2005 Annual Report of Accomplishments and Results

The Connecticut Agricultural Experiment Station

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Executive Summary (Overview)

Scientists and other staff members at the Connecticut Agricultural Experiment Station ("Station") work to meet the needs of all residents. The main mission is research. Since the institution is not a university, no federal funds are received for education or extension. However, federal formula and grant funds are received for research. Discoveries are continuously reported to the public in different venues, and efforts are made to include growers and other stakeholders in planning research projects. Outreach programs have been expanded and modified to meet the needs of the under-served and under-represented. Collaborations continue between the institution's scientists and extension specialists at the University of Connecticut and other land-grant universities and, thereby, continue to disseminate new findings to a broader base of stakeholders. State appropriations continue to exceed amounts of federal Hatch funds, but the latter continue to play an important role in our ability to respond quickly to emerging problems, conduct relevant research, and to meet the needs of society.

As in the past five years, we are pleased to report progress that benefits stakeholders. In many instances, the results obtained over the duration of the first five-year Plan of Work can now be more easily assessed regarding their immediate and long-range impacts on these people. Outcomes have resulted in economic, health, or environmental benefits or behavioral changes in stakeholders. The research accomplishments reported herein align with some focus areas of the CSREES budget: improved pest control, invasive species issue, organic agriculture, the importance of small farms, sustainable agriculture and forestry, food safety, and water quality. The research activities and other efforts at The Connecticut Agricultural Experiment Station are strongly supported by stakeholders of different racial and ethnic backgrounds, who in some instances call problems to our attention. Stakeholders have access to Station facilities and research information and are given opportunities to see laboratories and experimental plots, meet scientists, comment on research findings, and to request new research initiatives as the needs arise.

Research projects at The Connecticut Agricultural Experiment Station focus primarily on national priorities and federal (USDA) goals on improving the agricultural production system to be highly competitive in the global economy (goal #1). Food safety, bioterrorism, and environmental issues remain important concerns of stakeholders. Accordingly, there are some activities associated with USDA national goals #2 and #4, respectively. Some research projects described herein also

address goal #3 (“A healthy, well-nourished population”) and goal # 5 (“Enhanced economic opportunity and quality of life for Americans”). Details on how all 5 national goals are being met are described in the updated *Planned Program* sections. As required, this Annual Report of Accomplishments and Results includes financial data for federal FY2005. The research results and impact statements are primarily linked to FY2005 activities, but collective results for this updated Plan of Work cycle are described to show short and long-term benefits to society.

Our research efforts are designed to promote the competitiveness of our agricultural system in an expanding global economy. Many research initiatives are directed at adding value to new and old agricultural products, increasing profitability, encouraging energy efficiency, reducing the use of pesticides, and improving soil and water quality, plant health, and agricultural production. Multistate and integrated activities increase efficiency and enable us to make progress on a wide range of problems during times when funding and other resources have declined. Stakeholders have requested assistance on identifying insects that attack crops, diagnosing plant diseases, treating diseased and infested plants with minimal amounts of pesticides or by cultural practices, and on growing vegetables organically. Integrated Pest Management (IPM) practices are being accepted by growers. It is important to develop new analytical methods and to refine older methods in our efforts to detect and quantitate pesticide residues and unwanted chemicals in soil, air, food, and drinking water. Finally, with increased amounts of imported goods, there is a need to survey our nurseries, orchards, vegetable crops, and forests for exotic, invasive insect and plant species and to take corrective action when problems arise.

Highlights of major accomplishments and impacts in Hatch/state-supported program **goal #1** are as follows:

1. Consumers buy greenhouse-grown tomatoes during colder months. The use of shading methods increased fruit quality and, thereby, decreased labor costs by about $60.00 per 24 x 96 foot greenhouse per year. Less unmarketable fruit had to be picked and discarded. Farm efficiency increased.
2. Prompt testing for *Ralstonia solanacearum* race 3 biovar 2, an important bacterial agent that causes wilt in tomatoes, peppers, potatoes, and eggplant, prevented losses of about $200,000 to greenhouse operators. The pathogen entered Connecticut and other states on geranium cuttings from Guatemala.

3. Field tests revealed that pyrethoid insecticides effectively controlled the small Japanese cedar longhorned beetle on arborvitae. With proper treatment, 27,346 pest-free arborvitae plants (valued at about $945,000) were shipped from Connecticut nurseries and sold locally or in other states.
4. Three laboratories have been upgraded to analyze plant tissues for the agent that causes Ramorum blight (formerly Sudden Oak Death). During this reporting period, 213 samples of diseased plant tissues were tested for the DNA of the infectious agent. The pathogen was not detected, and thousands of dollars worth of nursery plants were allowed to be shipped from nurseries and sold.
5. Radicchio is demanded by restaurants and other consumers. Field tests of different cultivars revealed a high percentage (70%) of marketable heads. At an average yield of 4,800 pounds per acre and at a retail price of $4.99 per pound, there is a potential crop value of $23,952 per acre. Farmers are now growing radicchio to meet market demands.
6. The insecticide Talstar (bifenthrin) is less expensive and more effective in controlling pales weevils on Christmas trees than the insecticide Lorsban. The cost for Talstar ranged from $17.23 to $20.29 per acre, compared to Lorsban ($73.00) per acre. The expected long-term impacts include continued profitability for growers, a cleaner environment, and the use of a safer insecticide, which will reduce health risks.
7. Weekly foliar applications of a 50% by volume aqueous solution of either whole, skim, or powdered milk delayed the onset and severity of powdery mildew on pumpkins. Fruit rot was reduced from 20% to 8% and represented a savings of about $50 per acre in fungicide costs.

Goal 1: Federal Hatch Funds ($390,383), State Funds ($2,374,116), Scientist Years (15.8)

Stakeholders are concerned about food safety issues and potential bioterrorism. Residents have requested that we conduct analyses for pesticide and other chemical residues in the food supply. Under the guidance of The Connecticut Department of Consumer Protection, annual market basket surveys and analyses of food items yielded results of public interest.

Highlights of major accomplishments and impacts in program **goal #2**, which had support from Hatch and state funds, are as follows:

1. A pesticide shed caught fire on a strawberry farm. The Fire Marshall in that town would not release the picked strawberries until analyses showed no contamination of the fruit. Results obtained within 7 hours of the samples being received showed no contamination. The crop, valued at $60,000, was released to the market. A safe product was made available to consumers, and the farmer avoided economic losses.

Goal 2: Federal Hatch Funds ($139,216), State Funds ($263,432), Scientist Years (2.4)

Research objectives in program **goal #4** are designed to address a variety of environmental problems and issues that are of interest to stakeholders. Arthropod-transmitted pathogens that cause Lyme disease, anaplasmosis, ehrlichiosis, babesiosis, or encephalitis affect humans and domesticated animals. Monitoring for changes in the natural occurrence of these infections, developing methods of tick control, and improving laboratory diagnosis meets the immediate critical needs of stakeholders. There continues to be grower interest in learning about heavy metal and pesticide contamination of soil and water, more efficient plant nutrient management in greenhouses, developing composting methods, and in implementing integrated pest management (IPM) practices. Deer populations continue to rise, and with damage to crops and motor vehicle accidents caused by these animals, research on reducing deer was continued.

Highlights of major accomplishments and impacts in program **goal #4**, which had support of Hatch and state funds, are as follows:

1. Municipal officials are relying on farmers to dispose of leaves. Sheet composting of oak leaves resulted in higher yields of peppers (5.4 pounds per plant) than plots amended with maple leaves (5.2 pounds per plant) or controls (5.0 pounds per plant). On a per acre basis, there was a total potential crop value of $72,658 associated with sheet composting of oak leaves. Expected impacts include profitability for farmers in rural areas and less urban land space being devoted to composting.
2. Invasive aquatic plants eliminate native plants and reduce water quality. Spot treatments of herbicides controlled water milfoil, Eurasian milfoil, and Cabomba in two lakes in Connecticut. Residents regained full recreational use of the lakes, and water quality improved. The expected

long-term benefits include reduced eutrofication of lakes, improved water quality, and increased values of properties.

3. There were 43 isolations of the West Nile encephalitis virus from 4 species of mosquitoes in Connecticut following the analyses of 156,409 mosquitoes. There were an additional 37 isolations of Eastern Equine Encephalitis virus from 10 mosquito species. The majority of infected mosquitoes were from densely populated urban and suburban areas of the southern part of the state. Public health officials were notified, residents were advised to minimize mosquito bites, and local health departments treated major mosquito-breeding areas. These measures prevented mosquito-infection related fatalities in humans and horses during this reporting period.
4. At the request of veterinarians and other stakeholders, horses were tested for antibodies by newly developed procedures to a tick-transmitted bacterial pathogen, *Borrelia burgdorferi*, the agent of Lyme disease. Horses were exposed to this disease organism, and a new reagent used in the antibody test was effective in obtaining specific results. Stakeholders learned that this disease is important in northeastern United States. A small biotechnology company has accepted technological advances to develop a commercial assay for the diagnosis of Lyme disease.
5. The Connecticut Department of Consumer Protection requested assistance on determining the cause of possible human poisoning. The patient had entered a hospital with complete renal failure. Analysis of juice samples revealed a 40% concentration of ethylene glycol (antifreeze) in the juice. These findings had immediate impact. Results were quickly reported to state officials, who notified the attending physician. Proper treatment was given to the patient, who fully recovered. Juice samples collected from stores were not contaminated.
6. Continued efforts to convince nursery growers to adopt IPM practices are having impacts. One small nursery reduced quantities of active ingredient for an insecticide by 4.7 pounds per year with a short-term savings of $234. Success at nursery operations is enabling the effort to be extended to other growers. This change in attitude among growers will help achieve long-term benefits of having a cleaner environment and reduced risks of pesticide exposure to the users.

Goal 4: Federal Hatch Funds ($229,625), State Funds ($2,396,085), Scientist years (19.9)

There are new accomplishments during this reporting period that benefited a broad and diverse group of stakeholders by helping to solve immediate problems. Meaningful results were

reported to clientele and stakeholders in meetings, via the media, in written reports, on the station's web site (http://www.caes.state.ct.us), or by other means described later. There was continued good balance in the scope of impact with a mixture of multistate and state-specific projects.

The USDA-approved multistate Hatch research projects (NE-009, NE-183, NE-187, NE-1005, NE-1017, NE-1019, NE-1020, S-301, and W-082) allow for extensive scientific collaborations during times when individual experiment stations have had to reduce resources due to budget cuts and loss of staff positions. The diverse backgrounds and expertise of these scientists enhanced research efforts. Other less formal multistate collaborations also exist and benefited the overall research effort. The interaction with extension specialists allows for greater dissemination of new information to broader audiences and provides research scientists with different perspectives on stakeholder needs and concerns. The Hatch funds were efficiently utilized and are acknowledged in peer-reviewed publications. Hard copies of stakeholders' letters are also available on request as examples to show residents' gratitude and satisfaction for the services and research results they received.

Introduction

To comply with the Agricultural Research, Extension, and Education Reform Act (AREERA) of 1998, this sixth Annual Report of Accomplishments and Results (with accompanying impact statements) is consistent with the updated *Planned Programs* sections. The Connecticut Agricultural Experiment Station (referred to as the "Station" in this report) is unaffiliated with a university and does not receive federal funds for extension or education. Federal Hatch and McIntire-Stennis funds are received for research, however. Accordingly, the accomplishments and impacts reported herein are based on the Station's research program, the main mission of the institution. Some research efforts, however, are linked to extension programs at universities, and information on research findings was disseminated to extension personnel in accordance with the Station's approved updated Plan of Work. Improvements have been made in the multi-functional programs, including the integration of research and extension activities. Extension personnel at the University of Connecticut and other land-grant universities in northeastern United States heard oral presentations given by Station scientists and received written research findings that can be incorporated in educational programs directed at all five national USDA goals. Joint publications for scientists and other stakeholders have resulted. The main mission of CSREES to advance knowledge for agriculture, the

environment, human health and well-being, and communities parallels that of the Station. The main goals are to enhance economic opportunities and quality of life among families and communities and to transfer technology to stakeholders. Scientists at the Station develop creative research projects to provide the support, which growers and other stakeholders need to succeed.

The Station's outreach program and engagement with stakeholders is extensive and mutually beneficial. We define stakeholders as those who are interested in and benefit directly or indirectly from agricultural research (including forestry). Stakeholders include scientists, legislators, business leaders, farmers, administrators, forestry officials, industry personnel, state and federal workers, and the general public. The Station receives assistance from stakeholders, who contact state and federal legislators to inform them of problems that need attention and research progress. Publishing scientific results in peer-reviewed journals is an important venue for reaching scientists in the nation, but other means of communication, such as giving oral presentations, disseminating written materials, and participation as officers in civic group organizations are other effective mechanisms for interacting with stakeholders. The multistate, multi-institutional, and multi-disciplinary approach to research at the Station (1) addresses critical issues of strategic importance identified by stakeholders as described in the institution's approved Plan of Work; (2) addresses the needs and inputs of under-served and under-represented populations in the state; (3) meets the expected outcomes and impacts; and (4) results in improved program efficiency. As done in the first five annual reports, this accomplishment document provides new supportive information and documentation for the aforementioned statements. Accomplishments of multistate, multi-disciplinary, and integrated research for projects approved by a Regional Association and USDA/CSREES for The Connecticut Agricultural Experiment Station's participation will be further documented through annual northeast impact statements and the northeast (SAES-422) reports. As stated in the updated Plan of Work, the research initiatives at the Station focus mainly on national priorities and federal (USDA) goals on improving the agricultural production system to be highly competitive in the global economy (goal #1), providing a safe and secure food and fiber system (goal #2), and on greater harmony between agriculture and the environment (goal #4). Results reported under these national goals, however, also apply in some instances to goal #3 (a healthy, well nourished population) and goal #5 (enhanced economic opportunity and quality of life for Americans). Details on which projects address one or more national goals are provided, as appropriate, in the updated *Planned Programs* sections of this document. A program review process (merit and peer review system) is being used to evaluate

research projects for quality and relevance to national and state program goals and the needs of stakeholders.

Stakeholder Input Process

In accordance with Section 102 (c) of the Agricultural Research, Extension, and Education Reform Act of 1998, the Station reports on (1) actions taken to seek stakeholder input that encourages their participation, (2) the process used by the Station to identify individuals and groups who are stakeholders, and (3) how the collected input was considered in the Hatch and McIntire-Stennis research programs during fiscal year (FY) 2005. Station scientists, administrators, and other staff members continually seek stakeholder input to identify problems so that critical issues in Connecticut can be addressed. Oral and written stakeholder comments received during this reporting period were seriously considered by Station personnel. It is our policy to respond to all public inquiries and to be of service to those in all racial and ethnic groups. Examples of how the collected stakeholder input was considered in the design, execution, and changing of research goals of various projects are given throughout this document. During this reporting period, we received input from the media, legislators, and members of organized groups (e.g., Connecticut Forest and Parks Associations, Connecticut Beekeepers Association, Connecticut Pomological Society, Connecticut Nursery and Landscape Association, Connecticut Tree Protective Association, Federated Garden Clubs of Connecticut, foresters, etc.) in an open and fair process that encouraged participation of diverse groups. Notices were sent to members of 25 protected organizations (i.e., minority groups) announcing the institution's job vacancies and describing research projects. There were several methods used to receive stakeholder input on their needs, opportunities for people to see research plots and experimental results, and to encourage more meaningful engagements. Station scientists participated in dozens of public meetings attended by stakeholders and university extension personnel, gave oral presentations to civic groups, gave interviews to the media, and served on advisory boards of stakeholder organizations. In addition, the Station held open houses and other public events and invited stakeholder comments on research projects during all of these listening sessions.

There were interactions with growers during this reporting period concerning plant pest problems and with beekeepers concerning parasitic mites. Requests were made to the Director of the

Station to submit applications to the Connecticut Department of Environmental Protection and the US EPA so that Section 18 registrations would be given for two pesticides that have not received full labels for general miticide use in bee hives. The application papers were submitted, and EPA gave approval for the emergency use of both products.

In previous years, stakeholders requested the following publications: the identification of invasive aquatic plants, caterpillars that attack conifers, tick control, and a manual to identify mosquitoes. All publications have been completed and distributed to nursery growers, landscapers, boaters, foresters, public health officials, and the general public. The mosquito manual and tick control handbook have had national interest. Thousands of copies have been sent to persons in several states. The publication on identifying invasive aquatic plants had immediate impact because it informed the public that some plants were invasive and could harm lakes and ponds. Cleaning boats of plant debris before entering bodies of water is an important step in preventing the spread of the invasive plants.

During FY 2005, 823 talks and interviews were given by Station scientists in Connecticut in conjunction with Hatch and McIntire Stennis programs. These presentations were in response to stakeholders' requests and occurred in urban, suburban, and rural areas. In many instances, extension personnel from universities heard these presentations and received the latest research results. In addition, Station scientists organized or attended stakeholder meetings in FY 2005. People in the numerous groups, organizations, or agencies listed in the following pages heard scientific presentations on Hatch or McIntire-Stennis research findings, received assistance from Station scientists, provided comments on the research results, and gave input for research initiatives during question and answer sessions. These persons were, therefore, considered direct beneficiaries of agricultural research in Connecticut and elsewhere. An asterisk marks stakeholder interactions in the McIntire-Stennis research programs.

*American Chestnut Foundation
American Phytopathological Society
American Society for Horticultural Science
Asnuntuck Community College

Bartlett Arboretum

Bethany Garden Club

Bloomfield Garden Club

Branford Garden Club

Branford Land Trust

Brown University

Capitol Region Education Council Teachers Center

Central Connecticut State University

Cheshire Rotary Club

Connecticut Academy of Science & Engineering

Connecticut Beekeepers Association

*Connecticut Chapter of the American Chestnut Foundation

*Connecticut Chapter of the American Society of Foresters

*Connecticut Christmas Tree Growers' Association

Connecticut Department of Agriculture

Connecticut Department of Consumer Protection

*Connecticut Department of Environmental Protection

Connecticut Department of Health

Connecticut Entomological Society

Connecticut Farm Bureau

Connecticut Farm Wine Council

Connecticut Federation of Lakes

Connecticut Federated Garden Club

Connecticut Fire Academy

*Connecticut Forest and Park Association

Connecticut Gladiolus Society

Connecticut Greenhouse Growers Association

Connecticut Groundskeepers Association

Connecticut Invasive Plant Working Group

Connecticut Master Gardeners

Connecticut NOFA (organic farmers)

*Connecticut Nursery & Landscape Association

Connecticut Pomological Society

Connecticut River Coastal Conservation District

*Connecticut Tree Protective Association

*Connecticut Tree Warden School

*Connecticut Urban Forest Pest Council

Crompton Corporation

Eastern Plant Board

East Haven Garden Club

Entomological Society of America

Experiment Station Associates

Fairfield Christian Women's Club

Fairfield Horticultural Society

Future Farmers of America

George Washington Wildlife Management Area, Chepachet, RI

Guilford Garden Club

Invasive Non-Native Plant Working Group

Kellogg Environmental Center, Derby, CT

Kensington Garden Club

Ledgelight Health District

Lyme Disease Foundation

Maple Bank Farm

Mystic Aquarium

Natural Resources Council

Naugatuck Valley Community College

*New England Christmas Tree Growers Assoc.

*New England Society of American Foresters

New England Vegetable and Berry Growers

New Haven Garden Club

New Haven Land Trust

New Haven Public Schools

Newington Garden Club

North American Gladiolus Council

North Dakota State University

*Northeast Forest Pest Council

Northeastern Mosquito Control Association

Northeast Organic Farming Association

Northeastern Weed Science Society

*Northern Nut Growers Assoc.

Oregon State University

Quinnipiac Chapter of Sigma Xi

Quinnipiac River Watershed Association

Quinnipiac University

Rocky Hill Garden Club

Seth Haley Elementary School

Sikorsky Garden Club

Sleeping Giant Park Association

*Society of American Foresters

Society of Invertebrate Pathology

Southern Illinois University

Stratford Garden Club

Taft School in Watertown

Tolland Agricultural Center

Tunxis Garden Club

Trinity College

Trinity Methodist Church

University of Connecticut (includes Cooperative Extension)

University of Massachusetts

University of Missouri

*US Forest Service (Durham, NH; Hamden, CT)

*USDA/APHIS/PPQ

Vincent E. Mauro Elementary School

Wesleyan University
*Western Chestnut Growers Association
Wethersfield Garden Club
Windsor Garden Club
Wintergreen Magnet School
*Yale University (includes forestry and public health)

Stakeholders rely on diagnostic services provided by the Station. Identification of insects and plant diseases and soil analyses provide specific information on a variety of problems, but the effort is also useful in identifying emerging problems, such as the introduction of exotic pests. Our diagnostic services component coincides with a USDA management goal: agricultural communications, enhancing customer service/satisfaction information technologies. During state FY 2005, there were about 18,544 public inquires from stakeholders to all Station staff members. The problems varied. For example, scientists in the Department of Entomology answered 4,109 public inquiries. Of these, 1,233 (30%) were from persons who visited the department. Information obtained by growers and industry personnel enhanced their businesses. A total of 693 different insect and spider species were identified. Plant pathologists answered 7,739 inquiries. Scientists at the Valley Laboratory in Windsor, Connecticut answered 8,229 inquiries from the public, including those from commercial growers and pest control operators. Questions about hemlock woolly adelgid, a serious forest-insect pest, and blue mold disease continued to be most frequent. Scientists responded to special requests by visiting commercial and private properties on 309 different occasions to diagnose more complex problems and to give stakeholders immediate assistance in solving problems. One scientist made 52 visits to turf fields, parks, forests and to nursery and greenhouse operations. In addition, 9,044 soil tests were performed for homeowners, landscapers, and groundskeepers. There were daily contacts between residents and scientists, an exchange of scientific information, and public input into research initiatives and diagnostic services.

Newspaper reporters and other members of the media frequently request information. In some instances, such as mosquito research and encephalitis virus outbreaks and the entry of a plant pathogen called *Phytophthora ramorum* (a fungus-like agent that causes Sudden Oak Death or Ramorum blight), there was high national interest in research or survey findings. West Nile encephalitis viruses have spread quickly to western United States. An ambitious field research

project on mosquitoes was continued in response to stakeholders' concerns in Connecticut. Administrators in towns and cities were kept informed of weekly mosquito surveillance test results. Information on the isolation of encephalitis viruses from mosquitoes collected in different towns had immediate impact on stakeholders' lives and resulted in their following precautionary measures, such as the application of repellents and avoiding mosquito bites during high risk periods. The notices of infected mosquitoes and information on precautionary measures had an impact. During 2005, there were no fatalities from encephalitis virus infections in Connecticut. Other experimental findings on ticks, three tick pathogens that cause human diseases, hemlock woolly adelgids, gypsy moths, the small Japanese cedar longhorned beetle, composting, pressure-treated wood, food safety issues, and a variety of plant diseases continue to be of high interest to reporters and other stakeholders nationally. The Director, Vice Director, and all Department Heads conduct research and report findings to the media and other stakeholders.

Public meetings and open houses, announced in newspapers, newsletters, and on radio stations, were held at the Station to allow stakeholders to meet scientists, see experimental plots, visit research laboratories, and to review and discuss research findings. Stakeholders met with scientists and discussed research "face to face" or attended public talks and were able to address specific issues and concerns. Special contacts were made by phone or correspondence with members of organizations that serve protected individuals, trade groups, commodity associations, and with other state agencies to reach under-served populations. Dozens of civic groups used Station conference rooms or the auditorium on multiple occasions. This provided further opportunities for stakeholders to meet and hear presentations by Station scientists.

During this reporting period, the Station held special public conferences and open houses. Christmas tree growers attended a meeting at the Valley Laboratory in Windsor, CT during July 2005. They heard presentations on research and toured experimental plots. Nursery and landscape professionals attended the annual tour of the Valley Laboratory in July of 2005. Attendees were shown research plots and educational gardens. In addition, attendees received new information from staff members on biological and chemical control of hemlock woolly adelgids, and on managing insects, plant pests, parasitic nematodes, and weeds. Stakeholders also saw displays on the identification of weeds and insect pests of woody ornamentals. After the outdoor event, attendees heard other research talks in the conference room on managing nematodes in the landscape, effects of endophytic turf on white grubs, plant diseases, and updates on arthropods and pesticides. Discussions

followed the talks. At a public meeting on April 18, 2005 (Plant Science Day in the Spring), scientists reported their findings on Ramorum blight, exotic insect pests, and methods of surveying and controlling invasive aquatic plants. Additional information was presented on efficiency of pollination in corn plants, analytical chemistry techniques, a newly constructed Biosafety Level 3 laboratory for isolating encephalitis viruses from mosquitoes, and on Connecticut's surveillance effort for collecting mosquitoes as a part of a laboratory tour activity for stakeholders. On August 3, 2005, an open house was held at the Station's farm in Hamden, Connecticut. About 1,017 persons attended this event and were able to visit experimental plots, demonstrations, and exhibits to receive new scientific information on the control of invasive weeds in Connecticut lakes, wood-boring insects, forestry research, new grape cultivars, mosquitoes and West Nile virus, biological and chemical control of hemlock woolly adelgids, landscaping tips, the use of certain plants (green manure) for controlling nematodes, wind dispersal of corn pollen, and other topics. There were over 60 exhibits and field plots including organic farming; use of compost in nurseries; pesticide residues in water, food, and soil; light energy and photosynthesis; beetle pests of plants; reducing deer browse damage; and the use of salt to suppress root diseases in asparagus crops. In addition to the planned major open house events, small groups were given opportunities to visit the Station and hear brief presentations in laboratories on selected topics of interest. For example, high school students and their teachers were given a tour of the new building and learned about testing mosquitoes for encephalitis viruses. Information gained by attending all of these events impacted stakeholders' lives by helping people to improve gardening practices, use less pesticides, and to avoid potential hazards in the environment.

The Experiment Station Associates (ESA), with a membership of about 800 stakeholders, continued to promote scientific activities of the Station and published a quarterly bulletin describing highlights of research accomplishments. Their bulletin was sent to their membership, state legislators, and hundreds of other people interested in Station research results and events. In addition, a brochure on Station research activities was revised by the ESA for public distribution. These stakeholders requested the assistance of Station personnel in providing information for the brochures. Station scientists, including the Director, gave oral presentations and reports to ESA members at their annual meeting on March 15, 2005 and at bimonthly Board of Directors' meetings. Members in attendance at the annual meeting heard presentations by Station scientists on Ramorum blight and encephalitis viruses. All of these activities provided opportunities for stakeholder input on

critical issues in Connecticut agriculture and related problems. Interactions with stakeholders had impacts because more people became aware of Station research initiatives.

Station scientists worked closely with growers and foresters in research projects to solve specific problems. Special assistance was given to arborists, veterinarians, public health officials, groundskeepers, landscapers, members of the nursery industry, fruitgrowers, and vegetable growers. The nursery industry is valued at about $400 million annually in sales, whereas the forest products industry is valued at $500 million. Many experiments were conducted in nursery fields, greenhouses and other farmers' properties at the request of these growers to reduce pesticide use and costs. Stakeholders were involved with the planning process, execution of scientific experiments, and evaluation of the results. An important problem re-occurred during this reporting period. There was accidental introduction of *Phytophthora ramorum* on about 10,000 rhododendron plants shipped from Oregon to Connecticut. In a previous reporting period, this pathogen was accidentally distributed from California to several states. Nursery growers and the general public received immediate assistance. Federal action orders and stop sale notices prohibited the movement of rhododendrons after cultures confirmed the identity of the pathogen in Connecticut. Station staff members closely monitored quarantined plants and the destruction of these plants. These efforts prevented the further spread of the pathogen and had impact because stricter plant quarantines were placed on California and Oregon. A new molecular diagnostic laboratory for plant pathogens was created at the Station to detect emerging pathogens. These findings also had immediate impact by raising public awareness and by establishing extensive surveillance efforts. In other work, advances in the use of pathogenic nematodes has improved the control of black vine weevil grubs in nursery and strawberry fields and has resulted in lesser amounts of chemical pesticides being used. The resulting new management practice can now be applied in other infested sites.

A special problem occurred on a strawberry farm that needed immediate attention. A shed containing pesticides caught fire, and the Department of Agriculture requested Station assistance on determining if the strawberries were contaminated. Analyses were performed within 8 hours of receiving the samples. There was no contamination of the food product, which was valued at $60,000. The strawberries were allowed to be sold.

Forest stands are extensive in Connecticut. Approximately 60% of the state's land area is classified as woodlands. The Station's McIntire-Stennis program focuses on forest insect pests, such as hemlock woolly adelgids (*Adelges tsugae*) and the small Japanese cedar longhorned beetle

(*Callidiellum rufipenne*); breeding timber and nut-producing chestnuts; the host/pathogen/parasite system of chestnut blight disease; and general management of forests. The latter includes work on reducing browsing damage caused by white-tailed deer, long-term studies of hardwood stands, cutting methods of hardwoods, and studies on unmanaged forests in Connecticut. Statewide surveys are being conducted for early detection of Asian longhorned beetles, emerald ash borers, pine shoot beetles, the fungus-like pathogen for Ramorum blight, and other exotic pests that could cause extensive economic losses and disruption of forest ecosystems. These studies are being conducted to help the wood products industry in Connecticut, which includes 350 firms that employ 3,600 loggers, millworkers, and other employees. At the requests of stakeholders, 131 talks and interviews were given by Station staff in association with the McIntire-Stennis forestry research program.

Adelges tsugae, hemlock woolly adelgid, is a destructive introduced pest of eastern hemlock and Carolina hemlock in at least 16 eastern states from Georgia to Maine. With continued decline or death of hemlock trees, stakeholders requested assistance on control (biological and chemical). Pesticides can control *A. tsugae* on ornamental hemlocks but not in forests where thorough treatment with pesticides at ground level is difficult. At a stakeholder's request, tests were conducted on soil applications and systemic control (i.e., tree injection methods) of the pest with imidacloprid. Results indicated that soil injections or drench applications near the trunk were most effective. Arborists are now using soil treatments along with foliar applications of horticultural oil to protect trees.

In earlier work, a Station scientist found that *Sasajiscymnus* (*Pseudoscymnus) tsugae* is an effective beetle predator of all adelgid life stages. Foresters and the general public requested that these predatory beetles be mass-reared and released to help control *A. tsugae* in Connecticut. Accordingly, the beetle has been continually released in widely separated sites infested with *A. tsugae*. As a part of an ongoing effort over several years, more than one million beetles have been released thus far in at least 20 forest sites in Connecticut (including the Mashantucket Pequot Tribal property) and 13 other states. Beetles have been released in Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Tennessee, Vermont, Virginia, and West Virginia as a part of a cooperative multistate research project. Field research has demonstrated that the beetles are established at most sites and that the beetle is also attacking the balsam woolly adelgid, another important pest. These promising results provide immediate impact by showing that there is high potential for this beetle in biological control as an alternative to chemical control. Expected long-term benefits include healthy hemlock stands, less

pesticides being used, less adverse effects on non-target and beneficial organisms, and a cleaner environment. Current research includes the development of an artificial diet for the beetle, assessment of hemlock stand conditions, determining the patterns and timing of beetle release that will enhance the biological control effort, survival and dispersal of the beetles, and assessing the impacts of pesticides on the predatory beetle. Chemical applications are being modified to minimize adverse effects of pesticides on predatory beetles. Stakeholders now have a biological control option that may work in forests. The Station is also collaborating with the USDA Forest Service in improving colony health and mass-rearing methods for other related predatory ladybeetles (*Scymnus sinuanodulus*) imported from China. The *Scymnus* predatory beetles were released in Connecticut, Georgia, and Pennsylvania as a collaborative effort.

The success of rearing *S. tsugae* has led to commercialization efforts and short-term impacts. The predatory beetles can now be purchased through "The Green Methods" catalogue of the Green Spot via greenmethods.com in conjunction with ECOscientific Solutions in Scranton, Pennsylvania. People have been buying the beetles for release on their properties. As more beetles are released, long-term impacts of reducing *S. tsugae* infestations are expected. The geographical range of the hemlock woolly adelgid is expanding northward in New England and continues to be of great concern to federal, state, local government officials, and to arborists who are called upon to treat infested trees. There are numerous requests for information and guidance from stakeholders in different states on where the infestations occur. Scientists, arborists, foresters, owners and employees of nurseries, members of the Mashantucket Pequot Tribe in Connecticut, and other stakeholders benefited from the McIntire-Stennis program on the Station's research of hemlock woolly adelgids. In a multistate effort, Station scientists continue to collaborate with other scientists in the Virginia Department of Forestry on a related adelgid: balsam woolly adelgid. Knowledge gained from work on the hemlock woolly adelgid is aiding in these new studies. Stakeholder input was also received from questionnaires sent to arborists, from attendees of a Station scientist's talks at meetings, and from telephone conversations with state residents. Experiments were designed and revised based on stakeholders' input and needs.

A newly discovered fungus attacks elongate hemlock scale (*Firorinia externa*) in Fairfield County, Connecticut and Orange and Putnam Counties, New York. An infection rate of 78.5% was recorded for one tree. The identity and potential of the fungus as a biological control agent are being investigated.

During this reporting period, a Station scientist continued to contribute new information on adelgids and the predatory beetle for a website at Cornell University and continued to advise numerous arborists and extension agents in Connecticut and in New York State so that biological and chemical control results could be disseminated to a broader base of stakeholders in different states. Finally, stakeholders are collaborating in field studies on control and include businesses (i.e., tree care companies) and USDA Forest Service personnel. Evaluations of the efficacy of beetle releases are being conducted for cooperators.

A collaborative study with scientists at the University of Georgia, Western Connecticut State University, and a company is being conducted to determine if transgenic cottonwood trees can help remove mercury from soil at an old industrial site in Danbury, Connecticut. Two Station scientists were asked by stakeholders (i.e., Danbury city officials) to participate in the project because of progress made in other research problems on phytoremediation. The research is funded by the US EPA and the City of Danbury. The transgenic cottonwood trees are being provided by scientists at the University of Georgia, and USDA-APHIS is overseeing permits and other regulatory matters. The study site is located in a neighborhood section of Danbury, where residents are aware and approve of the research efforts to reclaim the land and eliminate an environmental problem.

In addition to the displays of research results at the Station's annual open houses for the public, other exhibits were presented at a Connecticut Tree Protective Association meeting, two Connecticut Nursery and Landscape Association meetings, Connecticut Flower and Garden Show, a Farm/City Week event, and the Eastern States Exposition (Big E) in West Springfield, MA. In addition, research results were presented to the U. S. Forest Service, USDA/APHIS, Eastern Plant Board meeting, and other regional forestry or regulatory meetings. Comments received by attendees of meetings were useful in modifying experimental designs.

The American chestnut population in eastern United States suffered a severe epidemic caused by an imported fungal pathogen, *Cryphonectria parasitica*, during the early 1900's. This blight reduced the American chestnut to understory shrubs, which decline, sprout from the base, decline and sprout again. There is continued strong public interest in reviving the American chestnut population, primarily for nut production. There is also demand for timber and a desire to improve the diversity of hardwood forests. Enhancement of forest ecosystems benefits the overall health of all plants and animals, reduces soil erosion problems, and protects water resources. Immediate impact of research results is evident. Preliminary studies revealed that the blight fungus could be controlled by using a

virus, which reduces the ability of the fungus to kill trees. The aim of this long-term research project in Connecticut and other states in a USDA-approved, award-winning multistate McIntire-Stennis research project (NE-1015) is to breed timber chestnuts for resistance to diseases and to introduce them into forests where native trees are preserved. The main goal is to allow natural crossing to introgress the resistance genes into the native population.

The first transgenic hypovirulent *C. parasitica* release was made in 1994 as a single-season experiment in the Housatonic State Forest in Sharon, Connecticut on American chestnut sprouts under a closed canopy of hardwood trees. A scientist at the University of Maryland and his co-workers made the transgenic forms from strains of the fungus isolated in the plots where tests were planned. The 24 experimental trees were re-examined during this reporting period, and some of the other 241 numbered chestnut sprouts were examined as well. Hypovirulence is established in *C. parasitica* exposed trees and continues to do well. The trees are alive and fruiting.

The second transgenic release was made in 1997, also with native *C. parasitica* strains genetically engineered by the scientist from the University of Maryland to contain a nuclear DNA copy of the prototypic hypovirus genomic RNA. Water-containing spores of these transgenic strains were sprayed onto sprouting American chestnut stems in a clear cut area of the Meshomasic State Forest in Portland, Connecticut. Stems in the control plot were sprayed with water. Both control and treated plots were re-examined during this reporting period. Experimental findings are very encouraging. There is short-term impact of this initiative because in overall appearance, the chestnut sprouts in the treated plot are bigger and healthier than those in the control plot. Field releases were successful. Stakeholders are able to see the direct outcome of several years of work and look forward to long-term benefits of having American chestnut trees for nut production. Recent work indicates that a dwarf chestnut tree being developed could be a boon to commercial growers. The promising dwarf variety produces nuts with great flavor and good size. They are excellent for cooking and peel easily. The small size of the tree is preferred by commercial growers. This multistate project has made a significant contribution toward improving timber and nut-bearing chestnut trees in eastern North America. Chestnut trees are now growing in forest plots, there is improved stand diversity, and there are potential economic opportunities for chestnut growers, who have vested interests in local and international markets.

A Station scientist heads the chestnut research activities in Connecticut. As in the past, she continued to interact with users of wood products (eg, lumber, fencing, poles, etc.), commercial nut

growers, and persons interested in forest health. This Station scientist has been writing annual articles for the Connecticut Forest and Park Association to reach stakeholders, to broaden interest in the research efforts, and to update research findings. There have been ongoing discussions with the National Wild Turkey Federation, the Mohegan Tribe in Connecticut, and the Connecticut Soil and Water Conservation Districts concerning new chestnut selections for plantings. In addition, stakeholders have direct contact with Station scientists via the internet (www.caes.state.ct.us); e-mail addresses are listed on at least six chestnut web pages. There have been numerous opportunities for stakeholders to continue to learn about chestnut research and to comment on all aspects of the work.

White-tailed deer cause severe damage to nursery plantings, homeowner shrubs, and tree regeneration in Connecticut forests. Oak, an economically important tree for lumber production, has been affected along with eastern hemlock and maple trees. Deer remove saplings from the forest and are impacting forest composition. Foresters, nursery growers, and water authority officials have requested that research be conducted to find ways of protecting oak conifer seedlings in areas of high deer density. Experiments are being conducted in state forests, water company properties, and on lands owned by a power company (Northeast Utilities). Research cooperators in these organizations continue to assist Station efforts by providing materials and labor, selecting plots for research, and in designing experiments. There currently is a solid expanding stakeholder base, which includes Great Mountain Forest and Hull Forest Products, in the research cooperative. Research findings have been disseminated to these and other professionals regularly.

Forest composition needs continual monitoring to ensure that quality forest resources are available in the future. Past work conducted at the Station outlined the general framework of forest stand dynamics, but these studies did not provide a means of predicting future development of an individual stand of trees with its unique initial composition and disturbance history. During a previous reporting period, foresters asked a Station scientist to address this shortcoming and to examine the factors that affect the growth and survival of individual trees. As in the past, research is supported by the State Division of Forestry-Connecticut Department of Environmental Protection, which oversees the study sites. Work continues in additional plots with the cooperation of other stakeholders (White Memorial Foundation, Great Mountain Forest, and the Town of Manchester), who are participating in the research.

As several upland forest oak stands approach economic and biological maturity in southern New England, there is growing public concern over species composition following stand

regeneration. A Station scientist conducted research on controlled burning of forested areas to help restore ecological functions, especially the oak regeneration process. State lands, Mashantucket Pequot tribal property, and private (Great Mountain Forest) lands were included in the study. The effects of prescribed burning on stand dynamics are being monitored. Under controlled conditions, oaks tend to survive better than other tree species, such as maple and birch. At the request of state foresters and utility company officials, long-term studies are being continued to investigate six distinct cutting methods and their effects on regeneration composition and residual stand growth. The research is designed to provide information on crucial hardwood management issues and will benefit forest managers from New England to West Virginia. Stakeholders from the State Division of Forestry-Connecticut Department of Environmental Protection, the Regional Water Authority, the White Memorial Forest, and Nature Conservancy are collaborating with a Station scientist and have had input on experimental design and data collection methods. By participating in the research, these collaborators obtain current information. To seek further stakeholder input, a Station scientist presented his research findings at meetings of the following groups: New England Society of American Forester, Connecticut Tree Protective Association, Connecticut Forest and Park Association, The Nature Conservancy, and Association of Northeast Forest Watershed Managers.

Ticks are abundant in southern New England and transmit pathogens that cause Lyme disease, babesiosis, monocytic ehrlichiosis, granulocytic anaplasmosis, and Rocky Mountain spotted fever. Males and females of the blacklegged tick (*Ixodes scapularis*) prefer deer as hosts. As deer become more numerous, tick populations also increase. Stakeholders requested Station assistance on the identification of ticks removed from themselves or family members. The ticks were submitted to health care professionals (eg. local health departments), who subsequently transferred the specimens to the Station. Blacklegged ticks were tested for the DNA of the Lyme disease organism, and results were reported to health care professionals, who then reported the findings to stakeholders. Knowledge of infected ticks has a direct impact on people, particularly when illness occurs, because physicians can more easily diagnose Lyme disease and prescribe antibiotics. Another immediate benefit of this research is that more stakeholders become familiar with the Station and its research mission. The establishment of new records for infected ticks in towns also provides other immediate benefits by clarifying the geographical distribution of the Lyme disease agent. A Station scientist has worked closely with these health districts in at least eight towns on community-based Lyme disease prevention projects supported by funding from the Centers for Disease Control and Prevention. He is

monitoring tick populations and infection rates in areas where control measures were implemented. Veterinarians requested Station assistance on performing antibody tests to determine if horses and cats were exposed to the Lyme disease and granulocytic anaplasmosis agents. Like the tick information, these results directly helped animal owners by diagnosing infections in their animals. Proper antibiotic treatment followed.

Stakeholder input also was obtained when scientists served as members of advisory boards and committees, adjunct professors at universities, or officers of organizations. During FY 2005, Station scientists interacted with stakeholders in the following public organizations or state or national committees:

Albert Einstein College of Medicine (Visiting Assistant Professor)
American Phytopathological Society
American Society of Horticultural Science Technical Program Committee
American Society of Plant Biologists
Animal Behavior Society
Bloomfield High School Advisory Board for Agri-Science
Chestnut Growers of America
Clay Minerals Society
Clear Lake Improvement Assoc.
Community Gardens, Knox Parks Foundation (Hartford)
Concentrated Animal Feeding Operation Committee, EPA
Connecticut Academy of Science and Engineering
Connecticut Butterfly Association
Connecticut Christmas Tree Growers' Association
Connecticut Council on Soil and Water Conservation
Connecticut Endangered Species Committee
Connecticut Entomological Society
Connecticut Environmental Industry Council
Connecticut Forest and Park Association
Connecticut Greenhouse Growers Association
Connecticut Groundskeepers Association
Connecticut Invasive Plant Working Group

Connecticut Nursery IPM Implementation Team

Connecticut Nursery & Landscape Association

Connecticut Pomological Society

Connecticut Tree Protective Association Board

Connecticut Urban Forestry Council

Cooperative Agricultural Pest Survey Committee

Cornell University (Adjunct Professor of Plant Pathology)

Florida Department of Agricultural and Consumer Services (Research Associate)

Eastern Plant Board

Endangered Species Taxonomic Advisory Committee for Plants

Goodwin Forestry Scholarship Committee

International Organizations for Biological Control

International Society for Horticultural Science

IR-4 Berry Fungicide Working Group

Journals

- Agricultural & Forest Meteorology
- Biological & Cultural Tests for Control of Plant Diseases
- Compost Science & Utilization (Editorial Board)
- Environmental Engineering Science (Editorial Board)
- Environmental Pollution (Editorial Board)
- Environmental Toxicology & Chemistry
- Eukaryotic Microbiology
- International Journal of Phytoremediation (Managing Editor)
- Nematology
- Plant Nutrition
- Weed Science

Mill River Watershed Association

Mycology Society of America

National Christmas Tree Growers Association

National Plant Disease and Pest Detection Network

Natural Areas Association

Natural Resources Conservation Service (USDA)
New England Aquatic Plant Management Society
New England Pest Management Network
New England Vegetable & Berry Growers' Assoc.
New England Wildflower Society
North American Blue Mold Warning System
Northeast Greenhouse and Ornamentals IPM Commodity Work Group
Northeast Organic Farming Association of Connecticut
Northeast Wildlife Damage Management Research and Outreach Cooperative
Northeastern Regional IPM Committee
Northeastern Weed Science Society
Northern Nut Growers' Assoc.
Organic Land Care Committee
RC & D Forestry and Stewardship Committee
Sigma Xi (Quinnipiac University Chapter)
Sleeping Giant Park Association
Society of American Foresters
State of Connecticut Mosquito Management Program
University of Connecticut, Department of Pathobiology (Adjunct Professor)
USDA Coop. Agric. Pest Survey Committee (USDA)
Yale University (Adjunct Professor, Lecturer, Research Affiliates)

Program Review Process (Merit and Peer Review)

There have been no significant changes in the review processes since the updated Plan of Work was submitted. In accordance with the approved updated Plan of Work, scientific proposals of the Station were 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 review for proposals followed criteria proposed by the National Science Foundation (NSF-99-172). The Station's processes of merit and peer review are evaluated annually by the Director for effectiveness and compliance with federal requirements. Project outlines for Hatch, McIntire-Stennis, multistate research funds, or grants were reviewed by qualified scientists within (including at least two Chief Scientists and the Director or Vice Director) or outside the Station. This process of review ensures

that the planned research is relevant to established priorities, which are consistent with stakeholders' changing needs, efficiently meets state and national USDA program criteria and goals, and has a reasonable likelihood of success. No federal funds were released for research on any project until CSREES approvals of project outlines and grant proposals were given. Reviews are kept on file in Chief Scientists' offices. Scientific peer review is required to determine the suitability and validity of the methods used (i.e., critically evaluate technical quality), originality of the study, and value of the work to the scientific community and public.

Station scientists are encouraged to publish their results in peer-reviewed journals that have national and international audiences and to write reports for the general public. Critical scientific reviews are important in ensuring quality science and accountability. Book chapters, symposia proceedings, Station bulletins, and state and regional publications are also acceptable means of communication to stakeholders. In addition to written reports, scientists presented their findings to their peers and stakeholders at international, national, and local meetings and conferences. Citizens who do not have scientific backgrounds are not excluded in this reporting process. They receive non-technical summaries included in Station publications for public use. Written or oral comments received were important in ensuring accountability, evaluating the usefulness of scientific accomplishments, and in the re-alignment of research initiatives to address changing needs and priorities.

Updated Planned Programs

Program Goal #1: **An agricultural system that is highly competitive in the global economy.**

Research. Goal 1: Through research and education, empower the agricultural system with knowledge that will improve competitiveness in domestic production, processing, and marketing.

Performance. Goal 2. To increase market shares for targeted agricultural products of Connecticut.

Output Indicators. 1. As stated in the Updated Plan of Work, the numbers of publications, talks, and interviews by scientists are tabulated annually and reported herein to document communication to stakeholders. There were 44 senior-authored publications and 325 talks and

interviews recorded for state FY 2005 in association with this program goal. There were 64 officerships and memberships held by Station scientists in stakeholders' organizations and national or state committees during this reporting period. Excerpts of letters from stakeholders regarding services rendered, media reports, and narratives of scientific accomplishments are on file. This information is available to those who are interested in the Station's research activities and results.

Output Indicators. 2. As described below, research was conducted to produce value-added agricultural products. Progress made on growing quality fruits and vegetables, reducing farm costs, and on improved quality of nursery plants are examples of accomplishments. In this and other sections of the report, concise annual accomplishment summaries are presented under the respective outcome indicators listed and represent progress made consistent with the updated Plan of Work. Accomplishment and impact headings are marked in bold type in each section. Impact statements are provided when the research has progressed to an appropriate stage of evaluation. Short- and long-term impacts are discussed to show positive behavioral changes by the intended users or economic, social, health, or environmental benefits for stakeholders. Whenever possible, efforts were made to present results summaries and impact statements in non-technical terms for clarity. In many cases, expected outcomes were accomplished in the past five years or during this reporting period, while in some other instances, more time is needed to complete research objectives and to meet expected goals within the next year.

Outcome Indicators. There are several expected outcomes and impacts, which include positive changes in behavior of stakeholders and economic benefits, associated with the performance goals listed in the updated Plans of Work. It is expected that

(1) Results of field studies on biological and cultural control of insect pests of vegetables will result in reduced pesticide use, lower costs of control, and reduced human exposure to pesticides. Those outcomes also apply to USDA goal #3 (healthy, well nourished population and goal #4 (greater harmony between agriculture and the environment). **Themes: Agricultural competitiveness, Agricultural profitability, Diversified/alternative agriculture, Innovative farming techniques, Niche market, Organic agriculture; Small farm viability; Sustainable agriculture**

Description: *Ralstonia solanacearum* race 3 biovar 2 is a highly infectious bacterium that causes wilt in tomatoes, potatoes, eggplant, and peppers. The organism was discovered on geranium

cuttings imported from Guatemala, and because it can be transmitted through soil, contaminated irrigation water, equipment or by personnel working in greenhouses, aggressive measures were needed to detect and control the pathogen.

Accomplishment/Impact: In cooperation with USDA (Animal and Plant Health Inspection Service) personnel, information was obtained on where the plants were distributed in Connecticut. Analyses revealed infected plants at four greenhouse operations. Instead of using pesticides, quarantines were imposed, and 1,600 plants were destroyed by incineration or burial to prevent further spread of the pathogen. These measures had immediate impact because the prompt destruction of infected plants prevented losses of about $200,000 in other greenhouse plants. There were other benefits because the bacterium was not detected in vegetable fields, where crops worth about $2 million were growing, more careful controls were placed on importing plants from foreign countries, and there was no human exposure to pesticides, thereby reducing health risks.

Sources of funds: Hatch and state

Scope of impact: national

(2) The dispersal of corn pollen will be determined, and models will be developed to aid in the establishment of effective strategies for gene flow management. Federal and state regulatory officials will be able to set buffer zones between genetically modified corn plantings and non-genetically modified plants. Results will provide a basis for new federal and state permit requirements.

Themes: Plant Regulatory Changes; Improved Pollination of Corn Agricultural competitiveness

Description: Field experiments were conducted in Connecticut and New York State (Cornell University) as a part of integrated activities to determine the dispersal of corn pollen. There is growing concern among stakeholders that there will be gene flow from genetically modified corn to conventional corn.

Accomplishment/Impact: In small plots (less than one acre), corn pollen normally does not move more than 0.5 miles from the source. Dispersal from large plots (more than 10 acres), however, can extend to almost one mile. Therefore, a one mile buffer zone seems to be adequate in preventing the outcrossing of genetically modified corn with conventional corn. This outcome has had impact

because this information is being used by USDA (APHIS) in establishing regulatory zones for planting genetically modified corn near non-genetically modified corn.

(3) More efficient IPM practices will lead to the reduction of pesticide use and more efficient pest control efforts in nurseries to facilitate international and interstate shipments. These outcomes also apply to USDA goals #4 and #5 (enhanced economic opportunity and quality of life for Americans. **Themes: Integrated Pest Management, Agricultural Profitability, Human Health**

Description: The small Japanese cedar longhorned beetle (*Callidiellum* rufipenne), an exotic insect pest from Asia, attacks arborvitae, red cedar, Atlantic white cedar and other species of ornamental and wild plants in the family Cupressaceae. This pest is established in at least 58 towns in southern Connecticut and has an economic impact on the nursery industry. At the request of nursery growers, tests were conducted with permethrin-based insecticides to control the insect.

Accomplishment/Impact: Field tests revealed that minimal applications of insecticides during the spring were effective in controlling the insect. These findings had immediate economic impact because, during this reporting period, 27,346 arborvitae plants (valued at about $945,000) were shipped from 77 nurseries and sold in local markets or in other states. There are other long-term benefits because permethrin-based insecticides degrade rapidly in the environment and are far less toxic to the users, compared to organophosphate insecticides. The expected long-term impacts are continued profitability for nursery growers, less pesticide residues in nurseries, less risk of contaminating ground and surface water sources (eg., streams, lakes, and ponds), and less human exposure to pesticides, thereby reducing health risks.

Sources of funds: Hatch, McIntire Stennis, state

Scope of impact: national

Sources of funds: Hatch and state.

Scope of impact: state-specific.

(4) Commercial greenhouse production facilities will operate more efficiently to reduce environmental contamination by fertilizers or to decrease labor costs. **Themes: Agricultural competitiveness; Agricultural profitability; Small farm viability**

Description: Consumers buy tomatoes grown in greenhouses during the colder months. There are about 50 growers in Connecticut that supply tomatoes to the market. Unblemished tomatoes sell for about $3.00 lb. Growers have some common problems with greenhouse production: high labor costs for picking tomatoes and fruit quality (i.e., cracking due to the thin skins of some cultivars). It was hypothesized that shading tomato plants increases fruit quality, and although numbers of tomatoes per plant would decline, labor costs could be reduced because there would be less unmarketable fruit. Experiments were conducted to test this hypothesis.

Accomplishment/Impact: Results replicated in different greenhouses verified that shading did indeed reduce total yield of tomatoes, but there was no significant difference in marketable yield. However, shade reduced the cost of picking tomatoes by about 10% because there was less unmarketable fruit. In a 24 x 96 foot greenhouse space, there was an average savings of about $60.00 in labor costs. Aside from the immediate economic impact of increased farm efficiency, consumers benefit by having fresh nutritious tomatoes available.

Sources of funds: Hatch and state

Scope of impact: multistate integrated research and extension (CT, MI, NJ, NY)

(5) Monitoring efforts in orchards, nurseries, and vegetable crop production areas will detect emerging insect and plant diseases that may affect plants. **Agricultural profitability, Integrated Pest Management.**

Description: Stateholders are concerned about new diseases emerging in agricultural settings. In response, orchards, nurseries, and vegetable crop production areas were surveyed for insect and plant pathogen problems.

Accomplishment/Impact: No new infestations were detected. Minor problems were solved by spot treatments of pesticides. These results had impact because unnecessary spraying was

avoided. At one small vegetable farm, there was an estimated savings of about $1,000 in insecticide costs, and there was less human exposure to pesticides, thereby, reducing health risks.

Sources of funds: Hatch and state

Scope of impact: state-specific

(6) Field-testing of new apple cultivars will identify high-yielding, marketable crops that are genetically resistant to plant disease. This outcome also applies to USDA goal #3. **Themes: Adding value to agricultural products; Agricultural competitiveness; Agricultural profitability; Innovative farming techniques; Plant health, Precision agriculture; Integrated pest management; Small farm viability**

Description: Fungal infections, such as apple scab, can cause economic losses in orchards. The annual value of the apple crop in Connecticut is estimated to be about $9 million. Stakeholders have requested that experiments be conducted to identify apple cultivars that are resistant to apple scab and other fungal infections so that amounts of fungicides can be reduced. As a part of a multistate, integrated project to meet intermediate and long-term critical needs of fruitgrowers, 30 cultivars of apple were re-evaluated in field tests in Connecticut to determine if there was resistance to the following fruit diseases: apple scab, cedar apple rust, cedar-hawthorne rust, powdery mildew, anthracnose, black rot, sooty blotch, bitter rot, and flyspeck.

Accomplishment/Impact: In replicated experiments, the cultivar “Suncrisp” had the slowest growth rate for bitter rot fruit infection, whereas “Ginger Gold” had the fastest growth rate. These results had short-term impacts because growers are now introducing the “Suncrisp” cultivar and are using other IPM practices, such as mulch mowing, to reduce fungal infections and, thus, minimize the need for fungicides. With more widespread acceptance by apple growers, nationally, implementation of resistant apple cultivars and the use of IPM practices could have the expected long-term benefit of saving about $3.5 million in fungicide costs. Another long-term impact, resulting from less pesticide

usage, is a cleaner orchard environment, reduced exposure of humans and wildlife to pesticides, and reduced risk of run-off of fungicides into surface and ground water.

Sources of funds: Hatch and state.

Scope of impact: multistate integrated research/extension (AL, AR, CT, ID, IN, MA, MI, NH, NY, NC, OH, OR, PA, UT, VA, VT, WA, WI, WV).

These accomplishments also apply to national goal #3 by providing food to ensure a healthy, well-nourished population (**Theme**: Human health).

(7) Field-testing of new niche crops, such as tropical pumpkin (Calabaza), jilo, maxixi, and radicchio, will provide growers added income and supply consumers with produce of high interest to ethnic groups. These outcomes also apply to USDA goals #3 and #5. **Themes: Agricultural competitiveness, Agricultural profitability, Small farm viability**

Description: Radicchio is a popular produce item in restaurants and among homeowners. Farmers are interested in diversifying crops grown, particularly when market prices are attractive. Several cultivars of radicchio were evaluated in different Connecticut farms to determine quality and yield.

Accomplishment/Impact: There was a high percentage of marketable heads (70%) and average yields of about 4,800 pounds per acre for the following cultivars: Carmen, Beacon, Leonardo, and Red Preco #1. The success in growing radicchio had immediate economic impact for growers. At a retail price of $4.99 per pound, there is a potential crop value of $23,952 per acre. Several small farms have begun growing radicchio as a “niche crop” during the spring and fall. Expected long-term benefits include increased economic opportunities for growers, the availability of locally grown produce for consumers, and preservation of open space.

Source of funds: Hatch and state.

Scope of impact: state-specific

(8) Laboratory tests on the molecular genetics and biochemistry of plants will characterize nucleobase/ascorbate transporters and other processes so that new plants can be ultimately developed to use fertilizers more efficiently. **Theme: Plant Genomics, Plant Health, Plant Production Efficiency.**

Description: Plant breeders have adapted crop plants to a broad range of growing conditions by selecting genes that alter basic patterns of growth and development. Semi-dwarf varieties of grain crops, for example, and bush versus vine type cultivars of vegetable crops represent basic genetic changes in plant architecture. Experiments were conducted on *Nicotiana benthamiana* plants (as a model) to identify the genes that control leaf development, with the main emphasis on formation of leaf blades.

Accomplishment/Impact: Key genes that control leaf development have been identified. These results have impact because plant materials and techniques are being used by scientists at other institutions, such as Eastern Connecticut State University and the University of California (Davis) to improve plant cultivars. The expected long-term benefits are the development of crops that are resistant to insects and plant pathogens and new crops that have high yields and improved qualities.

Sources of funds: Hatch and state.

Scope of impact: national.

Description: White pine weevil larvae are important pests of white pine trees. These insects attack the upper, leading branches of trees, and the unsightly appearance of trees with dead branches affects marketability. Weakened trees are also more susceptible to diseases. Christmas trees are grown on about 6,000 acres by 500 growers in Connecticut. White pines are present at most farms

and comprise about 20% of the $9 million annual gross revenue of harvested trees. Moreover, white pine trees are in great demand for local landscaping. The nursery industry requested assistance from Station scientists to meet immediate critical needs on solving a specific pest problem. Various insecticides were tested to find acceptable cost-effective control measures.

Accomplishment/Impact: The insecticide bifenthrin (Talstar) was most successful in controlling white pine weevils. Earlier studies showed that this product was also effective in controlling pales weevils on Christmas trees. These results had short-term impacts. Christmas tree growers have replaced chlorpyrifos (Lorsban), an organophosphate insecticide, with a much safer alternative. A well-timed, low concentration of bifenthrin controls white pine weevil and can save about $1,000 in damage to trees per acre. Sales of quality Christmas trees can continue, thereby enhancing local agricultural markets and expanding economic opportunities for nurseries in rural areas. Moreover, chlorpyrifos is an insecticide that can be hazardous to the users. The US EPA has subsequently changed the label requirements to restrict the use of this material. Selection of bifenthrin not only reduces costs but offers expected long-term benefits of having cleaner environments in and near nurseries, many of which border residential areas. There is also less human exposure to insecticides, continued profitability for growers, and fewer potential problems with contaminated streams and ground waters.

Sources of funds: Hatch and state.

Scope of impact: multistate integrated research (CT, MA, NY, RI) and extension.

Accomplishments also apply to goals #4 (**Theme: Pesticide application**) and #5

Allocated Resources. Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 2005.

	Fiscal Resources				Human Resources	
	Federal*		State		Scientist Years	
Years	Target	Actual	Target	Actual	Target	Actual
2005	$360,000	$390,000	$1,724,422	$2,374,116	12.1	15.8
2006	$360,000	$xxx,xxx	$1,724,422	$x,xxx,xxx	xx.x	xx.x

*Federal Hatch funds only.

Program Goal # 2: A safe and secure food and fiber system.

Research Goal: To ensure an adequate food and fiber supply and food safety through improved science based on detection, surveillance, prevention, and education.

Performance Goals (1). To annually increase the research and knowledge base available to CSREES partners and cooperators on food safety and food-borne risks and illnesses. (*2)* To increase consumer access to selected agricultural products of Connecticut, which provide greater assurances for safety.

Output Indicators. (1). Numbers of publications, talks, and interviews given by scientists were tabulated annually and are reported here to document interactions with stakeholders. During state FY 2005, there were four senior-authored publications recorded in association with this program goal. There were no talks or interviews.

Output Indicators (2). The Department of Analytical Chemistry is responsible for testing agricultural products and drinking water for pesticide residues. During FY 2005, produce was analyzed at the request of the State Department of Consumer Protection. Two emergencies were

addressed. Findings were reported to the appropriate state and federal agencies as well as to the public.

Outcome Indicators. There are two major expected outcomes and impacts associated with the performance goal(s) listed in the updated Plan of Work. It is expected that results of laboratory investigations with state-of-the-art equipment will lead to the development of new procedures to detect pesticides in plants, soil, and air. This outcome also applies to USDA goal #4.

(1) There will be greater consumer access to safe foods grown in Connecticut or produced elsewhere. This outcome also applies to USDA goal #3. **Themes: Food handling; Food safety**

Description: Strawberries are harvested in June and are marketed locally in Connecticut as well as in New York City and Boston. A fire at a farm in the state destroyed a shed containing pesticides. Smoke from the fire blew over the strawberry fields. The Fire Marshall in the town did not allow the release of the strawberries until analytical tests showed no contamination. Being a highly perishable product, analyses had to be performed immediately.

Accomplishment/Impact: Scientists in the Department of Analytical Chemistry at The Connecticut Agricultural Experiment Station analyzed strawberry samples for pesticide residues and determined that there was no contamination. Results were obtained within 8 hours of receiving the samples. There was immediate economic impact: the crop valued at $60,000 was released to the markets.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

Description: A Connecticut resident entered a hospital with kidney failure. Physicians suspected chemical poisoning and requested that juice samples from the patient's home be tested. The State Departments of Health and Consumer Protection provided the suspect juice samples as well as similar products with the same lot numbers obtained from supermarkets.

Accomplishment/Impact: All juice samples were screened for a wide range of chemicals within two days of receipt. Ethylene glycol (antifreeze) was detected at a concentration of 40% in the samples taken from the patient's home, but other samples obtained from supermarket shelves were not contaminated. The patient received proper treatment and fully recovered. Aside from the immediate impact of determining the cause of kidney failure and guidance given for treatment, state and federal officials learned that products for sale in supermarkets were safe and that a national recall of the product was not necessary. Moreover, success in detecting ethylene glycol in this case has other benefits because it showed that the chemists in the Department of Analytical Chemistry are prepared to meet the challenges of counter-terrorism activities as a part of their participation in the US FDA program: The Food Emergency Response Network.

Sources of funds: Hatch and state

Scope of impact: state specific

Description: Food safety is a major concern for the general public. Residents and state officials request assistance in analyzing foods for pesticide residues and other chemicals as a part of market basket surveys and specific responses to possible product tampering and contamination. During this reporting period, 196 samples of fresh and processed foods were tested for pesticide residues. An additional 165 food samples were analyzed as a result of consumer complaints to the State Department of Consumer Protection.

Accomplishment/Impact: There were two violations of misapplications of pesticides, and a yogurt product was found to contain an unwanted compound formed by the inadvertent omission of a preservative. There was immediate impact because products with certain lot numbers were removed from the market and reports to US Food and Drug Administration and US Environmental Protection Agencies prompted investigations in other instances. Stakeholders learned that other food products tested were safe to consume. The long-term benefits of food-testing analyses for pesticides and other chemicals are that the public will be re-assured that foods are being monitored regularly to ensure quality and safety and that there will be less human exposure to pesticides, which will reduce health risks.

Sources of funds: Hatch and state

Scope of impact: state specific

Allocated Resources. Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 2005.

	Fiscal Resources				Human Resources	
	Federal*		State		Scientist Years	
Years	Target	Actual	Target	Actual	Target	Actual
2005	$121,400	$139,216	$244,510	$263,432	2.6	2.4
2006	$121,400	$xxx,xxx	$244,510	$xxx,xxx	2.6	x.x

*Federal Hatch funds only.

Program Goal # 4: Greater harmony between agriculture and the environment.

Research Goal: Enhance the quality of the environment through better understanding of and building on agriculture's and forestry's complex links with soil, water, air, and biotic resources.

Performance Goal 2. To increase technology options available to agricultural producers to enhance profitability without damaging the environment.

Output Indicators. (1). Numbers of publications, talks, and interviews given by scientists were tabulated annually to document communication to stakeholders. During state FY 2005, there were 32 senior-authored publications and 400 talks and interviews recorded in association with this program goal. The number of officerships and memberships in stakeholder organizations and national or state committees was 48 during this reporting period. Letters from stakeholders regarding Station research findings and assistance, comments from the media, and narratives of scientific accomplishments are on file.

(2) Production practices options for reducing over-reliance on chemicals. See outcome indicators below for specific results.

(3) Methods of plant waste management which protect the environment. See outcome indicators below for specific results.

(4) Methods for removing chemicals from soil and water. See outcome indicators below for specific results.

(5) Methods for detecting and removing invasive plants from lakes and ponds.

Outcome Indicators. There are several expected outcomes and impacts associated with the above mentioned performance goals listed in the updated Plan of Work. It is expected that:

(1) Laboratory and field experiments will reveal more efficient, cost-effective methods of applying nutrients to greenhouse-grown tomatoes and other crops. This outcome also applies to USDA goals #3 and #5. **Theme: Nutrient management**

Description: There is continued strong consumer demand for tomatoes grown in greenhouses during the colder months. Cultivars of greenhouse tomato are available to the 50 growers interested in marketing this crop, but it is unclear which varieties are most appropriate for production in Connecticut. Sensitivity to nitrogen fertilizer varies greatly among cultivars, and there is a need to minimize excessive fertilizer use to reduce costs and to prevent contamination of surface and ground water supplies. To meet intermediate critical needs of stakeholders, different cultivars were re-evaluated in greenhouses with different fertilizer regimes. The main objective was to determine minimal amounts of nitrogen and potassium required to produce a quality crop.

Accomplishment/Impact: Of the 21 cultivars tested in greenhouses, “Cabernet”, an open-pollinated beefstake cultivar, had the highest yield of 12 pounds per plant. Minimal amounts of fertilizers were used. There was immediate short-term impact because growers immediately added Cabernet to their selection of cultivars and have implemented practices to reduce amounts of nitrogen and potassium nutrients in greenhouses. At a retail price of $2.29 per pound, there is a potential gross return of about $8,000 per 24 x 96 ft. greenhouse space for “Cabernet”. In addition to having quality fruits, increased production, and reductions in amounts of fertilizers used, there will be long-term benefits associated with less entry of nutrients into streams and lakes, which can cause eutrofication. Consumers will also have plentiful supplies of tomatoes during colder months, and growers will have continued profitability for a crop that is in demand.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

Results also apply to goal #1 **(Theme: Agricultural competitiveness; Agricultural profitability; Diversified/alternative agriculture; Plant production efficiency; and Small farm viability)** and goal #3 **(Theme: Human health)**.

(2) Laboratory tests will improve methods of detecting and degrading pesticides and other agricultural compounds that have contaminated soil and water. **Themes: Agricultural waste management; Hazardous materials; Soil quality; Water quality**

This objective has been completed. Accomplishments/Impacts were described in four previous annual reports.

(3) Results of field experiments will lead to more efficient production and use of compost in agroecosystems, including stakeholders' gardens. **Theme: Recycling; Yard waste/composting**

Description: Composting is an important process of re-cycling plant materials. Municipalities are relying on farmers to use leaves that accumulate rather than burning the plant materials. Farmers have been plowing the leaves into the soil (sheet composting) but do not know whether or not such measures result in increased yields of crops. Accordingly, experiments were conducted in pepper fields to determine if yields are greater when oak leaves are used.

Accomplishment/Impact: Sheet composting of oak leaves resulted in high yields of peppers (5.4 lbs/plant), compared to plots amended with maple leaves (5.2 lbs/plant) and control plots (5.0 lbs/plant). At a retail price of $1.39 per pound, there was a total potential crop value of $72,658 per acre associated with sheet composting of oak leaves. In addition to economic impact, there are

expected long-term benefits of recycling leaves because valuable space will not have to be devoted to composting in municipalities and there will be cleaner air because leaves will not be burned.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

Accomplishments also apply to goal #1 (**Themes: Home lawn and gardening; Plant production efficiency**).

(4) Laboratory analyses will identify which mosquito species are important in the transmission of West Nile, eastern equine encephalitis (EEE), and California group encephalitis viruses in forested areas so that there will be minimal use of pesticides for control resulting from a more precise time interval defined for application of pesticides. There will be rapid notification of virus isolation results to the public so that precautions on reducing mosquito bites can be taken. **Themes: Biological control; Integrated pest management; Pesticide application; Other (Wildlife science)**

Description: Mosquito-transmitted encephalitis viruses are of public health concern nationally. The West Nile encephalitis virus moved quickly to western United States following its initial discovery in Connecticut and New York in 1999. Infections of EEE virus have higher fatality rates of about 30%. To meet the immediate needs of stakeholders to warn if mosquitoes are infected, a statewide mosquito surveillance effort was continued to include 91 trapping sites.

Accomplishment/Impact: In analysis of 156,409 mosquitoes, representing 35 species, there were 43 isolations of West Nile virus from 4 species of mosquitoes collected from 8 locations in 6 towns. There were an additional 37 isolations of EEE viruses from 10 mosquito species. West Nile virus is well established in densely populated urban and suburban areas of southwestern and central Connecticut, whereas EEE virus is most abundant in swampy rural areas of southeastern Connecticut.

Following public notification of virus results, knowledge of widespread occurrence of infected mosquitoes had immediate impact on people. They used repellants and took other measures to minimize mosquito bites. The elderly were informed about elevated fatality rates of West Nile virus infections for their age group. Local health departments treated catch basins and other stagnant acquatic areas with larvicides to reduce mosquito populations. Since 1999, there have been 41 human cases of WNE reported in Connecticut with one fatality. There were no human or horse cases during this reporting period. Considering the widespread occurrence of WNE and EEE viruses in birds and mosquitoes, the annual surveillance and research activities offer long-term benefits because patterns of virus prevalence and changes in infection rates in mosquitoes will be clarified. If viral activity decreases to low levels, then pesticide applications can be reduced accordingly to meet the immediate needs, thereby reducing costs for municipalities (estimated to be about $20,000 per municipality) and human exposure to pesticides. Reduced pesticide use will also decrease risk of environmental contamination (i.e., ground and surface waters) and lessen the adverse effects on non-target organisms. Finally, having a mosquito surveillance/virus isolation project will facilitate the detection of certain pathogens in the event of bioterrorist activities.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

These accomplishments also apply to national goals #1 **(Themes: Animal health; Risk management)** and to goals #3 and #5 by providing information on emerging human and veterinary diseases so that there would be a healthy population and enhanced quality of life for citizens living in rural and suburban areas (**Themes: Human health; Children, youth, and families at risk**).

(5) New antibody tests will be developed for the laboratory diagnosis of Lyme disease, granulocytic anaplasmosis (formerly known as ehrlichiosis), and tularemia in human beings, domesticated animals, and wildlife species (i.e., deer and mice) to determine specific localities where there is risk of infection and a need to control ticks. **Themes: Integrated pest management; Pesticide application and management; Other (Emerging infections; Wildlife science)**

Description: *Borrelia burgdorferi* causes Lyme disease in horses, dogs, and humans in the United States and Europe. This pathogen is transmitted by *Ixodes scapularis* ticks in eastern United States and by related ticks in western United States and Eurasia. At the request of veterinarians in Connecticut, antibody tests were developed to determine if horses developed antibodies to a surface-exposed protein of the disease organism called VlsE. A special antigen (VlsE), produced by scientists at the University of Texas (Houston), had showed promise in testing human sera in earlier studies.

Accomplishment/Impact: Antibodies to VlsE were detected in horse sera, which confirmed that these animals were exposed to the Lyme disease agent. These results had immediate impact. Horse owners and veterinarians learned that Lyme disease was prevalent in certain towns. Technology for the new test has been transferred to a small biotechnology firm, which is pursuing the production of a commercial assay for domesticated animals. The expected long-term benefits of this research advancement are that new procedures are available to conduct analyses, and with more accurate diagnostic tests, technology can be applied to develop antibody-detection systems for other veterinary and human diseases. With commercialization of the assays, tens of thousands of stakeholders in the United States will benefit by receiving information on the health of domesticated animals.

Sources of funds: Centers for Disease Control and Prevention, Hatch, National Institutes of Health, and state.

Scope of impact: multistate (CT, GA, NY, TX) and integrated research and extension.

These accomplishments also apply to national goals #1 **(Theme: Animal health)**, #3, and #5 by providing important information on important tick-associated diseases so that there would be a healthy population and enhanced quality of life for citizens living in rural and suburban areas (**Themes: Human health; Children, youth, and families at risk; Promoting business programs)**.

(6) Field experiments will reveal prevalence of infected ticks near human dwellings and effective methods of controlling ticks that transmit pathogens to mammalian hosts. **Themes: Biological control; Integrated pest management; Other (Wildlife science)**

Description: The blacklegged tick, *Ixodes scapularis,* transmits a bacterium that causes Lyme disease. Ticks have become more abundant in or near forested areas where white-tailed deer have increased. Homeowners have requested assistance in finding ways of reducing ticks and the risk of Lyme disease near their homes. Field experiments were conducted to evaluate a fipronil-based rodent bait box system for treating white-footed mice and chipmunks, important hosts for ticks and reservoirs for the Lyme disease agent. Fipronil is the active ingredient in some flea and tick control products for dogs and cats.

Accomplishment/Impact: When bait boxes are applied to the landscape as directed, there is a significant reduction in ticks in localized settings. Communities have adopted this tick management practice. These results will have future impacts by saving hundreds of thousands of dollars in lost wages and medical costs if homeowners use tick control and personal protection measures to reduce

exposure to tick-transmitted pathogens. Homeowners will also benefit by being able to more freely use property near the house for gardening and other activities.

Sources of funds: Centers for Disease Control and Prevention, Hatch, and state.

Scope of impact: national multistate: CO (CDC), CT. These accomplishments also apply to national goals #1 **(Theme: Risk management)** and #3 and #5 by providing important information on Lyme disease so that there would be a healthy population and enhanced quality of life for stakeholders living in rural and suburban areas (**Themes: Human health; Children, youth, and Families at risk**).

Sources of funds: Hatch and state.

Scope of impact: multistate (CT, MD, NJ, PA).

Themes: Human health; **Children, youth, and families at risk; Forest resource management**. This project also applies to goal #1 (**Theme: Ornamental/Green Agriculture**).

(7) Laboratory analyses will determine concentrations of pesticides and other toxic chemical residues in air, water, food, or soil samples submitted by state regulatory agencies. Methods of control will be investigated. **Themes: Air quality; Soil quality, Hazardous materials; Pesticide application**

Description: Although banned for residential use, chromate copper arsenate (CCA)-treated wood remains present in or near homes and playgrounds. Compounds, such as arsenic, leach into the soil and could be taken up by certain plants. Arsenic is a class A carcinogen, and stakeholders are concerned about its presence in the environment. Experiments were performed to determine if coating the wood would slow or prevent leaching and subsequent uptake of arsenic by plants.

Accomplishment/Impact: Opaque, film-forming finishes applied to CCA-treated wood forms an effective barrier to arsenic leaching and plant uptake. The added step of growing plants 6 cm or more away from the wood further reduced risks of contamination. These results had immediate impact because new guidelines could be followed by greenhouse operators and homeowners to avoid contamination of arsenic. Reductions in arsenic leaching decrease exposure of humans and other animals to this dangerous chemical, thereby reducing health risks, and will provide a long-term benefit of reducing the build-up of arsenic in the environment.

Sources of funds: Hatch and state.

Scope of impact: state-specific. These accomplishments also apply to goal #1 **(Theme: Risk management).**

(8) Laboratory and field studies will identify species of entomopathic microsporidia that may be used to control mosquito larvae in wetland habitats and thereby reduce chemical control. **Themes: Biological control; Integrated pest management**

This objective has been completed. No significant new progress has been made following the results and impact statements reported in the previous four annual accomplishment reports.

(9) Field and laboratory experiments will be conducted to find environmentally safe methods of detecting and removing invasive aquatic weeds from lakes and ponds. **Themes: Improving Water Quality, Pest Management**

Description: Invasive aquatic plants eliminate native aquatic plants and reduce water quality. Water milfoil, Cabomba, and Eurasian water milfoil are invasive species, which have greatly impacted Connecticut lakes by reducing recreational uses. Members of lakes' associations have

requested assistance on finding ways to remove invasive plants from bodies of waters. Spot treatments of herbicides (fluoridone and 2, 4-D) were applied in localized infested areas.

Accomplishment/Impact: Late summer applications of herbicides were more effective than spring treatments. These findings had immediate environmental impacts because control methods were found to be effective in removing unwanted plants, and residents regained full recreational uses of the lakes. Control methods will be applied to other lakes to improve water quality. Expected long-term benefits are increased values of properties near the lakes, reduced eutrofication of lakes, and improved water quality over broader regions of the state.

Sources of funds: Hatch and state

Scope of impact: state-specific

(10) IPM methods will be developed for nurseries to reduce amounts of pesticides used and will result in more efficient uses of agricultural chemicals by producers. **Themes: Integrated pest management; Pesticide application**

Description: Efforts were continued to reduce amounts of pesticides used in commercial nurseries and to promote adoption of IPM practices. Three nurseries received intensive on-site assistance. Detailed pesticide records from one small nursery were available to calculate changes in pesticide use (pre-and post-IPM adoption) attributed to increased grower acceptance of IPM strategies.

Accomplishment/Impact: Compared to pre-IPM status in 2002, there was a decrease of active ingredient of an insecticide by 4.7 pounds. This translated into a short-term benefit of a $234 decrease in cost for insecticidal product. Participants were asked to complete a questionnaire regarding the IPM initiative. All responded that the research findings were useful. More importantly,

all participants stated that they would recommend the IPM practices to other nursery growers. Aside from a modest economic benefit, acceptance of the IPM effort is an important short-term goal and a departure from previous practices of excessive and unnecessary pesticide applications. Expected long-term benefits include the production of quality plants with less adverse effects on beneficial insects that help control pest species in nurseries; less pesticide contamination of ground water, streams, and rivers; and less human and animal exposure to pesticides, thereby reducing health risks. Nursery growers are more convinced that IPM practices are cost effective and useful. This change in attitude among growers will help achieve other expected long-term benefits of more widespread acceptance of IPM methods among other growers and having an overall cleaner environment.

Sources of funds: Hatch and state.

Scope of impact: state-specific, integrated research and extension.

These accomplishments also apply to national goal #1 **(Themes: Agricultural competitiveness; Agricultural profitability; Ornamental/Green agriculture; Precision agriculture; Small farm viability).**

Description: Powdery mildew can have a detrimental effect on the quality of pumpkins, a crop worth about $2 million annually in Connecticut. Fungicides are currently used to manage fungus infections and to preserve a marketable crop. There is increased interest among growers to find ways of reducing pesticide use and costs. This is a particularly important issue for organic farmers and homeowners. Accordingly, experiments were conducted to find alternative means of controlling powdery mildew.

Accomplishment/Impact: Weekly foliar applications of a 50% by volume aqueous solution of either whole, skim milk, or powdered milk delayed the onset and severity of powdery mildew on pumpkins. In-field and post-harvest fruit rot was reduced from 20% to less than 8% by the use of a

milk spray. This research development represents a savings of about $50 per acre in fungicide costs. Other expected long-term benefits include less human exposure to pesticides, thereby reducing health risks, and a cleaner environment.

Sources of funds: Hatch and state.

Scope of Impact: state-specific

Description: Work continued on the control of pales weevil, an important pest of Christmas trees. This insect weakens trees and causes significant economic losses. In Connecticut, about 500 growers harvest about 440,000 trees annually, representing about 6% of the total 7.7 million trees grown in the state. Stakeholders requested assistance on finding an insecticide that could be used minimally in an IPM effort to control the insect pest.

Accomplishment/Impact: Field experiments revealed that a well-timed application of Talstar was more cost-effective and efficient for control, compared to Lorsban, which was the material used previously for control. The cost for Talstar was $17.23 to $20.29 per acre, whereas Lorsban costs were as high as $73.00 per acre. Moreover, Talstar could be used at the rate of 2 fluid ounces per 3 gallons of water, while Lorsban was used at 16 fluid ounces per 3 gallons of spray. In addition to economic impact, the use of Talstar, a pyrethroid insecticide, was less toxic than Lorsban to the user and to beneficial insects. Expected long-term benefits include a cleaner environment and less risk of health hazards for the pesticide users.

Sources of funds: Hatch and state.

Scope of Impact: Multistate integrated research and extension (CT, MA, NY, RI).

Sources of funds: Hatch and state.

Scope of Impact: multistate (CT, MA) and integrated research and extension. These results also apply to national goal #1 **(Themes: Agricultural profitability; Plant health; Ornamental/green agriculture; Plant production efficiency; Small farm viability).**

Allocated Resources. Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 2005.

	Fiscal Resources				Human Resources	
	Federal*		State		Scientist Years	
Years	Target	Actual	Target	Actual	Target	Actual
2005	$286,227	$229,625	$1,945,864	$2,396,085	18.6	19.9
2006	$286,227	$xxx,xxx	$1,945,864	$x,xxx,xxx	18.6	xx.x

*Federal Hatch funds only.

Multi-Institutional, Multi-Disciplinary, and Multistate Research

The Station's Hatch projects, CRIS/CSREES accession numbers, and state and federal Hatch funds are listed in separate tables to document multi-institutional, multi-disciplinary, and multistate research (Tables 1-3). Table 4 shows a distribution of funds for this part of the research effort and the ≥25% required amounts for formula funds. Table 5 shows integrated activities with extension systems in land-grant universities, while Table 6 lists separate planned integrated projects showing actual allocated resources (SY) and costs for FY2005 and estimates for 2006. Table 7 reports actual distributions of Hatch and state matching funds for federal FY 2005 and estimates for 2006. The CRIS code for The Connecticut Agricultural Experiment Station is CONH.

Table 1. Multi-Institutional (FY 2005)

Hatch Project	CRIS Access.#	Collaborating institutions and businesses
CONH 135[c]	0187947	None
136	0188720	CT Dept of Environmental Protection, US EPA

137	0198865	CT Dept. of Consumer Protection, US EPA, US FDA
138	0199518	US EPA, CT Dept. of Consumer Protection
139[b]		CT Dept. of Environmental Protection
241	0191156	Yale University, Rutgers University
242	0191890	Yale University, University of Oxford (UK)
243	0198426	Yale University
244	0200136	Yale University, Purdue University
245[b]	0204616	Yale University
344[d]	0078445	Centers for Disease Control (Atlanta, GA and Fort Collins, Co), Georgia Southern Univ. (Statesboro), Yale Univ., Univ. of Connecticut (Storrs), University of Iowa, University of Texas (Houston), L^2 Diagnostics, LLC (New Haven)
371[d]	0179183	Univ. of Connecticut (Storrs), Cornell Univ.
375[a,d]	0183834	Univ. of CT (Storrs), Univ. of Mass., Univ. of Rhode Island, etc.
377[d]	0191684	Cornell Univ., Univ. of CT (Storrs), Rutgers Univ.
378[d]	0195135	University of Connecticut (Storrs), Univ. of Massachusetts, Cornell University, North Carolina State, Rutgers University, Penn. State
380[a,d]	0198512	Cornell University, Univ. of Massachusetts
383[a,b,d]	0205882	Univ. of Connecticut, Cornell Univ., Penn. State, Univ. of Mass., Rutgers Univ., Univ. of Rhode island
551[a,d]	0167653	Cornell Univ., W. Virginia (Univ.), Univ. of Georgia, Univ. of Arkansas, Virginia Tech. Univ., Michigan State Univ.
559[d]	0186018	CT. Dept. of Environmental Protection, CT. Nursery & Landscape Assoc., Cornell Univ., Penn. State Univ., Rutgers Univ., Univ. of Maryland, Virginia Polytechnic Inst., West Virginia Univ.
560[a,d]	0190494	Cornell Univ., Rutgers Univ., Penn. St. Univ., Univ. of Maryland, Virginia Polytechnic Inst., West Virginia Univ.
561[d]	0191645	CT. Dept. of Agriculture, Cornell University, Univ. of Oklahoma
563[d]	0193029	CT. Vegetable Producers, CT. Greenhouse Growers Assoc., Univ. of Connecticut,

565[a,d]	0198286	Cornell Univ., Michigan State Univ., Rutgers Univ., CT. Vegetable Producers, CT Greenhouse Growers Assoc., Univ. of Arizona, Univ. of Kentucky, Univ. of Nebraska, Penn. State, Univ. of Texas
566	0201194	Cornell Univ., Penn. State. Univ., Univ. of Maryland
567[d]	0201745	Cornell Univ.
568[ad]	0202597	Cornell Univ.
569[a,b,d]	0205754	Cornell Univ., Rutgers Univ., Penn. State
628	0187597	USDA Forest Service
630[d]	0195468	Cornell Univ., Univ. of CT (Storrs), Michigan State Univ., Penn. State
633[d]	0199708	Cornell Univ.
634[a,d]	0200180	Michigan State., Univ. of Rhode Island, Univ. of Florida, Univ. of Mass., Cornell Univ. (Ithaca & Geneva), Penn. State Univ., Univ. of Georgia, USDA (ARS)
768[a,d]	0170382	Several states cooperating on S-301, USDA/ARS Center for Med. Agric. & Vet. Entomology
770[a,d]	0184011	Several states cooperating on W-082
771	0188384	Univ. of CT (Storrs)
772	0192464	Cornell Univ., Univ. of CT (Storrs), Univ. of Virginia
805[d]	0198560	Univ. of CT (Storrs)
806[b]	0201979	New York State

[a]USDA approved multistate research project.

[b]New Hatch project approved during reporting period.

[c]Hatch project expired during reporting period.

[d]Includes integrated activities (research/extension).

Table 2. Multi-Disciplinary (FY 2005).

Hatch Project	Scientific Disciplines
CONH 135	analytical chemistry, food production systems

136	analytical chemistry, toxicology
137	analytical chemistry, toxicology
138	analytical chemistry, toxicology
139	analytical chemistry, toxicology
241	plant biochemistry, molecular genetics, plant physiology
242	plant biochemistry, molecular genetics, plant physiology
243	insect pathology, molecular biology
244	plant biochemistry, molecular genetics
245	plant biochemistry, molecular genetics
344	acarology, microbiology, immunology, molecular biology, epidemiology, human and veterinary medicine, wildlife diseases
371	acarology, entomology, IPM
375[a]	entomology, plant pathology, IPM
377	entomology, ecology
378	entomology, IPM
380[a]	entomology, horticulture, IPM
383[a]	entomology, IPM
551[a]	horticulture, plant pathology, plant genetics, entomology
559	animal behavior/ecology, deer management
560[a]	animal behavior/ecology, deer management
561	horticulture, composting, plant physiology
562[a]	horticulture, plant physiology
563	horticulture, plant physiology
565[a]	horticulture, plant physiology
566	animal behavior/ecology, deer management
567	horticulture, plant genetics
569	horticulture, plant physiology
568[a]	horticulture, genetics
628	plant pathology, mycology
630	mycology, plant pathology, horticulture, IPM
633	meterology, plant pathology, biophysics

634[a]	nematology, plant pathology
768[a]	protozoology, invertebrate pathology, entomology
770[a]	soil chemistry, environmental toxicology
771	soil and water chemistry, environmental toxicology
772	environmental toxicology, soil chemistry
805	analytical chemistry, horticulture, weed management
806	mycology, environmental toxicology

[a]USDA approved multistate research project.

Table 3. Multistate Collaborations (FY 2005).

Hatch Project	CSREES Multi-state Project Number	Participating states
CONH 135		
136		
137		
138		
139		
241		
242		
243		
244		IN
245		
344		CT*, CO, GA, IA, NY, SC, TX
371		CT*, NY
375	NE-187 [a]	CT*, FL, ME, MD, MA, NJ, NY, PA, RI
377		CT*, NJ, NY
378		CT*, MA, MN, NC, NH, NJ, NY, PA, RI
380	NE-009[a]	CT*, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, WV
383	NE-1025	CT, NJ, NY, MA, MD, PA, RI
551	NE-183 [a]	AL, AR, CT*, ID, IN, MA, MI, NH, NJ, NY, NC, OH, OR, PA, UT, VA, VT, WA, WI, WV
559		MD, NJ, NY, PA, VA, WV
560	NE-1005[a]	MD, NJ, NY, PA, VA, WV
561		NY, OK
563		

565	NE-1017[a]		AZ, CT*, KY, MI, NE, NH, NJ, NY, OH, PA,
566			MD, NY, PA
567			MA, NY
568	NE-1020[a]		CA, CO, CT*, ID, IA, KY, MD, MA, MN, NE,
			NV, NY, OH, OR, PA, SD, TX, UT, VA, WA
569			AZ, CT*, KY, MI, NE, NH, NJ, NY, OH, PA
628			
630			CT*, FL, MA, NY, PA
633			NY
634	NE-1019[a]		CT*, FL, GA, MA, MI, NY, PA, RI, SC, WV
768	S-301 [a]	(S-1024)	AL, AR, CA, FL, GA, ID, IL,
			KY, LA, ME, MN, MS, NJ, NY, NC, SC, TN
770	W-082[a]		AR, AZ, CA, CT*, FL, HI, IA, IN, KS,
			MN, MT, NV, NY, WA
771			
772			NY, VA
805			CT*, MA
806			NY

[a]USDA approved multistate research project.

CT* = University of Connecticut (unaffiliated with The Connecticut Agricultural Experiment Station).

Table 4. Distribution of Hatch and state matching funds at The Connecticut Agricultural Experiment Station (C.A.E.S.). Federal FY 2005 and 2006 data for Multi-Institutional, Multi-Disciplinary, and Multistate Projects.

			SY units	
	Connecticut		Multi-	Total
Fed. Hatch Funds	State Funds	Total	Categories	Hatch Program
FY 05 $541,401	$3,278,125	$3,819,526	27.9	38.1
FY 06 $xxx,xxx	$x,xxx,xxx	$x,xxx,xxx	xx.x	xx.x

Total funds available for entire Hatch program (FY 2005) at C.A.E.S.	$759,224
% Hatch funds dedicated to multi-institutional, multi-disciplinary, and Multistate research	71.3%

Table 5. Integrated research activities for all research projects between The Connecticut Agricultural Experiment Station (C.A.E.S.) and extension programs in land-grant universities during federal FY 2005 and 2006.

				SY units	
		Connecticut			Total
	Fed. Hatch Funds	State Funds	Total	Integrated only	Hatch Program
FY 05	$363,823	$2,537,212	$2,901,035	21.5	38.1
FY 06	$xxx,xxx	$x,xxx,xxx	$x,xxx,xxx	x.x	xx.x

Total funds allocated to entire Hatch program at C.A.E.S. in FY 2005	$759,224
% dedicated to all multi-categories and integrated activities with CT and other states	47.9%

The Connecticut Agricultural Experiment Station dedicated Hatch funds to integrated activities with extension systems in land-grant universities in different states. In Connecticut, $251,131 was dedicated to integrated activities in FY 2005 with extension at the University of Connecticut, an institution not affiliated with The Connecticut Agricultural Experiment Station.

Table 6. Distributions of projected and actual Hatch and state matching funds and SY units at The Connecticut Agricultural Experiment Station for all Multi-Institutional, Multi-Disciplinary, Multistate, and Integrated Activities for federal FY 2005 and 2006.

	Federal Hatch*	State funds*	Scientist Years
Projected	$260,360	$845,500	10.0
Actual (FY2005)	$363,823	$2,537,212	21.5
Actual (FY2006)	$xxx,xxx	$x,xxx,xxx	x.x

*Funds distributed to all “multi” categories with integrated activities.

Table 7. Distributions of projected and actual fiscal and human resources (SY units) dedicated to the entire Hatch and associated state research activities for federal FY2005 and FY2006.

	Total Federal Hatch	Total State Match	Total SY
Projected	$767,627	$4,068,700	36.8
Actual (FY2005)	$759,224	$5,033,633	38.1
Actual (FY2006)	$xxx,xxx	$x,xxx,xxx	xx.x

Progress Reports: Planned Integrated Activities

Attachments to Form CSREES-REPT. (Revised 09/04)

(Hatch Act Funds)

Federal FY 2005

Activities descriptions: As presented in the updated Plan of Work, 13 Hatch projects were listed as planned integrated activities (Hatch Act Funds). In a previous section of this Annual Report of Accomplishments and Results (including the Tables), descriptions and impact statements were given regarding progress made on the planned integrated and other projects. Form CSREES-REPT (09/04) reporting expenditures for FY 2005 follows these brief research summary statements for these specific activities. Please note: financial figures for items # 2, 5, & 7 and items # 6, 9, & 12 have been consolidated in Form CSREES-REPT under the planned activities titles "managing insects/fungi" and "IPM", respectively.

1. Tick-borne infections: Horses are bitten by ticks and subsequently develop Lyme borreliosis, where this disease and granulocytic anaplasmosis are prevalent in northeastern United States. Veterinarians requested assistance on evaluating a serologic test containing a new fusion protein reagent called VlsE. Serologic tests were conducted with serum samples from potentially infected horses. Antibodies were detected, which confirmed Lyme borreliosis infections. Aside from the immediate benefits of determining prevalence of antibody-positive animals, technology for this new test has been transferred to a small biotechnology company, which is considering commercialization of antibody assays for veterinary diagnostics.

2. Managing insects on vegetable crops: There is high public interest in organic farming. In Connecticut, there are at least 40 farmers growing vegetables without the use of pesticides. Progress is being made on identifying mulching techniques that reduce insect damage. As a result of prior research findings, Yale University continues to serve locally grown organic foods in a dining hall, and land care professionals have reduced their use of synthetic insecticides and fertilizers. These efforts will reduce business costs, decrease health risks for pesticide users, and will lead to a cleaner environment.

3. Plant genetic resources (NE-9): Field experiments continued on the control of flea beetles on vegetable crops. As determined earlier, Spintor once again had the lowest level of flea beetle damage on leafy brassica plants. This product contains spinosad, a microbial product, which will soon become available in an organically acceptable formulation. This new product will become an important part of pest management efforts for flea beetles and will lead to a cleaner environment and reduced human exposure to the more toxic insecticides.

4. Greenhouse production (NE-1017): There are about 50 growers in Connecticut who produce greenhouse grown tomatoes. Shading the plants increased fruit quality and decreased labor costs by about 10% because more marketable fruit was produced. For a given 24 x 96 foot greenhouse, there was an average daily savings of about $60 in labor costs.

5. Managing insects in apple orchards: The Eurasian green pug (*Chloroclystis rectangulata*) caterpillars attack at least 30 species of plants in the rose family (Rosaceae), including 23 species of apple and crabapple, five species of pears, and two species of shadbush. This exotic pest occurs throughout New England, in southeastern New York, and New Jersey. Field experiments in orchards revealed that well-timed insecticide treatments for other insect pests worked to control the Eurasian

green pug. No further pesticide treatments were required, and with minimal use of chemicals, there were no detrimental effects on natural biocontrol agents, such as parasitic wasps and flies. These findings advanced growers' knowledge of IPM practices. Expected long-term benefits include a cleaner environment, quality fruits for market, and less human exposure to pesticides, thereby reducing health risks.

6. Integrated pest management (IPM) for Connecticut nurseries: Three nurseries continued to receive intensive on-site assistance to implement IPM practices and reduce amounts of pesticides used. Examination of pesticide records for one small nursery showed that there was a decrease in active ingredient of an insecticide by 4.7 pounds for one year. This represents a savings of about $234. Additional growers have become more enthusiastic about implementing IPM methods. In addition to reduced costs of insecticide treatments, the long-term benefits of cleaner nursery environments and more effective biological control of pest species will be achieved.

7. Management of insects in soil and other pests (includes NE-187 and NE-1025): Pales weevils, an important pest of Christmas trees, can cause considerable economic losses. At the request of growers, tests were conducted to identify an insecticide that could be used to control the pest at a lower cost than Lorsban. Talstar, a pyrethroid insecticide, controlled pales weevil at a cost of $17.23 per acre, compared to $73.00 per acre with Lorsban. Talstar is also less toxic to the user than Lorsban is and reduces risk of health hazards as well as meeting the long-term benefits of reducing pesticides in the environment.

8. Evaluation of new apple cultivars (NE-183): Thirty apple cultivars are being re-evaluated for resistance to fungal infections. In replicated experiments, the cultivar "Suncrisp" had the slowest

growth rate for bitter rot fruit infection, whereas “Ginger Gold” had the fastest growth rate. This new information had immediate impact because fruit growers have planted “Suncrisp” rather than “Ginger Gold”. In other trials, cultivars “NY75414-1” and “Sunrise” exhibited the most severe fruit split due to heavy rainfall late in the season. These findings have helped growers select the most desirable cultivars for their farms.

9. Suppression of soil-borne diseases: Experiments were repeated from the previous year’s work to verify the effectiveness of cruciferous crop residues in reducing Verticillium wilt on eggplants. The experiments yielded similar results. By reducing the need to apply fungicides, there was an immediate benefit of saving $250 per acre in pesticide costs. The expected long-term impacts include cleaner farm environments, increased participation of growers’ acceptance of IPM methods, and reduced human exposure to pesticides.

10. Wildlife Management (NE-1005): White-tailed deer cause automobile accidents and crop damage. Being the chief host of *Ixodes scapularis* ticks, deer are a major factor in the rise of tick populations and prevalence of Lyme disease. Research on evaluating a fertility control method for deer has shown that a sterilization method used on males is working. Treatment did not affect antler development, mating, or mate-guarding behavior. Deer populations in study sites, however, have not decreased significantly. Consequently, females and fawns will need to be sterilized to achieve significant population declines. The research effort is designed to reduce deer in relatively small areas (i.e., near highways or agricultural fields) to reduce automobile accidents and crop damage. Effective deer management will also benefit forests by reducing browse damage to saplings.

11. Dispersal of corn pollen*:* Experiments are being conducted to determine the range of corn pollen dispersal. Results thus far indicate that about one mile is the maximum extent of pollen dispersal. This means that genetically modified corn must be planted at least one mile from non-genetically modified corn. Additional results from another year of experimentation are needed before a firm recommendation can be made on establishing buffer zones for federal and state regulatory purposes.

12. Integrated pest management of plant parasitic nematodes (NE-1019): *Pratylenchus penetrans* causes root damage of strawberries, which can lead to fungal infections. Rotation and use of selected plants (green manure) control this nematode, but it appears that different methods will be needed to control other nematode species that attack other crops. Growers are now using specific crops, such as dwarf Essex rapeseed and Black-eyed-Susan Rudbeckia hirta, to reduce nematode populations. There was a savings of about $400 per acre in fumigation costs.

13. Herbicides/weed control: Invasive plants spread quickly in the environment and displace native plants, thereby decreasing biodiversity. Experiments were conducted on Pale Swallwort to find a method of chemical control. Plants were effectively controlled by applying glyphosate or triclopyr. This treatment method may also be useful in nursery and other farm settings. The expected long-term impact is to enhance biodiversity by curtailing the spread of invasive plants.

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Actual Expenditures of Federal Funding for Multistate Extension and Integrated Activities
(Attach Brief Summaries)
Fiscal Year:____2005____

Select One: □ **Interim** □**X Final**

Institution: The CT. Agric. Exper. Station

State: Connecticut

	Integrated Activities (Hatch)		**Multistate Extension Activities (Smith-Lever)**		**Integrated Activities (Smith-Lever)**	
Established Target %	25	**%**	N/A	**%**	N/A	**%**
This FY Allocation (from 1088)	759,224		No funds		No Funds	
This FY Target Amount	189,806		N/A		N/A	
Title of Planned Program Activity						
Tick-borne infections	19,989					
Greenhouse production	87,557					
Managing insects/fungi	57,696					
Plant genetics resources	807					
IPM	34,255					
Apple cultivars	17,098					
Wildlife management	16					
Dispersal of corn pollen	4,599					
Weed control	33,729					
Total	255,746					
Carryover	0					

Certification: I certify to the best of my knowledge and belief that this report is correct

and complete and that all outlays represented here accurately reflect allowable expenditures of Federal funds only in satisfying AREERA requirements.

L. Magnarelli_____ __3/20/06_____

Director **Date**

Assistance to the Under-Served and Under-Represented/Equal Employment Opportunity

The Station's Affirmative Action Officer annually distributed a Policy Statement on nondiscrimination and revised the agency's Affirmative Action Plan in accordance with Connecticut regulations (46a-68-31 through 46a-68-74). During this reporting period, the Policy Statement was given to women, minority, and other employees and their unions and was posted in several locations visited by the public on Station property, including both experimental farms. The Station's policy on affirmative action and equal employment applies to all aspects of research activities and the employment process, such as applications, job qualifications, job specifications, recruitment, hiring, promotion, personnel policies (including those against sexual harassment), job structuring, orientation, training, counseling, grievance procedures, evaluation, layoffs, and termination. Pursuant to Connecticut regulations (46a-68j-21 through 43), special efforts have been made to increase purchases of items or services received from businesses owned by women and minorities. Highlights of activities for FY 2005 are described below as they relate to specific goals and procedures outlined in the Station's approved updated Plan of Work to assist the under-served and under-represented. The stated goals for these initiatives are consistent with USDA management goals on multi-cultural diversity issues.

Goals & Procedures: Program Delivery

Efforts have continued to reach under-served and under-represented groups during this reporting period. A notice was sent to members of 25 organizations serving protected groups to invite minorities to apply for positions and participate in existing research activities. Career specialists in New Haven high schools were contacted to recruit minority students for research mentorship programs. The main goals are to cultivate the interest of these persons in agriculture,

increase diversity among beneficiaries of Station research, seek further citizen input on research activities, and to disseminate research findings to stakeholders.

An initiative, started earlier, was continued during this reporting period. To attract minority students to agricultural research and to train these persons for future work, a joint effort between The Connecticut Agricultural Experiment Station and the Sound School in New Haven was renewed. An entomologist (White Female) at the Station assisted on writing a grant proposal for USDA funds in a previous reporting period. The project was awarded, and three Black males and two Black females worked under the supervision of Station scientists. These students learned about field research on crops grown at the Station's Lockwood Farm and were allowed to have their own garden plots to grow vegetables. This project had immediate impact. It encouraged minority student participation in Station research, promoted workforce diversity at the Station, provided specialized training for the interns, and stimulated interest in plant science and horticulture. Some of these students have entered college and are pursuing science majors. Grant support for this project has ended.

Construction of a new building (Johnson-Horsfall Laboratory) has been completed. An elevator is available for physically challenged persons. The old building, Johnson Laboratory, has been refurbished and is connected to the new building with the same method of access to meet ADA requirements. Residents of the state are allowed to use the meeting rooms for purposes related to plant science and agriculture. Tours are given to all persons interested in food safety and security, analyses of mosquitoes for encephalitis viruses, and biochemistry and genetics.

A cottage, located in a woodland area adjacent to open farm fields at Lockwood Farm in Hamden, has been refurbished to allow small groups of 30 or fewer stakeholders to meet. The remodeled facility meets all code regulations, including those for physically challenged persons. Stakeholders have been attracted to the experimental farm and have had more opportunities to see study plots. During this reporting period, a boardwalk was constructed for persons in wheelchairs to move from the cottage to the major plot areas of the research farm.

The Hispanic population in Connecticut continues to increase. Many Hispanics are working in nursery, tree care, and landscape companies. With limited English proficiency in this employment group, there is a need to communicate in Spanish so that these workers can effectively perform their duties. In previous years, a Station forester (White male) taught classes

on arboriculture in Spanish in Connecticut to attendees so that they could broaden their educational backgrounds and obtain arborist licenses. Most persons, who attended those classes, are now licensed arborists. This effort has brought Hispanics closer to the Station and has provided opportunities for these stakeholders to learn about research projects and the latest results. Fact sheets on mosquitoes and ticks have been written in Spanish and are being distributed to this group of stakeholders.

Goal 1: Annual public events will be scheduled to meet the needs and interests of all stakeholders, including those of under-represented groups, such as children, as a means of increasing their participation and inviting stakeholder input.

Procedures: Public events will be scheduled annually during the spring, summer, and fall. Notification of Station events will be published in the Experiment Station Associates Bulletin, which is also distributed to state legislators and the Associates' 800 members, and announced through the media (newspapers and radio stations). Efforts will be made to invite minority students. Public tours of Station facilities will be organized.

Report: Open house events occurred as planned during this reporting period. Plant Science Days were held in the spring (April 18, 2005) and summer (August 3, 2005) in the main auditorium and at Lockwood Farm, respectively. Notifications of these events were made as described above.

At the spring event, about 80 persons attended and heard three talks on invasive plants and insects, whereas about 1,017 persons attended the August open house at the Station's main research farm (Lockwood Farm) in Hamden, Connecticut. Efforts to increase the number of children (an under-served group) were particularly successful. Minorities attended both events and had opportunities to meet scientists and to see laboratories or experimental plots. A bus provided transportation within the farm to allow physically challenged and elderly persons better access to research plots. Restrooms have been remodeled to meet ADA requirements. Wheelchair accessible paths exist in the popular bird/butterfly demonstration garden plot to allow better access for all persons. To reach other minorities, the Station hosted and participated in Farm/City Week; about 850 students saw the research farm and displays. Station scientists participated in the Connecticut Flower and Garden Show in Hartford, and other annual fairs. These efforts had immediate impact. Hundreds of students, including Blacks and Hispanics from area high schools, attended these events and saw Station exhibits. Persons of diverse racial and

ethnic backgrounds had opportunities to become familiar with the Station's research projects, to learn of its findings, and to meet scientists, administrators, and other staff members.

Goal 2: The Station will work closely with inner city garden communities and encourage good agricultural practices.

Procedures: Station personnel will aid inner city residents by assisting on solving insect and plant disease problems. Groups of stakeholders will be invited to see experimental plots on Station-owned farms.

Report: During this reporting period, the Station farm manager at Lockwood Farm in Hamden, Connecticut and his assistants provided mulch for community gardens in the greater New Haven area and Hamden. Seeds for vegetables were once again donated by Station scientists. This enabled the poor, who live in different neighborhoods, to have gardens as a source of fresh vegetables. Station scientists provided expertise on diagnosing and solving insect and plant pathogen problems. In addition, Station scientists tested potential garden plots for heavy metal contamination. Polluted sites were not used for gardening. These efforts had many short-term benefits. Stakeholders learned about agriculture, became familiar with Station staff and research, had access to research findings, and produced fresh produce for their families. Minorities and other residents of New Haven were encouraged to attend Station events and to tour the experimental farm plots. Another Station scientist continued his work with the Knox Foundation in Hartford to help select sites for inner city gardens. Soil samples were tested to determine needs for fertilizers and if heavy metals were present.

Goal 3: The Station will donate produce to charitable organizations in food-sharing programs to meet the needs of the poor.

Procedures: Station personnel will make and maintain contacts with charities and coordinate the harvest and distribution of produce to organizations in food-sharing programs.

Report: About 8 tons of fruits and vegetables grown at the Station's farms in Hamden and Windsor, Connecticut were donated to charities, including food-sharing programs in the New Haven and Hartford metropolitan areas. Improved nutrition was a short-term benefit. These efforts address USDA national goal #3 ("A healthy well-nourished population").

Report: Public Notifications: The Station has a continuing policy of commitment to affirmative action and equal employment. In addition to a Policy Statement, there was re-notification to all bidders, contractors, subcontractors and suppliers of materials that the Station will not knowingly provide services and programs from or do business with anyone who discriminates against protected persons. A list of objectives for affirmative action was given during this reporting period to each Station employee. One of the objectives ensures equal access and nondiscrimination in all terms and conditions of all research activities. Employees and their unions were invited to review and comment on the Station's state-approved Affirmative Action Plan. All job notices included statements that the Station is an Affirmative Action/Equal Employment Opportunity Employer and were posted on the Station's Home Page (http://www.caes.state.ct.us), published in newspapers, sent to colleges and universities, submitted to scientific societies, and mailed to members of organizations representing protected persons in Connecticut. Public notification efforts had immediate impact because minority applicants were hired and there was improved workforce diversity. Policies regarding discrimination and equal opportunity were clearly stated or expressed in official Station documents or as a part of various public activities, including contract compliance. Station policies on equal employment and against discrimination were reviewed during this reporting period by the Director of the Station and are consistent with those of the United States Department of Agriculture outlined in memos on Departmental Regulations dated February 25, 1998 and March 16, 1998 from the Office of Civil Rights and the Office of the Secretary, respectively.

Goal 1: Job candidates will be notified of program availability and requirement of nondiscrimination on the basis of race, color, national origin, sex, disability, and other categories covered by state and federal laws.

Report: All procedures described in the updated Plan of Work and in the last five annual accomplishment reports were followed during this reporting period.

Diversity Training, Minority Training, and Employment

The Station is committed to further development of innovative programs to increase applicant flow from minorities and to train women and members of protected and non-protected

groups. One Other female was hired as a Postdoctoral Research Scientist in FY 2005. Two qualified Black males were hired in service/maintenance and now join one black male, two White males, and one Other female in that job category. Civil rights training for newly hired staff members is required to improve employee relations. Pursuant to Connecticut regulations (Public Acts 99-180, 00-72, and 01-53), newly hired permanent or temporary Station employees received a minimum of 3 hours of diversity training and education. An institutional policy on sexual harassment was written and distributed to all Station staff members, who were also required to attend training sessions. This educational program exceeded state legal requirements. The objectives are to increase workforce diversity, provide employment opportunities for promising students interested in science, and to promote harmony among staff members and the public. Station staff members, including the Director and Chief of Services, have been in contact with career specialists in area high schools and with other community leaders to reach minorities in urban settings. A teacher at the Sound School in New Haven continued to cooperate with Station administrators by recruiting five minority high school students (three Black males and two black females) during the summer of FY 2005 to work as interns in a USDA-funded project. These students learned about agricultural research at the Station and participated in Plant Science Day held in August at the Station's Lockwood Farm. To help stimulate student interest in Station research projects, a White male scientist gave talks on insects to elementary students in schools located in the greater New Haven area.

During summers, there are extensive field studies and needs for technical assistance. Station funds and federal dollars were made available to support research initiatives and to hire college students as Summer Workers. These students worked closely with scientists as apprentices in the field and laboratory and learned about agricultural research. This mentorship program has been successful. During FY 2005, three Black males, one Black female, and one Other female were hired along with 24 white males and 21 White females to learn new skills. Efforts have been made to locate qualified minority students. Aside from contacts with college and university professors, four White male scientists and one White female scientist have devoted their time to be judges in science fairs. The Station gave awards to one Black male, one White male, and one Hispanic male for their achievements.

A volunteer program is available for students to work part-time during the summer and school year. One White male and two Black males assisted entomologists and other scientists

and learned new skills. Both Black males were subsequently hired as Summer Workers to further their training. Training gained by these persons strengthened their educational backgrounds by providing "hands-on" experience.

To assist the under-served and under-represented in more advanced research, a workforce of two Other males and two Other females are employed as Postdoctoral Research Scientists. One Black female, who was a Postdoctoral Research Scientist in previous reporting periods, found a permanent job with another employer. The skills these minorities receive from White male scientists improve their qualifications for future permanent employment and upward mobility. Funds from federal grants, including those from USDA, enabled these persons to work in FY 2005 under the direct mentorship of established scientists.

Special Crops Initiative

Stakeholders of different ethnic groups continue to receive the Station's assistance on growing specialized crops, such as "personal-sized watermelons", arugula, radicchio, okra, jilo, leeks, artichokes, sweet potatoes, Calabaza (squash), and Chinese cabbage. All of these crops are very popular at farmers' markets. Jilo is in demand by Brazilians and is sold quickly in Connecticut and New York City markets. A Station scientist field-tested these crops to determine quality and yield. These efforts had immediate impact. There is increased interest among vegetable growers to raise ethnic crops, which represent an emerging "niche market", and produce is available in local markets. This activity has enhanced contacts with minorities. In response to stakeholder requests, another Station scientist is conducting research on organic farming practices. These efforts address USDA national goals #1 and #3.

Assistance to Mohegan and Pequot Tribes

Members of the Mohegan and Pequot tribes in Connecticut continue to rely on the Station for information and direct assistance on composting, forest/wetlands management, and control of hemlock woolly adelgids. Members of the Pequot Tribes have established greenhouses for tomato production. Station scientists have cooperated with tribal officials in finding ways to grow tomatoes, improve efficiency of composting paper products, to better manage forests and

wetlands in concert with commercial development of land, and to biologically and chemically control adelgids. The long-term impacts of these outreach efforts are: there will be locally grown produce that can be used in restaurants on tribal properties, efficient re-cycling of paper product waste materials, and preservation of forests and wetlands. This initiative addresses USDA national goals #1, #3, and #4.

Contract Compliance Program

In accordance with Connecticut regulations (Sec. 32-9(n) and Sec. 46a-68-35), the Station is required to report annually to the State Commission on Human Rights and Opportunities regarding the agency's efforts in awarding a fair proportion of its contracts for service or materials to small contractors, including businesses owned by minorities and women. Although a large portion of the Station's budget for services and materials must be awarded to businesses that have state contracts through the Department of Administrative Services, a small portion of the budget is available for outside bidders. This program yielded immediate short-term benefits. During state FY 2005, $279,122 was awarded to small business and minority business enterprises. This amount greatly exceeded the state-approved goal ($87,093). There were 25 Minority Business Enterprise set-aside purchases and contracts worth $217,575, which also greatly exceeded the state-approved goal of $17,419. Contracts were awarded to businesses owned by Blacks and women.

Evaluation of the Success of Multistate, Multi-Institutional, Multi-Disciplinary Programs and Joint Research/Extension Activities

As presented in Tables 1 and 2 of this annual accomplishment report, several Hatch projects continue to be linked to outside collaborating institutions or businesses and include a multi-disciplinary approach to research. Scientific collaborations are normally formed between or among scientists and are not mandated by administrators. The Director and Vice Director encourage collaborative work, however. These joint efforts have become more successful in obtaining grant funds. Some statutory requirements authorize cooperation among state agencies. Many scientists at The Connecticut Agricultural Experiment Station are trained or have gained

experience in different scientific disciplines and actively seek expertise from other investigators within or outside the institution when needed.

Multistate collaborations are likewise extensive (Table 3). Of the 35 Hatch projects listed, 22 (63%) have multistate affiliations. Scientists at The Connecticut Agricultural Experiment Station continue to interact with colleagues in at least 44 other states. The 9 USDA-approved multistate projects (NE-009, NE-183, NE-187, NE-1005, NE-1017, NE-1019, NE-1020, S-301, (S-1024), and W-082) include an extensive blend of scientific expertise for research and extension.

There are 13 Hatch projects identified as "planned" research/extension integrated activities. In most cases, the extension component is in the University of Connecticut.

There are four key questions that need to be considered: (1) did the planned program address the critical issues of strategic importance as described in the institution's updated Plan of Work; (2) did the planned program address the needs and inputs of the under-served and under-represented populations in the state; (3) did the planned program meet and describe the expected outcomes and impacts; and (4) did the planned program result in improved program effectiveness and efficiency? Advancements have been made regarding all of these key questions. A special effort was made to describe immediate short-and expected long-term impacts on how results led to positive changes in the behavior of stakeholders and (or) economic, environmental, product quality, improved human /animal health, or social benefits. We affirm that our program is meeting the stakeholders' needs as described in the updated Plan of Work and in this annual accomplishment report. The critical issues stated in each of the program goal sections of the updated Plan of Work are based mainly on stakeholder input. Contact with stakeholders is a continual process, and research initiatives are modified based on public needs. Solutions have been found for some problems, such as finding ways to reduce pesticides and increase

profitability, but new problems arise, such as the spread of exotic plant pathogens (i.e., *Phytophthora ramorum*) and accidental introduction of exotic wood-boring insects. Expanding the clientele of stakeholders, including minorities, and increasing their involvement in research projects remains a high priority. Farmers are asked to work along with scientists on solving problems. In return, they provide valuable space for field experiments. These stakeholders benefit by having continual discussions with scientists, by receiving early results, and seeing progress being made in their fields and greenhouses. We recognize the need to obtain financial data, whenever possible, to more clearly show profitability and impact of our research efforts. In this report, we have provided specific information on economic impacts (i.e., dollars saved, increased profitability measures, adoption of more efficient farming practices, etc.) for projects where sufficient progress has been made. In other scientific advancements, it is difficult to show a dollar value for a new discovery. Nonetheless, brief descriptions of short- and long-term impacts are included throughout this document to demonstrate the relevance of the scientific findings and to ensure accountability.

Our research objectives are being accomplished. The critical issues of producing new and value-added agricultural products and commodities; protecting crops and forests from insect pests and plant diseases; testing new crops for ethnic groups; improving small farm production; promoting sustainable agriculture, improving crop quality and yields; ensuring food safety and security; protecting soil and water from pesticide and other chemical contamination; reducing the use of pesticides and fertilizers in agricultural systems; finding ways to utilize farm and homeowner wastes (i.e., composted plant materials); and the issues of emerging human and veterinary pathogens transmitted by ticks and mosquitoes have been addressed. Many of these activities receive help from scientists in other states.

We have demonstrated how efforts are being made to identify and meet the needs of the under-served and under-represented. Because our main laboratories are located in New Haven, this has helped us meet and interact with minority groups in an urban setting. Other initiatives being carried out at our Valley Laboratory in Windsor, which parallel research activities in New Haven, have assisted us in addressing the needs of the under-served and under-represented in the Hartford area and in farming areas where Hispanic and other minority populations are increasing. Recent census data indicate a dramatic rise in the Hispanic population in Connecticut. A Station scientist, who speaks Spanish, taught courses for Hispanics on arborist-related topics in Connecticut. Also, by growing specialty crops, we are attempting to reach these people. Opportunities are given for the under-served and under-represented to attend Station open houses. Working with minority groups on the inner-city garden projects is particularly effective in describing the scope of our agricultural research. Fruits and vegetables from state and Hatch-supported research projects were donated to charitable organizations and food-sharing programs to help improve nutrition. Minorities received training when hired to assist on USDA grants and Hatch-supported research projects. Knowledge gained from research on composting techniques and forest management benefited members of the Mohegan and Pequot tribes in Connecticut. In general, the multi-faceted research activities and outreach efforts are successful in addressing the needs of a broader base of under-served and under-represented persons. Continual program expansion is planned, however, to assist more individuals.

The multistate projects continue to increase overall program effectiveness and efficiency by allowing for successful collaborations, reducing unnecessary duplication of research experiments, and by better utilizing dwindling resources of participating institutions within and outside Connecticut. Scientific collaborations have accelerated progress and helped to attract

extramural funding. The following are examples of improved efficiency resulting from recent research: providing specialized crops, such as jilo and calabaza, for growers; finding ways to remove invasive aquatic plants from lakes and ponds; implementation of IPM guidelines to monitor pest problems and reduce costs of controlling plant pathogens and insects; and finding ways to control ticks on homeowner properties. The availability of research data from USDA-approved multistate projects, particularly in the Northeast, has resulted in more efficient experimental design and better utilization of equipment and facilities located in cooperating institutions during times when state operating budgets have been reduced. Moreover, the impact statements for multistate projects, approved by the northeastern experiment station directors, have greatly facilitated the communication of research findings to a broad national audience. Information is available to all on the northeast regional association's (NERA) home page. The development of the National Information Management and Support System has greatly facilitated reporting and public access.

Integrated activities (research/extension) remain an important component. Good progress continues to be made on reducing the potential for environmental contamination by pesticides and other organic chemicals in agricultural systems. For example, collaborations of scientists from 3 states (NE-1019) have resulted in the effective use of selected plants (green manure) and crop rotation to control nematodes in strawberry fields. Lower amounts of pesticides were needed, which resulted in a savings of about $400 per acre. Moreover, nursery and vegetable growers are now using new, non-chemical control methods and IPM practices to reduce costs of operations. Modest reductions in the uses of pesticides in agricultural production areas have been achieved, and more growers have become enthusiastic about implementing IPM practices. The inclusion of research/extension specialists in other USDA-approved multistate projects in our research efforts,

(i.e., NE-009, NE-183, and NE-187 and NE-1005, NE-1017, NE-1019, NE-1020, S-301 and W-082), has benefited Station research by promoting collaborations, increasing efficiency, meeting stakeholder needs, providing a more concentrated and coordinated regional effort, and by allowing scientists to learn new skills. All integrated activities identified in this annual accomplishment report continue to have functional extension components where research results are reported to stakeholders in extension publications or at meetings. A publication on identifying invasive aquatic plants is very popular among boaters and members of lake associations. The mosquito identification manual and tick handbook are in great demand by public health officials, mainly in eastern United States. Foresters are interested in the guide on caterpillars that attack conifers. These technology transfer publications also have been made available to the general public and media. A homepage exists for NE-1019 “Biologically Based IPM Systems for Management of Plant-Parasitic Nematodes” at the Station website: (http://www.caes.state.ct.us/coopregionalresearchproject/multistatenematode.htm). Growers in all regions of the United States have access to scientists, research information, and science-related activities. The feedback from growers and other stakeholders continues to be positive. Finally, there is continued public concern over possible terrorist attacks and the safety and security of foods. Joint efforts between the Station, selected states, and US FDA continue to develop counter-terrorism programs as a part of the Food Emergency Response Network.

In conclusion, the Station’s multi-initiatives with joint research/extension activities have been making progress in solving specific stakeholders’ problems on farms and in homes and businesses. The frequent visits of scientists to farms are often made to more efficiently find solutions to problems and to develop stronger relationships with stakeholders. Although applied research activities dominate, there remains a strong core component for basic research.

Certification

This sixth Annual Report of Accomplishments and Results was prepared by Dr. Louis A. Magnarelli, Director, with input from Station scientists. This document is submitted as a part of specified reporting requirements, as mandated by the Agricultural Research, Extension, and Education Reform Act of 1998 and as allowed under the USDA's guidelines for preparing accomplishment reports.

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