments with diquat. Volunteers in lake associations will monitor boats for invasive plant parts attached to propellers and remove debris. It is also assumed that federal Hatch funds, used to start research programs, will continue to leverage other federal and private grant funds. State funds are declining and may impact workforce numbers.

2. Ultimate goal(s) of this Program

The ultimate goals of this research program are to promote greater public awareness of sources of pollution and remedies, take steps to prevent pollution, improve watershed conditions, increase knowledge of the presence and fate of specific pollutants in soil and water, and develop programs for long-term protection of soil and water resources.

V(E). Planned Program (Inputs)

1. Estimated Number of professional FTE/SYs to be budgeted for this Program

Year	Extension		Research	
	1862	1890	1862	1890
2014	0.0	0.0	5.0	0.0
2015	0.0	0.0	5.0	0.0
2016	0.0	0.0	5.0	0.0
2017	0.0	0.0	5.0	0.0
2018	0.0	0.0	5.0	0.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research activities will include the use of analytical methods (per aqueous liquid chromatography), chemical control procedures, and selected plants to remove pollutants from soil and water. Chemical analyses will be conducted to determine the need for fertilizers. Herbicides and biological controls will be evaluated to remove invasive plants from lakes, and DNA procedures will be relied on to identify aquatic weeds. The expected outputs are scientific publications, newsletters, and fact sheets; talks and interviews; and numbers of state residents served directly by analyzing soil samples or identifying invasive aquatic weeds. All activities, services, or events are designed to disseminate new information to stakeholders and to seek their input on the research program. Interactions with members of lake associations in group discussions, workshops, and one-on-one discussions are particularly important because permission must be granted to perform experiments on removing aquatic weeds from lakes. Limited diagnostic services are available to determine the extent of pollution problems and to determine the success of field experiments.

Information will also be made available to all stakeholders on the Station's website, in newsletters and fact sheets, and in displays at the agency's open house events or at agricultural fairs. It is also expected that there will be interest from reporters to write articles on the research, thereby enhancing the educational process. Results of these output activities will lead to specific outcomes, such as increased stakeholder knowledge of pesticide pollution and prevention, clearing lakes and ponds of invasive aquatic plants, and preventing pollution.

2. Type(s) of methods to be used to reach direct and indirect contacts

Extension

Direct Methods	Indirect Methods
● Workshop	● Newsletters
● Group Discussion	● TV Media Programs
● One-on-One Intervention	● Web sites other than eXtension
● Demonstrations	● Other 1 (Youth via teachers)

3. Description of targeted audience

A diverse group of stakeholders, including under-represented and under-served persons, is targeted. It is expected that the following stakeholder groups will directly benefit from the research by receiving new scientific results on soil and water quality problems and solutions: farmers, lake associations, homeowners, water company officials, environmentalists, extension specialists, corporate and municipal officials, participants of urban community garden programs, and pesticide producers. Special efforts will be made to contact and include members of minority organizations, women, and children to provide information and to participate in open house events.Data on direct contacts are derived mainly from workshops, demonstrations at agricultural fairs, group discussions when Station scientists give talks to civic groups, and diagnostic services provided. Indirect contacts with adults are accomplished by newsletters and media coverage of scientific results. Indirect contacts with adults and youth will be estimated, respectively, by multiplying 0.05 and 0.01% times the newspaper audience (e.g., number of subscriptions) when a story on Station research findings is published in the newspaper. Youth are effectively reached indirectly via teachers. Past records are used as a guide to estimate public contacts.

V(G). Planned Program (Outputs)

NIFA no longer requires you to report target numbers for standard output measures in the Plan of Work. However, all institutions will report actual numbers for standard output measures in the Annual Report of Accomplishments and Results. The standard outputs for which you must continue to collect data are:

- Number of contacts
  - Direct Adult Contacts
  - Indirect Adult Contacts
  - Direct Youth Contacts
  - Indirect Youth Contact
- Number of patents submitted
- Number of peer reviewed publications

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(H). State Defined Outputs

1. Output Measure

- Total research papers
- # of talks and interviews given to stakeholders
- # of diagnostic tests performed

☑ Clicking this box affirms you will continue to collect data on these items and report the data in the Annual Report of Accomplishments and Results.

V(I). State Defined Outcome

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 Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 133 - Pollution Prevention and Mitigation

4. Associated Institute Type(s)

- 1862 Research

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 133 - Pollution Prevention and Mitigation

4. Associated Institute Type(s)

- 1862 Research

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 133 - Pollution Prevention and Mitigation

4. Associated Institute Type(s)

- 1862 Research

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

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

Description

The main external factors that may directly affect outcomes are financial stability and unexpected changes in the workforce. With poor economic conditions, state appropriations are expected to be dramatically lower and competition for federal grants will be greater. This could impact the availability of technical help, automobiles, and supplies. A vacancy still exists for a scientist to work on soil quality problems. Consequently, reduced research capacity would greatly impact the progress of field and laboratory studies. Also, Postdoctoral Research Scientists assigned to this research program eventually leave for better jobs regardless of available federal grant funds. Although the Hatch funds are helpful in supporting this research, these funds probably will be insufficient to sustain research activities over the long term. Also, compared to the other three research programs, there have been relatively higher turnover rates for employees in this research program. Finally, ongoing research on invasive aquatic plants will be directed on at least 4 large lakes.

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

Two forms of evaluations seem most appropriate for this research program: "during program" and "before and after" program. For example, assessments of research progress and seeking stakeholder input on analyses of contaminated soil before and after experiments, when phytoremediation methods will be used, is expected to show improvement in soil quality and customer satisfaction. Studies on invasive aquatic plants will also include this type of evaluation, but during program assessments are also applicable. Participating stakeholders will be able to see progressive improvements in water quality. Depending on the local situation, retrospective evaluations of lakes and ponds with repeated surveys and receiving stakeholders' concerns on water quality might also be applied because invasive plants may re-invade bodies of water over time. Also, residents who request soil analyses will receive results and, with the help of scientists, will be able to make decisions on whether soil is suitable as is for garden use or in need of nutrients and organic matter to grow crops.