2004 Annual Report of Accomplishments and Results

The Connecticut Agricultural Experiment Station

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Executive Summary (Overview)

Staff members at the Connecticut Agricultural Experiment Station ("Station") serve the needs of all residents. The institution is not a university, and no federal funds are received for education or extension. However, federal formula and grant funds are received for research. Research findings are continuously reported to the public in different venues. Efforts are made to include growers and other stakeholders in the research planning process. 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 four years, we are pleased to report progress that benefits stakeholders. In many instances, the results obtained over the past four years 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 program, organic agriculture, the importance of small farms, sustainability of agriculture and forestry, food safety, and water quality. The research programs and other activities 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 programs 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 programs 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 and environmental issues remain important concerns of stakeholders, particularly with regard to potential terrorism activity. Accordingly, there are program activities associated with USDA national goals #2 and #4, respectively. Some research programs 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 *Planned Program* sections. As required, this Annual Report of Accomplishments and Results includes financial data for federal FY2004. The research results and impact statements are primarily linked to FY2004 activities, but collective results for this Plan of Work cycle are described to show short and long-term benefits to society.

Our research efforts 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. As a result of a successful workshop held earlier on organic farming practices, Yale University has dedicated a dining hall to providing organic foods. Landscapers, who took a course on organic land care, are now using practices which do not rely on synthetic insecticides or synthetic fertilizers. This advancement will lead to safer foods and a cleaner environment.
2. New analytical procedures were developed and detected chlordane residues in the soil, air, and

   crops. Consequently, some vegetable growers are not planting edible crops in chlordane-contaminated soil. Safer foods are expected as a long-term benefit.

3. In evaluations of 30 apple cultivars, suncrisp had the slowest growth rate of bitter rot fruit infection. Apple growers are now planting this cultivar in their orchards with expected long-term benefits of reducing amounts of fungicides.
4. Arugula and mustard greens readily absorb arsenic through their root systems in areas where chromated copper arsenate (CCA)-tested wood was used. Homeowners now know that they can not grow edible plants near decks, garden borders or other facilities where CCA-treated wood is present. Findings on arsenic leaching and plant uptake have contributed to the US EPA decision to phase out all residential users of CCA-treated wood. These actions will reduce health risks for people.
5. An exotic wood-boring insect, *Hesperophanes campestris*, was discovered in wooden baskets imported from China. This insect is a threat to hardwood trees. The discovery led to a quarantine of baskets in warehouses, a national warning issued by USDA-APHIS, and the destruction of unsold baskets. These actions helped preserve a wood-products industry in Connecticut valued at about $500 million annually.
6. The insecticide, bifenthrin, was successful in controlling pales weevils on Christmas trees. Growers are now using bifenthrin instead of chlorpyrifos, a highly toxic organophosphate insecticide. 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. New information is available on the spread of the late blight pathogen, *Phytophthora infestans*, of potato crops. Implementation of new control strategies in the northeast, where more than 50,000 acres of potatoes are grown, are estimated to save about $50 to $100 per acre.
8. Two new cultivars of broccoli were field tested in Connecticut and had high yields of about 11,000 pounds per acre. At a retail price of $2.19 per pound, the potential market value for these cultivars is about $24,000 per acre. Growers have new cultivars of broccoli to plant and to receive profits, consumers will have locally grown, fresh produce to buy, and farmers' markets and other retail establishments will benefit by selling a popular and nutritious vegetable.
9. As a part of multistate, integrated project, strawberry growers are using dwarf Essex rapeseed and Black-eyed-Susan Rudbeckia hirta as rotation and green manure crops to control a lesion nematode, *Pratylenchus penetrans.* Use of this new control strategy saved about $400 per

acre in fumigation costs and is expected to result in a cleaner environment and reduced health risks to the pesticide users.

Goal 1: Federal Hatch Funds ($391,558), State Funds ($2,229,057), Scientist Years (15.5)

Stakeholders are concerned about food safety issues and have requested analyses for pesticide and other chemical residues in the food supply. Annual marketbasket 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. Yeast, considered to be a foreign material in certain foods, was detected in several bottles of syrup. In other cases, the pesticide endosulfan was detected in blueberries grown in Connecticut. There was immediate impact because these findings were reported to the US Food and Drug Administration, which resulted in a voluntary recall and destruction of food products. The long-term benefits of these actions and having food-testing programs are that there will be safer foods available to consumers and reduced health risks.

Goal 2: Federal Hatch Funds ($129,014), State Funds ($277,546), Scientist Years (2.8)

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 and improving laboratory diagnosis meets the immediate critical needs of stakeholders. There continues to be grower interest in more efficient plant nutrient management in greenhouses, developing composting programs, and in implementing IPM programs. 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. In evaluations of tomato cultivars for greenhouse production, Cabernet had a high yield (16 pounds per plant). Some growers have added this cultivar to their production and have implemented programs to reduce amounts of nitrogen and potassium nutrients in greenhouses. At a retail price of $2.19 per pound, there is a potential market value of $8,000 per 30 x 96 ft. greenhouse space. In addition to higher profits, there will be less fertilizers used, which will result in cleaner streams and lakes.
2. Analyses of fertilizer samples revealed common deficiencies of nutrients, such as iron, manganese, zinc, copper, and boron, in some products. Manufacturers were notified to correct the problem, and consumers learned which products were in compliance with guarantees stated on the label. The expected long-term benefits include quality products for sale, reduced economic risks associated with inferior products, and less environmental pollution of soil and water.
3. There were 278 isolations of the West Nile encephalitis virus from 9 species of mosquitoes in Connecticut. 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 during this reporting period.
4. At the request of dairy farmers, cattle were tested for antibodies by newly developed procedures to two tick-transmitted bacterial pathogens, *Borrelia burgdorferi* and *Anaplasma phagocytophilum*, the agents of Lyme disease and granulocytic anaplasmosis, respectively. Cattle were exposed to both agents, but prevalence of antibody-positive sera for Lyme disease greatly exceeded that for anaplasmosis. There was scant evidence of co-infections or clinical disease. Stakeholders learned that these diseases are of minor importance to cattle health. A small biotechnology company is using technological advances to develop a commercial assay for the diagnosis of these human and veterinary diseases.
5. The Connecticut Department of Environmental Protection requested assistance on determining the causes of dog poisoning. Analysis of food samples revealed large amounts of the insecticide diazinon and pentobarbital. These findings had immediate impact. A superior court judge issued an arrest warrant against the alleged perpetrator, a local veterinarian. Moreover, the US Food and

Drug Administration and the USDA have selected analytical chemists at the Station to cooperate on establishing a food emergency response network to develop counter-terrorism programs.

6. Continued efforts to convince nursery growers to adopt IPM practices are having impacts. Two small nurseries reduced quantities of fungicide by 108 pounds at a short-term savings of $1,141. Success at these nursery operations is enabling the program 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.
7. At the request of greenhouse owners, assistance was given to find an effective herbicide to control liverwort. Flumioxazin spray and an oxadiazon plus copper sulfate treatment provided the best control with minimal injury to the products for sale. Finding a solution to this problem allows growers to provide quality plants and to increase their market share.

Goal 4: Federal Hatch Funds ($240,392), State Funds ($2,092,815), Scientist years (22.5)

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-171, NE-183, NE-187, NE-1005, NE-1017, 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 citizens' gratitude and satisfaction for the services and research results they received. However, there is growing concern among stakeholders about bioterrorism and the nation's food supply.

Introduction

To comply with the Agricultural Research, Extension, and Education Reform Act (AREERA) of 1998, this fifth Annual Report of Accomplishments and Results (with accompanying impact statements) included in the *Planned Programs* sections is submitted. 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 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 is consistent with 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. Staff members at the Station develop creative research to provide the support that 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 testify at state appropriation hearings to support Station programs as new budgets are developed. 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 four annual reports, this accomplishment report 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 results (SAES-422) reports. As stated in the Plan of Work, the research programs 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 *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) 2004. 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 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 (eg., 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 24 protected organizations (i.e., minority groups) announcing the institution's job vacancies and describing research programs. 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 citizens' 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 citizens' comments on research programs during all of these listening sessions.

There were interactions with beekeepers during this reporting period concerning two parasitic mites that attack honey bees. 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 use. The application papers were submitted, and EPA gave approval for the emergency use of both products.

In another initiative, stakeholders requested a publication on native alternatives for invasive ornamental plant species and a turf manual for pest control. Of the 12,000 printed copies on native alternatives, all materials were distributed to nursery growers, landscapers, and the general public over a two-year period. This project was a collaborative effort with the U.S. Fish and Wildlife Service and had the assistance of an extension specialist at the University of Connecticut. The publication had immediate impact because it informed the public that some plants are invasive and harmful to the environment and that other native, non-invasive plants could be used to provide attractive landscapes and gardens. Surveys will be conducted to determine if there have been changes in the behavior of stakeholders seeking to buy the native plants rather than the invasive plants. A turf manual, another joint publication with extension, was completed in the last reporting period. Of the 2,000 printed copies, 1,500 manuals have been purchased by stakeholders, who are now relying on the information to identify and control pest problems.

During FY 2004, 748 talks and interviews were given by Station scientists in Connecticut. 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 2004. 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 programs 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 Rhododendron Society
American Society for Horticultural Science
Asnuntuck Community College
Backyard Beekeepers Association
Bartlett Arboretum
Bethany Garden Club
Bloomfield Garden Club
Branford Land Trust
Brown University
Centers for Disease Control and Prevention (Atlanta, GA and Fort Collins, CO)
Cheshire Rotary Club
Compton Corporation of Uniroyal Chemical
Connecticut Academy of Science & Engineering
Connecticut Agricultural and Natural Resources Foundation
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 Forest and Park Association

Connecticut Gladiolus Society

Connecticut Greenhouse Growers Association

Connecticut Groundskeepers Association

Connecticut Horticultural Society

Connecticut Invasive Plant Working Group

Connecticut Maple Syrup Producers Association

Connecticut Master Gardeners

Connecticut Municipal Tree Wardens' Association

Connecticut NOFA (organic farmers)

*Connecticut Nursery & Landscape Association

Connecticut Nurserymen's Foundation

Connecticut Rhododendron Society

Connecticut Rose Society

Connecticut Pomological Society

Connecticut River Coastal Conservation District

*Connecticut Tree Protective Association

*Connecticut Tree Warden School

*Connecticut Urban Forest Pest Council

Connecticut Valley Independent School Science Teachers

Cornell University Cooperative Extension

Council for Agricultural Science & Technology

Danbury Hospital

Doolittle School (Cheshire)

Eastern Plant Board

East Haven Garden Club

Entomological Society of America

Environmental Industry Council

Experiment Station Associates

Fairfield Horticultural Society

Future Farmers of America

Guilford Garden Club

Housatonic Valley Regional High School

Invasive Non-Native Plant Working Group

Kensington Garden Club

Lyme Disease Foundation

*Massachusetts Blueberry Growers' Association

Natural Resources Council

Naugatuck Community College

Naugatuck Valley Audubon Society

*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

*Newtown Forest Association

North American Gladiolus Council

*Northeast Forest Pest Council

Northeastern Mosquito Control Association

Northeast Organic Farming Association

Northeastern Weed Science Society

*Northern Nut Growers Assoc.

Notre Dame High School

Pioneer Hi-Bred International

Prides Corner Farms

Quinnipiac Chapter of Sigma Xi

Quinnipiac University

Rocky Hill Garden Club

Seth Haley Elementary School

Sikorsky Garden Club

Sleeping Giant Park Association

*Society of American Foresters

Southern Connecticut State University

Southern Illinois University

Stratford Garden Club

Suffield High School

Thomas Edison Middle School

Tunxis Garden Club

Trinity College

University of Connecticut (includes Cooperative Extension)

University of Massachusetts

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

*USDA/APHIS/PPQ

Wesleyan University

*Western Chestnut Growers Association

Wethersfield Garden Club

Windsor Garden Club

Wintergreen Magnet School

Working Lands Alliance

*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 program is also useful in identifying emerging problems, such as the introduction of exotic pests. Our diagnostic services program coincides with a USDA management goal: agricultural communications, enhancing customer service/satisfaction information technologies. During state FY 2004, there were about 15,700 public inquires from stakeholders to all Station staff members. The problems varied. For example, scientists in the Department of Entomology answered 4,302 public inquiries. Of these, 1,331 (31%) were from persons who visited the department. Information obtained by growers and industry personnel enhanced their businesses. Questions on natural resources (79%) were most frequent followed by inquiries on pests of humans or persons' dwellings (17%) and on food crop insects (4%). Scientists at the Valley Laboratory in Windsor, Connecticut answered 1,010 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. Plant pathologists answered 8,461 inquiries. Scientists responded to special requests by visiting commercial and private properties on 350 different occasions to diagnose more complex problems and to give stakeholders immediate assistance in solving problems. One scientist made 155 visits to nursery and greenhouse operations. In addition, 6,560 soil tests were performed for homeowners, landscapers, and groundskeepers. There was daily contact between citizens and scientists, an exchange of scientific information, and public input into research programs and diagnostic services.

Members of the media frequently request information. In some instances, such as mosquito research and encephalitis virus outbreaks, the entry of a plant pathogen, *Ralstonia solanacearum* race 3 biovar 2, in the United States and the spread of *Phytophthora ramorum*, the fungus-like agent that causes Sudden Oak Death and ramorum leaf blight. There was national interest in research or survey findings. West Nile encephalitis has spread to western United States. An ambitious field research program on mosquitoes was continued in response to stakeholders' concerns in Connecticut. Administrators in towns and cities were kept informed of weekly mosquito and bird 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 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 2004, there were no fatalities from encephalitis virus infections. Other experimental findings on ticks, three tick pathogens that cause human diseases, hemlock woolly adelgids, 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 and newsletters, 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. Twenty eight different civic groups used Station conference rooms or the auditorium on 89 occasions. This provided further opportunities for stakeholders to meet and hear presentations by Station scientist.

During this reporting period, the Station held special public conferences and open houses. About 20 Christmas tree growers attended a meeting at the Valley Laboratory in Windsor, CT during the summer of 2004. They heard presentations on research and toured experimental plots. Over 40 nursery and landscape professionals attended the annual tour of the Valley Laboratory in July of 2004. Attendees were shown research plots and educational gardens. In addition, attendees heard short talks by staff members on hemlock woolly adelgids, postproduction fertility management, and new findings on managing turf insects, parasitic nematodes, and weeds. Stakeholders also saw displays on identification of weeds and insect pests of woody ornamentals. After the outdoor program, attendees heard other research talks in the conference room on managing nematodes in the landscape, effects of endophytic turf on white grubs, plant disease problems, and updates on arthropods and pesticides. Discussions followed the talks. At a public meeting on April 19, 2004 (Plant Science Day In the Spring), scientists reported their findings on maintaining healthy gardens, new vegetable crops, and growing tomatoes in the garden and greenhouse. Additional information was presented on detecting serum antibodies to the tick-transmitted agents that cause Lyme disease, ehrlichiosis (anaplasmosis), and babesiosis; chestnut trees; aerial disposal of corn pollen; arsenic in

pressure-treated lumber; pesticides in food and the environment; and on testing mosquitoes for encephalitis viruses as a part of laboratory tour program for stakeholders. On August 4, 2004, an open house was held at the Station's farm in Hamden, Connecticut. About 800 persons attended this event and were able to visit experimental plots, demonstrations, and exhibits to hear updated scientific reports on control of invasive weeds in Connecticut lakes, basic techniques for propagating plants, mosquitoes and West Nile virus, biological control of hemlock woolly adelgids, homeowner tree care tips, the phase out of pressure treated wood due to arsenic leaching, wind dispersal of corn pollen and other topics. There were over 60 exhibits and field plots describing work on 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 on selected topics of interest in laboratories. For example, on February 27, 2004, a group of teachers, who instruct students in the Future Farmers of America program, visited the Station and heard reports on tick control, tick-borne infections, West Nile encephalitis, diagnostic services, and the dispersal of corn pollen. Information gained by attending 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 825 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 programs and events. In addition, a brochure on Station research programs 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 25, 2004 and at bimonthly Board of Directors' meetings. Members in attendance at the annual meeting heard presentations by Station scientists on exotic wood-boring insects and gardening. 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 programs.

Station scientists worked closely with growers in research programs to solve specific problems. Special assistance was given to arborists, veterinarians, public health officials,

groundskeepers, landscapers, the nursery industry, fruitgrowers, and vegetable growers. The nursery industry is valued at about $400 million annually in sales. Many experiments were conducted in nursery fields and greenhouses and other farmers' properties at the request of these growers to reduce pesticide use and costs. Stakeholders were involved with the planning process and evaluation of scientific results. An important problem re-occurred during this reporting period. The accidental introduction of a plant bacterial pathogen, *Ralstonia solanacearum* race 3 biovar 2, in the United States from Guatemala, prevented greenhouse owners from moving plants because of federal quarantines and state regulations. These stakeholders received immediate assistance. Federal action orders and stop sale notices prohibited the movement of geranium plants from 4 greenhouse operations in Connecticut. Station staff members closely monitored quarantined plants and the destruction of these plants. These efforts prevented the spread of the pathogen and had impact because the potential economic losses of tens of thousands of dollars in plant sales were avoided. Station scientists were called upon to address another important national problem: the spread of the Sudden Oak Death pathogen from California and Oregon nursery production areas. Camellia plants, infected with *Phytophthora ramorum*, were shipped from California to many states. In Connecticut, plants were shipped by mail order to 112 residents. These people were contacted by phone and correspondence to determine if diseased plants were discarded to outdoor settings. Dead plants were properly discarded by normal trash pickup, and culture results were negative. Nurseries and dealers were notified by mail to inform people about the status of *P. ramorum* infections. The shipment of infected rhododendron plants from Oregon to Connecticut resulted in a quarantine and destruction of plants at nurseries and a garden center. In tests conducted at the Station, there were culture-positive results, which proved that plants with active infection were shipped. These findings had immediate impact by raising public awareness and by establishing extensive surveillance programs. In other work, 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.

In the previous reporting period, pumpkin growers requested assistance on determining the causes of severe crop losses. A Station scientist responded and discovered that a parasitic fungus, *Fusarium solani,* caused the problem. This finding had an immediate impact on growers because fungicide treatments were applied as needed to save crops. Also, a monitoring system for this infection is established to prevent future losses and to determine more precisely when the crops

needed treatment. The monitoring program will lead to long-term benefits by preventing future crop losses and determining precise times for fungicide treatment.

Forest stands are extensive in Connecticut. Approximately 60% of the state's land area is classified as forests. 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, and the fungus-like pathogen for Sudden Oak Death exotic pests that could cause extensive economic losses and disruption of forest ecosystems. These studies are being conducted to help preserve the $500 million (annual) wood products industry in Connecticut, which includes 350 firms that employ 3,600 loggers, millworkers, and other employees. At the requests of stakeholders, 90 talks and interviews were given by Station staff in association with the McIntire-Stennis forestry research program.

The hemlock woolly adelgid, *Adelges tsugae*, is a destructive introduced pest of eastern hemlock and Carolina hemlock in at least 16 eastern states from Georgia to New Hampshire. 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, a new initiative began in the previous reporting period. Tests are being conducted on systemic control (i.e., tree injection methods) of the pest with imidacloprid. Preliminary results indicate that soil injections or drench applications near the trunk are most effective.

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 was 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 15 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 program. Field research has demonstrated that the beetles are established at most sites and that the beetle is attacking the balsam woolly adelgid as well. Therefore, 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 studies are designed to develop an artificial diet for the beetle, to assess hemlock stand conditions, the patterns and timing of beetle release that will enhance the biological control effort, survival and dispersal of the beetles, and to determine 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 program 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* species) imported from China. The *Scymnus* predatory beetles were released in Georgia and Pennsylvania as a collaborative effort. In a recent publication by D.H. Thompson of Mississippi State University on the history and evaluation of the McIntire Stennis Cooperative Research Program administered by USDA/CSREES, Station research on the biological control of the hemlock woolly adelgid was chosen as one of five case studies to describe the national impact of this federally supported program.

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 ww.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 citizens. Experiments were designed and revised based on stakeholders' input and needs.

A newly discovered fungus attacks elongate hemlock scale (*Firorinia exterma*) in Fairfield County, Connecticut and Orange and Putnam Counties, New York. Infection rates were as high as 78.5% on 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 two Connecticut Nursery and Landscape Association meetings, Connecticut Flower and Garden Show, Farm/City Week event, Eastern States Exposition in West Springfield, MA, and at annual meetings of arborists. A Station scientist participated in a special workshop organized by the Connecticut Chapter of the Society of American Foresters and held on June 8, 2004. In addition, research results were presented to the Northeast Forest Pest

Council, 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, but also for wood products and 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 current focus 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 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 was 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. Most of the living stems in the control plot have no cankers, or single, sunken cankers. Living stems in the treated plot have multiple, frequently swollen cankers. There is short-term impact of these results 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 boom 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 program in Connecticut. As in the past, she continued to interact with users of wood products (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 program.

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 studies 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, 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 program is that more stakeholders become familiar with the Station and its research programs. 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 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, and holding educational workshops for commercial pesticide applicators. About 150 persons from over 50 private Connecticut companies have been trained. Some of these persons received state certification to apply pesticides for tick control. Veterinarians requested Station assistance on performing antibody tests to determine if horses and cats were exposed to the Lyme disease agent. 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 2004, 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
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)

Community Gardens Committee, New Haven Land Trust

Concentrated Animal Feeding Operation Committee, EPA

Connecticut Academy of Arts and Science

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 Mosquito Management Program

Connecticut Nursery IPM Implementation Team

Connecticut Nursery & Landscape Association

Connecticut Pomological Society

Connecticut State Technical Committee

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

Environment Committee, Mill River Watershed Association

Epidemiological Committee of the National Plant Disease & Pest Detection Network

Goodwin Forestry Scholarship Committee

International Organizations for Biological Control

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

Lyme Disease Foundation

National Christmas Tree Growers Association

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 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

Peabody Museum, Yale University (Curatorial Affiliate)

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 5-year Plan of Work was submitted. In accordance with the approved Plan of Work, scientific proposals of the Station were subjected for 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 programs to address changing needs and priorities.

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 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 39 senior-authored publications and 356 talks and interviews recorded for state FY 2004 in association with this program goal. There were 66 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 program 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 an extension of the 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 four 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 two years.

Outcome Indicators.

(1) Results of field studies on biological and cultural control of insect pests of vegetables will be reported to organic farmers during a farmer/scientist workshop. **Themes: Agricultural competitiveness, Agricultural profitability, Diversified/alternative agriculture, Innovative farming techniques, Niche market, Organic agriculture; Small farm viability; Sustainable agriculture**

Description: This workshop was held as planned during the first reporting period. Details on stakeholder interactions with scientists and on the publication of the conference proceedings were included in the first year's accomplishment report. This objective has been completed, and the main goal of convincing vegetable growers to follow sustainable agricultural and IPM practices is being accomplished. New initiatives have resulted from the original workshop. During this reporting period, 40 people, including restaurant owners and academic administrators, attended an open house at an organic farm in Cromwell, Connecticut. In addition, 80 stakeholders took a course in organic land care in Connecticut and Massachusetts. **Impact:** several immediate benefits are evident. Profitable non-chemical control alternatives are now available to farmers. Field test results have promoted sustainability of organic crop production and are enhancing market expansion in New England. For example, Yale University has a dining hall dedicated to providing organic foods that are produced locally. Landscapers who took the organic land care course have adopted practices which do not use synthetic insecticides or synthetic fertilizers. The long-term benefits of having no pesticides used in small farm plots or in other land areas and of utilizing composted materials will lead to a cleaner environment. Also, there is growing interest in organic farming, and there are now 33 organic farms in Connecticut. The produce is sold in farmers' markets, but consumer demands for organically-grown vegetables still exceeds supply, however. As more farmers adopt organic farming practices, production will increase, more efficient and environmentally compatible management strategies will be developed, and there will be expanding economic opportunities in rural America. Long-term benefits of having a sufficient supply of vegetables with no pesticide residues are expected.

Sources of funds: Hatch and state

Scope of impact: state-specific.

These accomplishments and impacts also apply to goals #2 (safe, secure foods) and #3 (healthy, well-nourished population). **Themes:** food **safety** and **human** health

(2) a written record of proceedings of a farmer/scientist workshop on control of insect pests of vegetables will be prepared, including stakeholder discussions, and given to interested parties. **Themes: Agricultural competitiveness; Agricultural profitability; Diversified/alternative agriculture; Innovative farming techniques; Niche market, Organic agriculture; Small farm viability; Sustainable agriculture**

A book of proceedings on the workshop was prepared in FY 2000, as reported in the first year's accomplishment report, and was distributed to participants. The speakers provided a summary of their conference talks, and the audiotapes were used to document discussions among the participants. After minor editing, the book was printed by the Natural Resource Agriculture and Engineering Service. Feedback from conference participants and the impact of the conference were summarized in the 2001 accomplishment report. This objective has been completed. The short-term impact is that there is a written record describing scientific discoveries and conference proceedings available to all interested persons. The information has helped growers start organic farming. The expected long-term benefits are that there will be continued efforts for collaboration among farmers and scientists, which will lead to profitability for small farms in rural settings and increased supplies of organic vegetables to meet high consumer demands.

(3) Appropriate technology will be developed for users of the food and fiber system. **Themes: Hazardous materials; Water quality; Food quality; Food safety**

Description: Chlordane, a banned chlorinated hydrocarbon pesticide since 1988, continues to cycle in biotic and abiotic processes in the environment. Persisting in the soil for at least 20 years, there is concern that the pesticide may enter food crops and be released from the soil into the air.

Accomplishment/Impact: Recently developed chiral gas chromatography with ion trap mass spectrometry methods can detect and measure chlordane residues in soil and ambient air. Ambient air concentrations of chlordane in Connecticut are similar to those recorded for other areas

of the country where this pesticide was used, but chlordane from a 40-year-old application site in Connecticut continues to volatilize. Recent research findings show that chlordane present in Connecticut air is likely the result of volatilization of chlordane from areas where it was used to control termites. In addition, some chlordane enters the state in air from other regions. Volatilization tends to occur from the top centimeter of contaminated soil and can be affected by crop cultivation practices. The short-term impact is that these methods can be used to identify chlordane-contaminated sites so that certain crops are not planted in these areas. Consequently, dozens of growers in Connecticut are not planting edible plants in chlordane-contaminated soil to avoid possible short and long-term problems of contaminated foods. The expected long-term benefits are safer foods for human consumption and more accurate monitoring of chlordane in the environment. Overall, there will be less human exposure to chlordane, thereby reducing health risks.

Sources of funds: Hatch and state.

Description: Growers and consumers are concerned that chlordane may be entering the food supply**.** A detailed dose-in-soil/uptake-by-plants study, using chiral gas chromatography to detect chlordane in crops, has been completed. *Cucurbitae pepo* plants were grown in containerized soil in a Connecticut field plot containing four levels of weathered chlordane contamination. The air surrounding the plants was monitored throughout the growing season. Greenhouse experiments were conducted as a comparison. At harvest, roots, stems, leaves, and fruit were collected to determine chlordane content. Studies were designed to generate information which could be used to predict chlordane content in zucchini fruit if the chlordane soil contamination concentration was known.

Accomplishment/Impact: All zucchini plant parts contained chlordane. Therefore, soil-bound persistent organic pollutants, such as chlordane, could have potential adverse chronic affects on humans, domestic animals, and wildlife for decades to come. This finding had short-term impact

by verifying that zucchini should not be planted in contaminated soil, and growers are no longer planting zucchini in chlordane-contaminated soil. Knowledge of the presence of chlordane in soil will help minimize harmful dietary impacts resulting from crops grown in contaminated areas. Use of the analytical methods will result in long-term benefits of more accurately assessing chlordane and other pesticide residues in other crop systems and ensuring safe foods for consumers. By decreasing human exposure to pesticides, there will be reduced health risks.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

These accomplishments and impact also have application to goal #2 (safe, secure foods) and goal #3 by ensuring a healthy, well-nourished population (**Themes: food safety and human health)**.

(4) Field trials of six cultivars of sweet corn will reveal a variety that is suitable for growing in northeastern United States and will have high yields and maintain sweetness and flavor of the product. **Themes: Agricultural competitiveness; Agricultural profitability; Small farm viability**

This objective has been completed, and there is no further work planned. Accomplishments and impacts were summarized in the first two accomplishment reports. Growers are planting the more desirable cultivars.

(5) Field and laboratory investigations of a pathogenic fungus, *Entomophaga maimaiga*, of gypsy moth caterpillars will determine whether or not this pathogen has the ability to infect caterpillars after several years of dormancy. **Themes: Forest crops; Biological control; Risk Management; Other (forest health)**

This objective has been completed. Accomplishments and impacts were summarized in each of the previous annual accomplishment reports. Foresters in New England continue to use the computer model developed to predict the *E. maimaiga* infections of gypsy moth caterpillars in nature.

(6) Field experiments on the fungus that causes apple scab will indicate more precisely when fungal ascospores are released in orchards so that more timely fungicide applications can be made, amounts of chemical pesticide used in apple orchards can be reduced, and that yields and quality can be maintained or increased. **Themes: Adding value to agricultural products; Agricultural competitiveness; Agricultural profitability; Innovative farming techniques; Plant health, Precision agriculture; Integrated pest management; Small farm viability**

Description: Apple scab and other fungal infections are serious problems in orchards. The annual value of the apple crop in Connecticut is estimated to be about $8 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 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: The cultivar Suncrisp had the slowest growth rate for bitter rot fruit infection. 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).

Description: Results obtained from earlier studies of apple scab and a model system to estimate infections are now being applied to another problem: drift of corn pollen from genetically modified (GM) plants. The recent and rapidly accelerating introduction of genetically modified (transgenic) corn into agricultural production has renewed the importance of quantifying the aerial dispersal of corn (*Zea mays*) pollen. Off-site movement of pollen makes possible crosses of GM varieties with corn in managed non-GM organic and conventional production fields. In addition to clarifying aerial dispersal patterns, it was important to determine survival of corn pollen. These results will be beneficial in determining regulatory buffer zones for experimental field trials when applications are submitted for USDA/APHIS/PPQ and state permits.

Accomplishment/Impact: Laboratory tests revealed that corn pollen survives well for about two hours in moderate temperature and humidity. Based on information in newly developed mathematical models, wind can potentially transport pollen several miles, but dilution of the pollen cloud and competition from local pollen sources limits dispersal during moderate weather conditions. These results had immediate impact because state regulatory officials are considering the expansion of the buffer zones between GM corn plantings and non-GM organic or conventional production

fields. The long-term impacts will be more efficient management and regulation of GM crop systems and reduced risks of cross-pollination from transgenic plants.

Source of funds: Hatch and state.

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

This accomplishment also applies to goal #3 by providing a food source to ensure a healthy, well nourished population (**Theme: Human health**) and goal #4 which addresses greater harmony between agriculture and the environment (**Theme: Pesticide application**).

(7) Laboratory experiments on enzymes in plants will reveal which enzyme protects plants from photooxidative damage. **Themes: Plant genomics; Plant health; Plant production efficiency**

This objective has been met, and there is no further work planned. Summaries were reported in two previous accomplishment reports.

(8) Field and laboratory experiments on wood preservatives will determine if surface soil becomes contaminated. **Theme: Hazardous materials; Home lawn and gardening; Risk management**

Description: Chromate copper arsenate (CCA) is the most widely used wood preservative. Compounds leach into the soil where arsenic, a class A carcinogen could be taken up by edible plants. Millions of board feet of CCA-treated wood have been produced annually in the United States and are used in decks, picnic tables, garden borders, posts, stakes, playground equipment, highway sound barriers, and utility poles. Stakeholders expressed concern over possible uptake of undesirable chemicals by plants grown near CCA-treated wood because vegetable gardens are

sometimes planted near these wood products. Experiments were conducted to determine if plants uptake arsenic from contaminated potted soil. A variety of leaf crops (16 types including 11 varieties of brassicas) were grown in pots spiked with arsenic.

Accomplishment/Impact: Modest uptakers included romaine lettuce, Chinese cabbage, and collards, while arugula and mustard greens were considered high uptakers. These results had immediate impact. Stakeholders now know that they should not plant edible crops near CCA-treated wood. Homeowners have removed CCA-treated wood in some instances from vegetable gardens. Removing CCA-treated wood offers long-term benefits of having less arsenic introduced into the environment and reducing uptake by edible plants. Reductions in arsenic leaching decreases exposure of humans and other animals to a dangerous chemical, thereby reducing health risks. Moreover research findings on arsenic leaching and plant uptake have contributed to the EPA decision to phase-out all residential uses of CCA-treated wood, effective January 1, 2004. These actions will result in less human and other animal exposure to arsenic as a long-term benefit and reduce the buildup of arsenic in the soil.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

These accomplishments also apply to national USDA goal #2 by providing information on a safe and secure food and fiber system (**Theme: Food safety)** and to goal # 5 by enhancing the quality of life for Americans (**Theme: Children, youth, and families at risk**).

(9) Forest health monitoring programs will detect emerging insect and plant diseases that may affect nursery-grown plants. **Themes: Agricultural competitiveness; Agricultural profitability; Invasive species; Plant health; Plant production efficiency; Risk management; Small farm viability; Ornamental/ green agriculture**

Description: With increased globalization and movement of commerce from Asian countries (eg., Japan, Korea, Taiwan, and China) to the United States, there is increased risk of importation of exotic pests. Warehouses and surrounding forested areas were surveyed for exotic insect pests.

Accomplishment/Impact: Live larvae of a wood-boring insect (*Hesperophanes campestris*) were found in wooden baskets imported from China. The unsold baskets remaining in the Connecticut warehouse were quarantined and destroyed. Six baskets sold to the public were examined and found to be free of the beetle. These findings had immediate impact nationally. State and federal plant regulatory officials issued warnings, which resulted in surveys in several states. Since the beetle has potential to infest a wide variety of hardwood trees, the long-term benefits of detecting exotic insect pests before they enter woodlands are preservation of forest stands and diversity, continued supply of wood products for consumers, preventing soil erosion near streams and rivers, and maintaining economic opportunities for those working in the wood-products industry valued at about $500 million annually in Connecticut.

Sources of funds: Hatch, McIntire Stennis, and state.

Scope of impact: multistate (CT, MA, NJ, NY, RI).

Accomplishments also apply to goal #4 (**Theme: Pesticide application**).

(10) Laboratory and field experiments on chemical control of soil-inhabiting beetle larvae in container-grown nursery stock will reveal a more cost-effective and efficient method of treating nursery stock for national and international shipments. **Themes: Agricultural competitiveness; Agricultural profitability; Invasive species; Ornamental / green agriculture; Plant health; Small farm viability**

Description: Pales weevil (*Hylobius pales*) larvae are destructive to plant roots in field-grown Christmas tree farms. The presence of these insects can weaken trees and make them more susceptible to diseases. Christmas trees are grown on about 6,000 acres by 500 growers in

Connecticut. There are about 440,000 trees harvested annually, representing about 6% of the total 7.7 million trees grown. The annual gross revenue for the locally harvested trees is about $9 million. The nursery industry requested assistance from Station scientists to meet immediate critical needs on solving some specific pest problems. Various insecticides were tested to find acceptable control measures.

Accomplishment/Impact: The insecticide bifenthrin (Talstar) was most successful in controlling pales weevils. These results had short-term impact. Christmas tree growers have replaced chlorpyrifos (Lorsban), an organophosphate insecticide, with a much safer alternative. A well-timed, low concentration of bifenthrin controls pales weevil. 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 also reduced costs. On a per acre basis, application of this insecticide was about $20.00, compared to chlorpyrifos treatment ($73.00). The expected long-term benefits of using bifenthrin, a pyrethroid insecticide, are cleaner environments in and near nurseries, many of which border residential areas, 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

(11) Field and laboratory tests will reveal new methods of managing plant nematode, insect, and soil-borne pathogen infestations with reduction in pesticide usage on vegetable and fruit crops.

Themes: Agricultural competitiveness; Agricultural profitability; Emerging infectious diseases;

Integrated pest management; Organic farming; Precision agriculture; Plant health; Plant production efficiency; Risk management; Small farm viability; Urban gardening

Description: Apple tortrix (*Archips fuscocupreanus*) is an Asian leafroller pest that has become established in southern New England. The caterpillars attack 91 species of mainly woody plants in at least 15 plant families. The majority of the plant species are in Rosaceae, which includes the economically important pome and stone fruits. In Connecticut, apple production is valued at about $8 million. Fruitgrowers, who use insecticides as a preventive strategy, requested assistance on determining more specific host susceptibility to this insect so that effective control methods can be used with minimal amounts of insecticides.

Accomplishment/Impact: Field studies revealed that apple tortrix larvae ingested sufficient nutrients from certain key plant hosts and, consequently, egg production (i.e., fecundity) was high. Preferred hosts included European buckthorn, oriental bittersweet, autumn olive, and pear. Oriental bittersweet and autumn olive are considered to be invasive plants. These results had immediate regional impact because growers learned which plants contributed to the buildup of the pest's population and that removal of certain host plants was sufficient to reduce numbers of apple tortrix. No additional insecticide treatments were needed. This action coupled with knowledge that pre-bloom sprays for other insects were also effective for control resulted in a savings of about $30 per acre in pesticide spraying costs. The expected long-term benefits of reduced pesticide spraying are a cleaner orchard environment with less pesticide residues, less human exposure to insecticides, thereby reducing health risks, less adverse effects on beneficial insects that keep apple tortrix and

other fruit pests under control in IPM programs, the ability to produce quality fruit, and reduced risks of contaminating surface and ground waters.

Sources of funds: Hatch and state.

Scope of impact: multistate integrated research (CT, MA, NJ, NY, RI) including extension. Accomplishments also apply to goal #3.

Description: Late blight of potato is caused by a fungus, *Phytophthora infestans.* There are about 250 acres of potato production in Connecticut, and when conditions are favorable, *P. infestans* can have a severe impact on the crop. Stakeholders requested more specific information on how fungus outbreaks occur so that effective control methods can be used.

Accomplishment/Impact: Late blight is an episodic disease, being highly variable between years and among days within years. The spread of the fungus is limited by its relatively short infectious period. The pathogen is more likely to spread distances greater than 10-20 km by people rather than by passive dispersal through the atmosphere. The short-term benefit of these results is that potato growers can better control the disease through integrated use of sanitation, scouting, weather forecasting, using late blight resistance potato varieties, and minimal use of fungicides. It is estimated that overall use of new strategies to control late blight in the northeast on more than 50,000 acres of potatoes can result in a savings of about $50 to $100 per acre. With IPM practices in use, the expected long-term impacts are less pesticide residues in potato fields, 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 and state.

Scope of impact: multistate integrated research (CT, FL, MA, MD, MI, NY, PA, RI, WV) and extension.

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

Description: *Pratylenchus penetrans,* a lesion nematode, causes root damage, which may serve as an infection site for a fungus that causes black root rot of strawberry. The annual retail market value for strawberries in Connecticut is about $2.8 million for about 230 acres of production. As a part of integrated multistate research and extension (NE-171), experiments were conducted in strawberry fields to evaluate the influence of rotation and use of green manure crops for control of *P. penetrans.*

Accomplishment/Impact: Rotation and green manure crops controlled nematodes as passive non-hosts or as active antagonists, producing nematicidal compounds. However, different plants were more effective against some nematodes than others. These results had immediate impact. Growers are now using specific crops, such as dwarf Essex rapeseed and Black-eyed-Susan Rudbeckia hirta, to reduce nematode populations in efforts to lower amounts of pesticides used. There was a savings of about $400 per acre in fumigation costs. Expected long-term benefits are less pesticide residues on strawberries and cleaner field production environments, many of which are near residential areas. “Pick-your-own” farm operations are very popular with consumers. Knowledge of pesticide reduction in growing areas will reassure stakeholders that they can enter strawberry fields

and safely harvest fruit. With reductions in pesticide use, water quality of streams, lakes, and ground water also will be enhanced.

Sources of funds: Hatch and state.

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

Description: *Fusarium oxysporum* is a soil-borne fungus that affects many crops. Fungicides are marginally effective, but with no other options available, farmers tend to rely on chemical treatments anyway. It is believed that the pathogen has virulent and avirulent phases, and it is unclear whether DNA analyses or vegetative compatibility tests are more accurate for determining which phase the organism is in. Experiments were conducted on basil seedlings to evaluate testing procedures.

Accomplishment/Impact: Both types of analyses were suitable for identifying pathogenic strains of *F. oxysporum.* When this pathogen is present, farmers would not be able to use their fields, and a cover crop would need to be planted until the organism disappears. These results had immediate benefits because there are two options available for identifying pathogenic and non-pathogenic isolates. Also, when the fungus is in a non-pathogenic phase, there is no need to apply fungicides, and after a year or two of cover crop growth, desirable cash crops can be safely planted. Growers are not applying unnecessary chemical treatments. Replanting desirable crops sooner, when the pathogen is cleared from fields, will result in increased profits. The expected long-term benefits of reduced fungicide applications are less pesticide residues on the crop (safer foods) and in the soil, less pesticide run-off to streams and ground water supplies, continued savings for growers (estimated at about $5,000 per farm), and less exposure of humans and other animals to fungicides.

Sources of funds: Hatch and state.

Scope of impact: multistate integrated research and extension (CT, FL, MI, NJ, PA, WA).

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

(12) Field testing of apples, grapes, raspberries, okra, leeks, sweet potato and other vegetable cultivars will identify high-yielding, marketable crops that are genetically resistant to plant diseases. **Themes: Agricultural competitiveness; Agricultural profitability; Niche market; Plant genomics; Plant health, Plant production-efficiency; Small farm viability**

Description: There is a network of farmers' markets in major cities, densely populated suburbs, and numerous roadside stands in Connecticut. These markets provide opportunities for growers to sell produce directly to the consumer and receive higher profits. Consumers want locally grown, fresh produce. Seven cultivars of broccoli were evaluated for marketing in Connecticut.

Accomplishment/Impact: Yield of the cultivars "Gypsy" and "Lucky" exceeded 11,000 pounds per acre. These findings had immediate impact by meeting the immediate needs of growers and consumers. Growers now know that high-yielding broccoli can be grown in Connecticut and that there are potential profits. At a retail price of $2.19/lb, the potential market value of these new broccoli cultivars is about $24,000 per acre. Broccoli is now being grown as a niche crop in rural areas, and there is economic opportunities for these farmers. There are expected long-term benefits for growers and consumers. Growers have new cultivars of a popular crop to plant for profits and

consumer groups can purchase locally grown produce. Farmers' markets and other retail establishments also benefit by selling a quality crop that is nutritional and in demand.

Sources of funds: Hatch and state.

Scope of impact: state specific.

These accomplishments also apply to national goal #3 by providing food to ensure a healthy, well-nourished population (**Theme**: **Human health**) and goal #5 by enhancing opportunity and quality of life for Americans.

(13) Field testing of flax cultivars will reveal which varieties are most suitable for growth in Connecticut. **Themes: Adding values to new and old agricultural products; Agricultural profitability; Diversified / alternative agriculture; Plant genomics**

This objective has been completed, and findings were presented in the first annual accomplishment report. The scientist conducting these studies has retired.

(14) Laboratory tests will identify more efficient methods of extracting taxanes from *Taxus* plants. **Themes: Adding value to new and old agricultural products; agricultural profitability; New uses for agricultural products**

This objective has been completed. Results and impacts were reported in the first and second annual accomplishment reports.

(15) Laboratory tests will identify key genes involved with photoprotective response and photosynthesis. **Theme: Plant genomics; Plant health; Plant production efficiency**

This objective has been completed. Results and impacts were reported in the first three Annual Accomplishment Reports.

Allocated Resources. Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 2004.

	Fiscal Resources				Human Resources	
	Federal*		State		Scientist Years	
Years	Target	Actual	Target	Actual	Target	Actual
1999	$447,704	$448,618	$2,417,000	$2,258,559	17.8	17.8
2000	447,704	$407,429	$2,417,000	$2,380,683	17.8	17.6
2001	447,704	$418,616	2,417,000	$2,490,608	17.8	18.3
2002	447,704	$472,244	2,417,000	$2,678,216	17.8	18.4
2003	447,704	$437,495	2,417,000	$2,177,548	17.8	15.5
2004	447,704	$391,558	2,417,000	$2,229,057	17.8	15.5

*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 Goal 1. To annually increase the research and knowledge base available from CSREES partners and cooperators on food safety and food-borne risks and illnesses.

Performance Goal 2. To increase consumer access to targeted agricultural products of Connecticut that provide greater assurances for safety.

Output Indicators. (1). The numbers of publications, talks, and interviews given by scientists were tabulated annually and are reported here to document interactions with stakeholders. During state FY 2004, there were two senior-authored publications recorded in association with this program goal.

Output Indicators (2). The Department of Analytical Chemistry is responsible for testing agricultural products for pesticide residues. During FY 2004, produce was analyzed at the request of the State Department of Consumer Protection.

Outcome Indicators.

(1) There will be greater consumer access to safe Connecticut produced foods. **Theme: Food handling; Food safety**

Description: There are stakeholder concerns about food safety. Citizens and state officials requested assistance on analyzing foods for unwanted substances. Two hundred and twenty four samples, submitted by the Connecticut Department of Consumer Protection were analyzed for evidence of possible product tampering and contamination.

Accomplishment/Impact: Yeast, considered a foreign material in certain foods, was detected in several bottles of syrup. In other instances, there was an overtolerance of the pesticide endosulfan in blueberries grown in Connecticut. There was immediate impact because these findings were reported to the US Food and Drug Administration and prompted a voluntary recall and destruction of the food products. In other instances, stakeholders learned that other food products tested were safe to consume. The expected long-term benefits of food-testing programs for pesticides are that the public will be reassured that foods are being analyzed on a regular basis 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.

(2) Laboratory studies will determine how maple syrup becomes contaminated with lead. **Theme: Food handling; Food safety, Human health**

This objective has been completed. Results and impacts were reported in the first three annual accomplishment reports. The sources of lead contamination were identified and solutions were found to eliminate the immediate problems as short-term benefits. However, at the request of maple syrup producers, a quality control program has been continued to reassure stakeholders that there is no new lead contamination problem. This monitoring program continues as a long-term benefit to consumers and maple syrup producers to reassure stakeholders that the food product is safe.

(3) In cooperation with maple syrup producers, guidelines will be developed to lower or eliminate lead content in finished maple syrup. **Theme: Food safety, Human health**

This objective was completed and results were reported in the first annual accomplishment report. The guidelines continue to be followed as a long-term benefit to prevent contamination of maple syrup.

(4) Results of laboratory investigations with state-of-the-art equipment will lead to the development of new procedures to detect pesticides in food and drinking water. **Theme: Food safety;**

Water quality, Human health

This objective has been addressed, and accomplishments/impacts have been reported in the first three annual accomplishment reports.

(5) Field and laboratory studies will reveal when *E. coli* enters cider production during the fall and will clarify the natural history of *E. coli* in orchards. **Theme: Foodborne illness; Food safety, Human health**

This objective has been completed. Accomplishments/impacts were reported in the first four annual reports.

Allocated Resources. Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 2004.

	Fiscal Resources				Human Resources	
	Federal*		State		Scientist Years	
Years	Target	Actual	Target	Actual	Target	Actual
1999	$114,550	$114,951	$341,700	$252,328	2.6	2.4
2000	$114,550	$138,764	$341,700	$296,896	3.0	2.6
2001	$114,550	$141,277	$341,700	$419,336	3.0	3.9
2002	$114,550	$155,273	$341,700	$312,448	3.1	3.6
2003	$114,550	$122,824	$341,700	$294,071	3.1	2.9
2004	$114,550	$129,014	$341,700	$277,546	3.1	2.8

*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 1. To annually increase the research and knowledge base available from CSREES partners and cooperators on environmental sciences and agriculture, including conserving, maintaining, and protecting ecosystem integrity and biodiversity.

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

Output Indicators. (1). The numbers of publications, talks, and interviews given by scientists were tabulated annually to document communication to stakeholders. During state FY 2004, there were 25 senior-authored publications and 392 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 39 during this reporting period. Letters from stakeholders regarding Station programs 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 that protect the environment. See outcome indicators below for specific results.

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

Outcome Indicators.

(1) Laboratory experiments will reveal more efficient, cost-effective methods of applying nutrients to greenhouse-grown tomatoes and other crops. **Theme: Nutrient management**

Description: Vegetable growers produce tomatoes in greenhouses to satisfy consumer demands for fresh and native vegetables with improved taste and nutritional qualities. Tomato cultivars of greenhouse tomato are available to the 40 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 tested in greenhouses with different fertilizer regimes. Twenty-one cultivars were evaluated over a 4-year period for yield and fruit quality when adequate but not excessive amounts of nitrogen and potassium were used as fertilizer.

Accomplishment/Impact: Cabernet, an open-pollinated beefstake cultivar, had the highest yield (at least 12 pounds per plant). There was immediate short-term impact. Some growers have added Cabernet to their selection of cultivars and have implemented programs 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. In addition to having quality fruits, increased production, and reductions in amounts of fertilizers used, there will be long-term benefits associated with less run-off 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 the 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: Stakeholders are concerned about elevated levels of nitrate in the ground water and Long Island Sound. Unlike inorganic fertilizer, nutrients in compost are not immediately available but are released slowly at a rate in which plants can use for optimum growth. Utilization of compost as a soil amendment could reduce the need for commercial inorganic fertilizer and also reduce the possibility of surface and ground water contamination. Experiments were conducted in the field to determine if leaf compost could partially replace inorganic fertilizers in vegetable production.

Accomplishment/Impact: Butternut squash, unlike tomatoes and peppers, requires the full rate of inorganic fertilizer, even with compost, to achieve optimal yields. These results had immediate impact because stakeholders now know that leaf compost is insufficient. This practice,

however, is suitable for finding uses for leaf compost and promotes sustainable agricultural. In urban areas, gardeners have begun to use leaf composted material. The expected long-term benefits of using composted materials will be a cleaner environment with less accumulated leaf compost.

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**).

Description: Fertilizers have widespread use by commercial growers and homeowners. There is concern by users that some commercial fertilizers might be deficient in certain nutrients. Accordingly, samples of fertilizer products were analyzed.

Accomplishment/Impact: Of the 179 fertilizer samples tested, 66 (37%) products were deficient in nutrients; 49 samples were deficient in one or more of the proximate analytes. Common deficiencies in iron, manganese, zinc, copper and boron were noted. These results had short-term benefits because manufacturers were notified of the results so that corrections could be made. Private individuals and commercial growers learned which products were in compliance with guarantees stated on the label. Customers were reassured that products were being monitored. Long-term benefits include reduced economic risks associated with inferior products and less environmental pollution of soil, surface waters, and ground water.

Sources of funds: Hatch, state, and Environment Protection Agency

Sources of impact: state-specific

Accomplishments also apply to goal #1 (**Themes**: **Home lawn and gardening; Plant production efficiency; Human health; Food safety; Agricultural waste management).**

(4) Laboratory analyses will identify which mosquito species are important in the transmission of eastern equine encephalitis and California group encephalitis viruses so that there will be minimal use of pesticides for control in forested areas and a more precise time interval defined for application of pesticides. **Themes: Biological control; Integrated pest management; Pesticide application; Other (Wildlife science)**

Description: Surveillance for encephalitis viruses in mosquitoes is an important component of public health programs. The West Nile encephalitis virus has spread quickly to western United States following the initial discovery in Connecticut and New York in 1999. To meet the immediate needs of stakeholders to learn if mosquitoes are infected, a statewide mosquito surveillance program was expanded to include 91 trapping sites in 72 municipalities to detect viruses in the environment.

Accomplishment/Impact: There were 278 isolations of West Nile virus from 9 species of mosquitoes, based on analyses of 192,412 mosquitoes. The majority of the isolations were from densely populated urban and suburban areas of southern Connecticut. Public health officials were notified, and residents were advised to take precautions from mosquito bites. 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 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. Considering the widespread occurrence of WNE virus in birds and mosquitoes, the annual surveillance and research programs offer long-term benefits because patterns of virus prevalence in the environment 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 program 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 and granulocytic anaplasmosis (formerly known as ehrlichiosis) 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 inform stakeholders. **Themes: Integrated pest management; Pesticide application and management; Other** (**Emerging infections; Wildlife science)**

Description: *Borrelia burgdorferi* and *Anaplasma phagocytophilum* (formerly *Ehrlichia phagocytophila*) cause Lyme disease and granulocytic anaplasmosis, respectively, in horses, dogs, and humans in the United States and Europe. Both pathogens are transmitted by *Ixodes scapularis* ticks in eastern United States and by related ticks in western United States and Eurasia. At the request of dairy farmers in Connecticut, antibody tests were developed to determine if cattle were

exposed to either or both bacteria. Enzyme-linked immunosorbent assays were relied on in this multistate, integrated project to provide evidence of infections.

Accomplishment/Impact: Cattle were exposed to both agents, but prevalence of antibody-positive sera was significantly greater for Lyme disease than ehrlichiosis. There was scant evidence of co-infections and clinical disease, however. These results had immediate impact. Cattle owners and veterinarians learned that both diseases were of minor importance, unlike these infections in humans, horses, and dogs. A small biotechnology firm 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 a new emerging animal and human disease, granulocytic anaplasmosis, 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 Lyme disease spirochete (a bacterium) to a wide range of mammalian and avian hosts in North America. This tick also transmits pathogens that cause human babesiosis, human granulocytic anaplasmosis, and equine and canine ehrlichioses. Homeowners have requested assistance on developing methods of controlling these ticks, preferably non-chemical control, in localized settings around homes. A device developed by the USDA, called the 4-poster, delivers acaricide to deer when they feed at the equipment. The 4-poster device was evaluated for its ability to control ticks at a site in Old Lyme, Connecticut.

Accomplishment/Impact: Treatment of deer over a 5-year period resulted in a 69% reduction in the nymphal tick population at the study site. The immediate benefit of this work is that the 4-poster device seemed to have a positive effect on reducing ticks, a result that parallels findings for other tick species in southern states. The field experiments have been expanded to determine if the device works similarly in different habitats where deer and ticks are abundant. Collaborative efforts have been developed with the Connecticut Department of Public Health, the Centers for Disease Control and Prevention, and officials in the following Connecticut towns: Westport, Weston, Salisbury, Canaan, Cornwall, and Groton. The expected long-term benefits are decreased tick populations, less human disease, reduced impact on beneficial insects, and a cleaner environment.

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

Scope of impact: 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**).

Description: Overpopulation of deer has led to crop damage, destruction of natural and ornamental plants, automobile accidents (about 3,300 per year), and the rise of ticks that transmit bacterial and protozoan agents to humans and other mammals. A new fertility control method is being evaluated for deer. The sterilization technique consists of injecting a sclerotizing agent into the cauda epidymis of tranquilized males. The process causes a scar to develop within the epidymis, thus blocking the flow of sperm. At the request of the nursery industry, new studies have been initiated to track deer movement in forests, estimate population densities, and to control deer by this humane sterilization method. Investigations in Connecticut are integrated (research and extension) in an approved multistate project NE-1005.

Accomplishment/Impact: Analyses of 27 treated males indicate that the sterilization method is working. Treatment did not affect antler development, mating, or mate-guarding behavior. These findings had immediate impact. Scientists in other states are now using this method in deer management programs. The expected long-term benefits of improved deer management programs are lower deer populations over broad areas, a reduction of deer damage to homeowner and nursery plants, and fewer automobile accidents. Decreasing deer herds will also improve the health of forests by reducing damage to regeneration of valuable species, including oak. Effective deer management along with proper silvicultural practices would enhance the value of the Connecticut forest by an estimated $500 million, and, like homeowners' properties, would improve the aesthetic quality of lands.

Sources of funds: Hatch and state.

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

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 pesticide residues in air, water, food, or soil samples submitted by state regulatory agencies. **Themes: Air quality; Hazardous materials; Pesticide application**

Description: The Department of Analytical Chemistry analyzes samples for state agencies and municipalities. During this reporting period, there were suspected dog poisonings. At the request of the Connecticut Department of Environmental Protection, animal food was analyzed for pesticides and other compounds.

Accomplishment/Impact: Results of analyses provided an immediate answer. The samples contained large amounts of the insecticide, diazinon. Four samples contained pentobarbital. These findings had immediate impact. A superior court judge issued an arrest warrant against the alleged perpetrator, a local veterinarian. The long-term benefits are that the analytical procedures used were effective at detecting diazinon and pentobarbital and can be used in similar future cases to clarify unexplained mortality in pets. In addition, the US Food and Drug Administration and US Department of Agriculture have selected analytical chemists at the Station to cooperate with them and those in 3 other state laboratories to establish the Food Emergency Response Network to address counter-terrorism activities. This program expands the ongoing cooperative agreement between the Centers for Disease Control and Prevention and the Connecticut Department of Health.

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. Results and impact statements were reported in the previous four annual accomplishment reports

(9) Field and laboratory experiments will determine the growth of woody and herbaceous nursery crops in media amended with biosolids compost and if this nutrient source is suitable for commercial use. **Themes: Agricultural waste management; Ornamental /green agriculture; Biobased products; Recycling; Other (Biosolids compost)**

This objective has been completed. Results and impact statements were presented in the first three annual accomplishment reports.

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

Description: Scientists continue to work with commercial nursery growers on an integrated project to promote adoption of IPM practices. Five nurseries received intensive on-site assistance. Detailed pesticide records from two nurseries were used to calculate changes in pesticide use (pre- and post-IPM adoption) attributed to increased adoption of IPM strategies. Two of these firms have

large production facilities located near residential areas or close to Long Island Sound, where sensitive ecosystems exist. In addition, assistance was requested to develop an IPM program for Rhododendron Leafminer so that pesticide costs could be reduced.

Accomplishment/Impact: Overall, insecticide/miticide usage decreased by 103 pounds, compared to pesticide use records before IPM programs were established. This translated into a short-term benefit of a combined $1,141 decrease in cost for insecticidal product. After IPM programs were established for Rhododendron Leafminer in two nurseries, there was an average net return of $15,000 per acre from more efficient control efforts. Participants were asked to complete a questionnaire regarding the IPM program. One responded that the program as excellent, while the remaining four respondents gave a good rating. All participants stated that they would recommend the IPM program to other nursery growers. Acceptance of the IPM effort is an important short-term benefit and a departure from previous practices of excessive 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 effective. This change in attitude among growers will help achieve other expected long-term benefits of more widespread acceptance of IPM programs 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: Liverwort (*Marchantia polymorpha*) is a troublesome weed in greenhouses and in container nursery production operations. This plant is spread by spores instead of seeds. Most of the standard herbicides used in nursery production are ineffective at controlling this plant. At the request of stakeholders, experiments were conducted to identify more effective control measures. These tests were performed in two Connecticut nurseries with a focus on liverwort management in containers with Japanese andromeda and mountain laurel.

Accomplishment/Impact: Flumioxazin spray and an oxadiazon plus copper sulfate treatment provided the best control. Herbicide injury to both types of ornamental plants was minor. There was short-term impact because nursery managers are now using flumioxazin, a new herbicide. Compared to the costs of hand-weeding potted plants, the use of this herbicide can save growers about $4,000 per acre. The expected long-term benefits are that growers will have an economical and useful option for the control of noxious weeds, quality products to sell, and increased market share.

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 2004.

	Fiscal Resources				Human Resources	
	Federal*		State		Scientist Years	
Years	Target	Actual	Target	Actual	Target	Actual
1999	$205,373	$205,057	$1,310,000	$1,446,155	15.5	17.1

2000	205,373	$222,280	$1,410,000	$1,510,458	16.0	17.1
2001	205,373	$207,127	$1,410,000	$1,600,558	16.0	18.6
2002	205,373	$139,394	$1,410,000	$1,721,621	16.5	16.5
2003	205,373	$200,222	$1,410,000	$2,012,206	16.5	20.8
2004	205,373	$240,392	$1,410,000	$2,092,815	16.5	22.5

*Federal Hatch funds only.

Multi-Institutional, Multi-Disciplinary, and Multistate Programs

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 programs (Tables 1-3). Table 4 shows a distribution of funds for this part of the research program and the ≥25% required amounts for formula funds. Table 5 shows integrated activities with extension systems in land-grant universities, while Table 6 and Table 7 report actual distributions of Hatch and state matching funds for federal FY 2004. The CRIS code for The Connecticut Agricultural Experiment Station is CONH.

Table 1. Multi-Institutional (FY 2004)

Hatch Project	CRIS Access.#	Collaborating institutions and businesses
CONH 134[c]	0183796	U.S. Environmental Protection Agency (EPA)
135[c]	0187947	None
136	0188720	CT Dept of Consumer Protection, US EPA
137[b]	0198865	CT Dept. of Consumer Protection, US EPA, US FDA
138[b]	0199518	US EPA
240[c]	0188383	Yale University, Univ. of Oxford (UK)
241	0191156	Yale University
242	0191890	Yale University
243[b]	0198426	Yale University

244[b]		Yale University
344[d]	0078445	Centers for Disease Control (Atlanta, GA and Fort Collins, Co), Georgia Southern Univ. (Statesboro), IDEXX Laboratories (Westbrook, Maine), Yale Univ., Univ. of Connecticut (Storrs), University of Iowa, University of Texas (Houston), L^2 Diagnostics (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., Univ. of Maine, Univ. of Mass, Univ. of New Hampshire, Univ. of Rhode Island
378[b,d]	0195135	University of Connecticut (Storrs), Univ. of Massachusetts, Cornell University
380[b,d]	0198512	Cornell University, Univ. of Massachusetts
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	0191645	CT. Dept. of Agriculture
563[d]		CT. Vegetable Producers, CT. Greenhouse Growers Assoc.
565[a,b,d]	0198286	Cornell Univ., Michigan State Univ., Rutgers Univ., CT. Vegetable Producers, CT Greenhouse Growers Assoc.
566	0201194	Cornell Univ., Penn. State. Univ., Univ. of Maryland
577	0201745	Univ. of Massachusetts, Cornell Univ.
625[d]	0178255	Yale Univ., Univ. of CT (Storrs), Cornell Univ., Wageningen Agric. Univ. (Netherlands)
628	0187597	USDA Forest Service
630[d]	0195468	University of CT (Storrs), Michigan State Univ., Penn. State Univ.

633[b,d]	0199708	Cornell Univ.
634[a,b,d]	0200180	Cornell, Penn State, Michigan State., Univ. of Rhode Island, Florida
695[a,d]	0139748	Univ. of Mass., Cornell Univ. (Ithaca & Geneva), Penn. State Univ., Univ. of CT (Storrs), Univ. of Rhode Island, Michigan State Univ., Univ. of Florida
766[c]	0181763	Biolog. Bundesanstalt fuer land-und Forstwirtschaft (Germany)
768[a,d]	0170382	Several states cooperating on S-301, USDA/ARS Center for Med. Agric. & Vet. Entomology
769[c]	0187670	State of CT. Dept. of Transportation
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
804[c,d]	0179283	Univ. of CT (Storrs)
805	0198560	Univ. of CT (Storrs)

[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 2004).

Hatch Project		Scientific Disciplines
CONH	134	analytical chemistry, food production systems
	135	analytical chemistry, food production systems
	136	analytical chemistry, toxicology
	137	analytical chemistry, toxicology
	138	analytical chemistry, toxicology
	239	plant biochemistry, molecular genetics, plant physiology, immunology
	240	plant biochemistry, molecular genetics, plant physiology
	241	plant biochemistry, molecular genetics, plant physiology

242	plant biochemistry, molecular genetics, plant physiology
243	insect pathology, molecular biology
244	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
551[a]	horticulture, plant pathology, plant genetics, entomology
559	animal behavior/ecology, deer management
560[a]	animal behavior/ecology, deer management
562[a]	horticulture, plant physiology
563	horticulture, plant physiology
565[a]	horticulture, plant physiology
566	animal behavior/ecology, deer management
567	horticulture, plant genetics
625	meteorology, plant pathology, epidemiology, biophysics, biological control
628	plant pathology, mycology
630	mycology, plant pathology, horticulture, IPM
633	meterology, plant pathology, biophysics
634[a]	nematology, plant pathology
695[a]	nematology, plant pathology
766	environmental toxicology, soil chemistry
768[a]	protozoology, invertebrate pathology, entomology
769	soil microbiology, horticulture, composting
770[a]	soil chemistry, environmental toxicology
771	soil and water chemistry, environmental toxicology
772	environmental toxicology, soil chemistry

804	analytical chemistry, horticulture, weed management
805	analytical chemistry, horticulture, weed management

[a]USDA approved multistate research project.

Table 3. Multistate Collaborations (FY 2004).

Hatch Project	CSREES Multi-state Project Number	Participating states
CONH 134		
135		
136		
137		
138		
240		
241		
242		
243		
244		
344		CT*, GA, IA, SC, TX
371		CT*, NY
375	NE-187 [a]	CT*, FL, ME, MD, MA, NJ, NY, PA, RI
377		CT*, MA, ME, NH, NJ, RI
378		CT*, NY
380	NE-009[a]	CT*, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, WV
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		
563		
565	NE-1017[a]	CT*, MI, NJ, NY

566		MD, NY, PA
567		MA, NY
625		CT*, NY
628		
630		CT*, FL, MI, PA, WA
633		NY
634	NE-1019	CT*, FL, GA, MA, MI, NY, PA, RI, SC, WV
695	NE-171 [a]	CT*, FL, MA, MD, MI, NY, PA, SC, WV
766		
768	S-301 [a]	AL, AR, CA, FL, GA, ID, IL, KY, LA, ME, MN, MS, NJ, NY, NC, SC, TN
769		
770	W-082[a]	AR, AZ, CA, CT*, FL, HI, IA, IN, KS, MN, MT, NV, NY, WA
771		
772		NY, VA
804		CT*, MA
805		CT*, MA

[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 1999, FY 2000, 2001, 2002, 2003, and 2004 data for Multi-Institutional, Multi-Disciplinary, and Multistate Projects.

			SY units	
	Connecticut		Multi-	Total
Fed. Hatch Funds	State Funds	Total	Categories	Hatch Program
FY 99 $375,854	$1,287,854	$1,663,282	15.7	37.3
FY 00 $392,951	$1,579,780	$1,972,731	15.9	37.3
FY 01 $354,106	$1,668,647	$2,022,753	18.1	40.8
FY 02 $346,197	$1,769,108	$2,115,305	15.9	38.5
FY 03 $351,342	$1,598,218	$1,949,560	17.1	39.2
FY 04 $359,080	$2,390,848	$2,749,928	21.9	40.8

Total funds available for entire Hatch program (FY 2004) at C.A.E.S.	$760,964
% Hatch funds dedicated to multi-institutional, multi-disciplinary, and multistate programs	47.2%

Table 5. Integrated research activities between The Connecticut Agricultural Experiment Station (C.A.E.S.) and extension programs in land-grant universities during federal FY 1999, 2000, 2001, 2002, 2003, and 2004.

				SY units	
	Fed. Hatch Funds	Connecticut State Funds	Total	Integrated only	Total Hatch Program
FY 99	$288,340	$977,827	$1,266,167	8.5	37.3
FY 00	$298,777	$1,022,467	$1,321,244	8.1	37.3
FY 01	$260,671	$1,181,464	$1,442,135	10.6	40.8
FY 02	$255,442	$1,328,591	$1,584,033	9.9	38.5
FY 03	$309,537	$1,453,215	$1,762,752	14.4	39.2
FY 04	$343,697	$2,002,629	$2,346,326	19.5	40.8

Total funds allocated to entire Hatch program at C.A.E.S. in FY 2004	$760,964
% dedicated to all multi-categories and integrated activities with CT and other states	45.2%

The Connecticut Agricultural Experiment Station dedicated Hatch funds to integrated activities with extension systems in land-grant universities in different states. In Connecticut, $247,075 was dedicated to integrated activities in FY 2004 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 Multi-Institutional, Multi-Disciplinary, Multistate, and Integrated Activities for federal FY1999, 2000, 2001, 2002, 2003, and 2004.

	Federal Hatch*	State funds*	Scientist Years
Projected	$260,360	$845,500	10.0
Actual (FY1999)	$288,340	$977,827	8.5
Actual (FY2000)	$298,777	$1,022,467	8.1
Actual (FY2001)	$260,671	$1,181,464	10.6
Actual (FY2002)	$255,442	$1,328,591	9.9
Actual (FY2003)	$309,537	$1,453,215	14.4
Actual (FY2004)	$343,697	$2,002,629	19.5

*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 program for federal FY1999, FY2000, FY2001, FY2002, FY2003, and FY2004.

	Total Federal Hatch	Total State Match	Total SY
Projected	$767,627	$4,068,700	36.8
Actual (FY1999)	$768,626	$3,957,042	37.3
Actual (FY2000)	$768,473	$4,188,037	37.3
Actual (FY2001)	$767,020	$4,510,502	40.8
Actual (FY2002)	$766,911	$4,712,285	38.5
Actual (FY2003)	$760,541	$4,483,825	39.2
Actual (FY2004)	$760,964	$4,599,418	40.8

Progress Reports: Integrated Activities

(Hatch Act Funds)

Federal FY 2004

Program descriptions: As presented in form CSREES-PLAN (2/00), 11 programs (13 Hatch projects) were listed for integrated activities (Hatch Act Funds). In a previous section of this Annual Report of Accomplishments and Results (including the Tables), descriptions and impact statements are given regarding progress made on the planned integrated and other programs. Form CSREES-REPT (2/00) reporting expenditures for FY 2004 follows brief research summary statements for these specific programs.

1. Tick-borne infections: Lyme disease and granulocytic anaplasmosis are prevalent in northeastern United States. Dairy farmers asked for assistance to determine if their cattle were exposed to the bacterial pathogens for Lyme disease and anaplasmosis. Serologic tests were developed to detect antibodies. Cattle living in tick-infested areas were exposed to either or both agents, but there was no evidence of disease. Aside from the immediate benefits of determining prevalence of antibody-positive animals, technology for this new test has been transferred to a biotechnology company, which is considering commercialization of antibody assays for veterinary diagnostics.

2. Managing insects on vegetable crops: A workshop on organic farming practices was held during the first year of this five-year Plan of Work. In addition to convincing stakeholders (i.e., vegetable growers) that sustainable agricultural and IPM practices can be effective, there is new interest among restaurant owners, academic administrators, and land care professionals. Yale University has dedicated a dining hall for serving locally grown organic foods, and land care professionals have

reduced their use of synthetic insecticides and synthetic fertilizers. These efforts will reduce health risks associated with pesticides.

3. Plant genetic resources (NE-9): Research continued on the control of flea beetles on vegetable crops. Of the products tested, Spintor had the lowest level of flea beetle damage on leafy brassica plants. This product contains spinosad, a microbial product, which will become available in an organically acceptable formulation. This new product will lead to a cleaner environment and reduced human exposure to more toxic insecticides.

4. 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. Studies were conducted to determine if there were parasitic wasps that could be used in biological control programs. No parasites were found. Stakeholders were informed that well-timed pesticide treatments would prevent plant damage and ensure a quality crop. An expected long-term benefit of these findings is profitability for growers.

5. Integrated pest management (IPM) for Connecticut nurseries: five nurseries continued to receive intensive on-site assistance to implement and evaluate IPM practices. Examination of pesticide records for two small nurseries showed that insecticide/miticide usage decreased by 103 pounds of product due to more efficient farming practices. This resulted in a savings of $1,141 for growers. In other work, economic analyses were performed for two nurseries where IPM practices were

implemented for a rhododendron leafminer problem. There was increased plant production and an average net return of about $15,000 per acre as a result of the IPM program. Growers have become more enthusiastic about implementing IPM programs. 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.

6. Management of insects in soil and other pests (includes NE-187): Black vine weevils are major pests of strawberries. At the request of growers, 21 commercial varieties of plants were evaluated for resistance to this insect. Five cultivars were resistant to adult beetles, but these and the other cultivars were susceptible to the larval beetles. Further selective breeding of plants is needed to identify a cultivar which can be used by growers in IPM programs to meet long-term benefits of reducing pesticides in the environment.

7. Evaluation of new apple cultivars (NE-183): Work continues on the evaluation of 30 apple cultivars for resistance to fungal infections. The cultivar “Suncrisp” had the slowest growth rate for bitter rot fruit infection. This new information had immediate impact because fruit growers can more efficiently select the most desirable cultivars for their farms to reduce pesticide use and farm costs.

8. Suppression of soil-borne diseases: Replicated field trials were continued from the previous year’s work. By using eggplants grown in infested soil, the incorporation of cruciferous crop residues reduced the impact of Verticillium wilt, thereby, 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 programs, and reduced human exposure to pesticides.

9. Analysis of risk for plant diseases: Studies on the dispersal of apple scab spores have been completed. The positive results on modeling have led to new work on assessing drift of corn pollen from genetically modified (GM) plants. Wind can potentially transport pollen several miles, but dilution of the pollen cloud and competition from local pollen sources limits dispersal during moderate weather conditions. These results had immediate impact because state regulatory officials are considering the expansion of the buffer zones between GM corn plantings and non-GM organic or conventional production fields. The long-term benefits of this work will be more efficient management of GM and non-GM modified crop systems, reduced risks of cross pollination from transgenic plants, and reduced public relations problems.

10. Integrated pest management of plant parasitic nematodes (NE-171): *Pratylenchus penetrans* causes root damage of strawberries, which can lead to fungal infections. Experiments were conducted in the field to evaluate the influence of rotation and green manure crops for nematode control. Rotation and green manure crops controlled nematodes as passive non-hosts or as active antagonists, producing nematicidal compounds. 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.

11. Herbicides/weed control: Weeds growing in potted greenhouse or nursery-grown plants reduce quality and require costly herbicide treatments. Liverwort (*Marchantia polymorpha*) is a

troublesome weed that needed attention. This plant is spread by spores instead of seeds. Flumioxazin spray and an oxadiazon plus copper sulfate treatment was most effective. Nursery managers are now using this control method to ensure quality products. The expected long-term impact is continued profitability.

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results
Multistate Extension Activities and Integrated Activities
(Brief Summaries Precede This Page)

Institution The Connecticut Agricultural Experiment Station (New Haven)
State Connecticut

Check one: ___ Multistate Extension Activities
_X_ Integrated Activities (Hatch Act Funds)
___ Integrated Activities (Smith-Lever Act Funds)

	Actual Expenditures				
Title of Planned Program/Activity	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Tick-borne infections	$ 61,204	$42,307	$44,475	$42,671	$27,655
Managing insects on vegetable crops	6,367	7,294	5,503	361	804
Plant genetic resources (NE-9)	9,117	2,581	1,672	219	805
Managing insects in apple orchards	68,890	61,222	58,148	40,782	33,795
IPM for Connecticut nurseries	4,649	2,511	2,603	279	10,111
Management of insects in soil (NE-187)	1,722	9,915	11,277	586	1,344
Evaluation of new apple cultivars (NE-183)	1,699	4,346	58,992	9,251	395
Suppression of soil-borne diseases	44,279	8,875	9,657	62,592	10,910
Analysis of risk for plant fungal disease	17,989	54,833	8,017	13,323	1,718
IPM for management of plant nematodes (NE-171)	69,690	63,654	55,098	56,001	101,377
Herbicides/weed control	13,171	3,133	17,623	47,283	24,926
Total	$298,777	$260,671	$255,442	$273,348	$213,840

_____ _____
Director Date

Form CSREES-REPT (2/00)

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 programs 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 2004 are described below as they relate to specific goals and procedures outlined in the Station's approved Plan of Work to assist the under-served and under-represented. The stated goals for these programs are consistent with USDA management goals on multi-cultural diversity issues.

Goals & Procedures: Program Delivery

Special efforts were made to reach under-served and under-represented groups during this reporting period. A notice was sent to members of 24 organizations serving protected groups to invite minorities to apply for positions and participate in existing research programs. Career specialists in two 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 programs, and to disseminate research findings to stakeholders.

A special initiative, started earlier, was continued during this reporting period. In an effort to attract minority students to agricultural research and to train these persons for future work, a joint program between The Connecticut Agricultural Experiment Station and the Sound School in New Haven was reaffirmed. An entomologist (White Female) at the Station assisted on writing a grant proposal for USDA funds in a previous reporting period. The program was awarded, and during federal FY 2003, one Hispanic male, one Black female, one Hispanic female, and a White male worked under the supervision of three White male and one White female scientists. During FY 2004, one White male, one Black male, one Hispanic male, and one Hispanic female worked with one White male and one White female scientists. This program had immediate impact. It encouraged minority student participation in Station programs, 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 program has ended.

Construction of a new building (Johnson-Horsfall Laboratory) is near completion. 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 methods of access to meet ADA requirements.

A cottage, located in a woodland area adjacent to open 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.

The rise in the Hispanic population in Connecticut has resulted in changes in the state's labor force. For example, 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. The courses included topics on tree structure, biology, and on pruning techniques. A new

initiative has begun. In cooperation with personnel in the Connecticut Department of Environmental Protection and extension at the University of Connecticut, plans are being made for this forester to teach the arboriculture courses in neighborhoods of Hartford and Bridgeport. Contacts are being made with Hispanic civic groups to organize the program. In addition, fact sheets on mosquitoes and ticks, written in Spanish, were made available to Hispanic stakeholders in Connecticut.

Goal 1: Annual public events will be scheduled to meet the needs and interests of all stakeholders, including those of under-represented groups 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 distributed to state legislators and the Associates' membership, and announced through the media (newspapers and a radio station). 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 19, 2004) and summer (August 4, 2004) in the main auditorium and Lockwood Farm, respectively. Notifications of these events were made as described above.

About 800 persons, including minorities, attended the Plant Science Day event held in August at the Station's main research farm (Lockwood Farm) in Hamden, Connecticut. Minorities attended the event and had opportunities to meet scientists and to see 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 improved bird/butterfly demonstration garden plot to allow better access for all persons. About 75 citizens attended the Plant Science Day in the spring at the Station's main auditorium in New Haven. Selected laboratories were opened for public inspection. To reach other minorities, the Station participated in Farm/City Week, 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 programs, 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 plowing garden plots and assisting on solving insect and plant disease problems. Groups of stakeholders will be invited to see experimental plots on Station-owned farms.

Report: During each spring, the Station farm manager at Lockwood Farm in Hamden, Connecticut and his assistants plowed inner city garden plots in New Haven for no fees. 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. As in the past, minority students from New Haven were allowed to grow vegetables at the Station farm in Hamden. These efforts had many short-term benefits. Stakeholders learned about agriculture, became familiar with Station staff, and brought home fresh produce to their families. Including vegetables in their diets improved nutrition. Entomologists and plant pathologists gave assistance, as needed, to minimize pest problems. 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.

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. Apples and potatoes from Station farms were distributed to elderly residents at a fall event. 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 programs. 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 program 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 Plan of Work and in the first four 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 White female was granted educational leave to pursue her Ph.D. One Black female and two White males were hired as a Postdoctoral Research Scientists in FY 2004. 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. 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 four high school students during the summer of FY 2004 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 farm. To help stimulate student interest in Station research programs, a White male scientist gave talks on insects to elementary students in five schools located in four towns 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 programs and to hire college students as Summer Research Assistants. 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 2004, two Black males, one Black female, one Hispanic male, and one Hispanic female were hired along with 17 white males and 20 White females to learn new skills. Efforts have been made to locate qualified minority students. Contacts with college and university professors have been very helpful.

A volunteer program is available for students to work part-time during the summer and school year. One White male assisted entomologists and learned new skills. Training gained by this person strengthened his educational background by providing "hands-on" experience.

To assist the under-served and under-represented in more advanced research, a workforce of two Other males, two Other females, one Black female, and two White males were employed as Postdoctoral Research Scientists. One Other female, who was a Postdoctoral Research Scientist in previous reporting periods, was promoted to Assistant Scientist II. The training these minorities received from four White male scientists improved their qualifications for future permanent employment and upward mobility. Funds from federal grants, including those from USDA, enabled these persons to work in FY 2004 under the direct mentorship of established scientists.

Special Crops Program

Stakeholders of different ethnic groups continue to receive the Station's assistance on growing specialized crops, such as arugula, radicchio, okra, jilo, leeks, artichokes, sweet potatoes, Calabaza (squash), and Chinese cabbage. Sweet potatoes are very popular at farmers' markets. Jilo is popular among Brazilians and is in demand 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 program has enhanced contacts with minorities. In response to stakeholder requests, another Station scientist is conducting field studies to find desirable cultivars of arugula and 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. There is continued interest from members of the Pequot Tribes to establish greenhouses for tomato production. Four Station scientists continue to cooperate 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 2004, $33,971 was awarded to small contractors. This amount greatly exceeded the state-approved goal ($12,874). There were 15 Minority Business Enterprise set-aside purchases and contracts worth $29,036, which also greatly exceeded the state-approved goal of $3,219. 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 38 Hatch projects listed, 21 (55%) have multistate affiliations. Scientists at The Connecticut Agricultural Experiment Station continue to interact with colleagues in at least 40 other states. The 8 USDA-approved multistate projects (NE-009, NE-171, NE-183, NE-187, NE-1005, NE-1017, S-301, and W-082) include an extensive blend of scientific expertise for research and extension.

There are 11 programs (including 13 Hatch projects) identified as 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 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, human /animal health, or social benefits. We affirm that our program is meeting the stakeholders' needs as described in the Plan of Work and in this annual accomplishment report. The critical issues stated in each of the program goal sections of the Plan of Work are based mainly on stakeholder input. Contact with stakeholders is a continual process, and research programs 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 and accidental introduction of exotic wood-boring insects. Expanding the clientele of stakeholders, including minorities, and increasing their involvement in

research programs remains a high priority. Farmers, who work along with scientists on solving problems, provide valuable space for experimental plots. These stakeholders benefit by having continual discussions with scientists and by receiving early results. We recognize the need to obtain financial data, whenever possible, to more clearly show profitability and impact of our research programs. 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. 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.

Research goals 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; food safety; 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 programs receive help from scientists in other states.

As described in this section of the accomplishment report, efforts are being made to identify and meet the needs of the under-served and under-represented. The main laboratories of the Station are located in New Haven. This has helped staff members meet and work with minority groups in an urban setting. Other initiatives being carried out at our Valley Laboratory in Windsor 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 ethnic crops that they desire, 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 programs 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, food-sharing programs, and senior citizen groups 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 programs and outreach efforts are successful in addressing the needs of a broader base of under-served and under-represented persons. Continual program expansion is needed, however, to assist more individuals.

The multistate, multi-institutional, and multi-disciplinary programs continue to increase 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. Examples of improved efficiency resulting from recent research include the application of sensitive and specific chiral gas chromatography with ion trap spectroscopy methods for detecting chlordane residues in soil and air; implementation of IPM programs to monitor pest problems and reduce costs of controlling

plant pathogens and insects; finding uses for biowastes; and developing more sensitive and specific diagnostic tests for human and veterinary diseases associated with ticks. 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 activity (research/extension) remains productive and meaningful. Good progress continues to be made on reducing the potential for environmental contamination by pesticides and other organic chemicals in agricultural systems. For example, interactions of scientists from 14 states (W-082) have helped to develop chemical methods to remove certain pollutants from contaminated soil and water. 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 programs. The inclusion of research/extension specialists in other USDA-approved projects, such as NE-009, NE-171, NE-183, and NE-187 and NE-1005, NE-1017, and S-301 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 programs 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 brochure on native alternatives for invasive ornamental plant species is very popular among nursery growers and the public. A turf manual on the management of pests is nearly sold out. A tick management handbook has been distributed to hundreds of people nationally. Technology transfer publications on forest insect pests have been produced and made available to the public. More stakeholders, however, need to be encouraged to access national databases for results of USDA-approved multistate programs. Greater public awareness of USDA internet programs is needed. A homepage exists for NE-171 "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 and programs. The feedback from growers and other stakeholders continues to be positive. Finally, there is growing public concern over possible terrorist attacks. Stakeholders have asked questions about how we are protecting our food supply. Joint efforts between the Station and US FDA have begun to address counter-terrorism programs. The Station is officially participating in the Food Emergency Response Network program along with several federal partners and scientists in Florida, Minnesota, and New York.

In conclusion, the Station's multi-programs 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 program for basic research.

Certification

This fifth Annual Report of Accomplishments and Results was prepared by Dr. Louis A. Magnarelli, Director, with input from Station scientists and 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.

Dr. Louis A. Magnarelli, Director