2002 Annual Report of Accomplishments and Results

The Connecticut Agricultural Experiment Station

P.O. Box 1106

New Haven, CT 06504

March 1, 2003

Contact person:

Louis A. Magnarelli, Vice Director

Louis.Magnarelli@po.state.ct.us

phone (203) 974-8466

fax (203) 974-8502

TABLE OF CONTENTS

Executive Summary (Overview)

The Connecticut Agricultural Experiment Station ("Station") continues to serve the needs of all citizens. This institution is separate from the University of Connecticut. No federal funds are received for extension, but federal funds are received for research. Research findings are reported to the public. Whenever possible, 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 new problems, conduct relevant research, and to meet the needs of society.

Similar to the past two years, we are pleased to report progress that benefits citizens. 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, and water quality. The research programs at The Connecticut Agricultural Experiment Station are strongly supported by stakeholders, 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 are also of concern to 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 FY2002. The research results and impact statements are linked to FY2002 activities.

To enhance 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, and improving plant health and production. Multistate and integrated activities increase efficiency and enable us to make progress on a wide range of problems. Stakeholders have requested assistance on identifying vegetable and fruit plant cultivars that are resistant to plant diseases and insect infestations, treating diseased and infested plants with minimal amounts of pesticides or by cultural practices, and on growing vegetables organically. It is important to develop new analytical methods and to refine older methods in our efforts to detect 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 in Hatch/state-supported program **goal #1** are as follows:

1. A new analytical procedure (chiral gas chromatography with ion trap mass spectrometry) has been developed to quantitate chlordane residues in crops grown on fields where chlordane was used decades ago. Analyses of food collected in marketbasket surveys are underway. Consumers will benefit by knowing that their food is safe.
2. A computer model has been developed to assimilate rainfall data and biological information. This model can be used to predict fungus infectivity rates of gypsy moth caterpillars. Homeowners will benefit by not having to spray trees.
3. As a part of integrated (research/extension) activities on apple scab, a model has been developed to estimate probability of apple scab infection. The model synthesizes information on aerial dispersal of fungal spores, which spread within and between orchards. The model system can be added to existing IPM programs to help minimize the need for pesticide sprays. Fruitgrowers benefited by knowing when to spray. Results also apply to national **goal #3**.
4. Earlier studies showed that chromated copper arsenate (CCA) preservative of wood products (eg., picnic tables, decks, and garden borders) contaminates soil. New results indicate that romaine lettuce and Indian mustard greens grown near CCA-treated wood take up arsenic.
5. Recent field studies revealed that the smaller Japanese cedar longhorned beetle, a wood-boring pest

of arborvitae and cedar trees, has a broad geographic distribution in eastern United States. Nursery growers in several states have been alerted so that infested stock is not transported and that proper chemical treatment can be applied when necessary.

6. In a multistate research effort to improve IPM programs for weed control in vegetable plots, various cover crops were evaluated. Rye/vetch, rye alone, wheat, and winter-killed oats were most effective for weed control. Vegetable growers benefited by knowing how to control weeds with lower amounts of applied herbicides. Results also apply to **goal #3**.
7. As a part of integrated activities, field investigations were continued on an exotic insect pest (apple tortrix) in fruit orchards in northeastern United States. Apple tortrix caterpillars have been found feeding on 75 species of wild or cultivated woody plants. In addition to apple, suitable hosts include pear, European plum, Japanese plum, and sweet cherry. Pheromone trap data indicate that this pest has spread to 16 coastal counties in Massachusetts, Connecticut, Rhode Island, New York, and New Jersey. Fruitgrowers benefited by knowing where these pests occur, which crops are attacked, and when to control the insects. Also **goal #3**
8. A new species of Heterorhabditid nematode was discovered parasitizing black-vine weevil grubs, an important pest in strawberry and nursery fields. These nematodes have been added to existing IPM programs. Also **goal #3**.
9. In a multistate, integrated project, *Pratylenchus penetrans* (nematodes of potato) were extracted from the roots of a fall oat cover crop. Polynema marigold and sorghosudangrass cover crop rotations greatly reduced *P. penetrans* populations. Vegetable growers benefited by not having to use as much pesticide. Also **goal #3.**
10. As a part of multistate (NE-183) and integrated research, new apple cultivars were evaluated for disease resistance, yield, and fruit quality. Apple scab, a major problem in orchards, was at low incidence on Pioneer Mac, Braeburn, Creston, Fuji Red, Sport #2, Gala Supreme, Golden Delicious, Senshu, Shizuka, and Sunrise. In addition, Fortune, Gala Supreme, and Fuji Red Sport had good fruit size and yield. Fruitgrowers benefited by knowing which apple cultivars show promise for future production. Also **goal #3**.
11. Field evaluations of grape cultivars revealed that Villard Noir, Villard Blanc (a french hybrid cultivar), Seyval, and Chardonnay had high yields, produced high sugar content, and demonstrated hardiness by surviving a late spring frost. Grape growers benefited by knowing that these cultivars are suitable to grow in southern New England.

12. Field evaluations of calabaza (squash) revealed acceptable yields. Calabaza is an ethnic crop and is popular in farmers' markets. Consumers and vegetable growers benefited by having produce available for sale. Also **goal #3**.
13. Ten cultivars of leeks, an ethnic vegetable crop, were evaluated for yield. Two cultivars, Carina, Electra, and Leefall, had yields greater than 17,000 lb/acre. This is a new niche crop for growers. Vegetable growers and consumers benefited by having produce available for sale. Also **goal #3**.

Goal 1: Federal Hatch Funds ($472,244), State Funds ($2,678,216), Scientist Years (18.4)

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 in program **goal #2**, which had support from Hatch and state funds, are as follows:

1. In analyses of produce for captan, dicofol, permethrin, chlorothalonil, endorsulfan, iprodione, malathion, dieldrin, chloropyrifos, and vinclozolin, concentrations of compounds were usually well below tolerance levels established by the U.S. EPA. Rinsing fresh fruits and vegetables under tap water helps reduce pesticide residues. The general public benefited by knowing that the produce items were safe to eat and that washing produce was an effective practice.
2. Studies were conducted to determine if a 1% Palmolive solution or commercial wash products were effective in removing pesticide residues from produce. All products tested provided little or no reduction in removing pesticide residues, compared to tap water rinsings. These results answered citizens' questions.
3. The insecticide, chlordane, has been detected in produce despite the banning of this chemical decades ago. A new analytical procedure has been developed to quantitate chlordane concentrations. These methods have application for analyses of soil, air, and compost samples as well as produce.

Goal 2: Federal Hatch Funds ($155,273), State Funds ($312,448), Scientist Years (3.6)

Research objectives in program **goal #4** are designed to address a variety of environmental problems and issues that are of interest to stakeholders. Tick-associated diseases, such as Lyme disease, ehrlichiosis, and babesiosis, and mosquito-borne encephalitis viruses affect humans and domesticated animals. Veterinarians and public health officials have requested assistance on monitoring and diagnosing these diseases. There continues to be grower interest in plant nutrient management in greenhouses, initiating composting programs, and in implementing IPM programs.

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

1. When low amounts of nitrogen and potassium were used in greenhouses, the following tomato cultivars had high yields (13 pounds per plant): Cabernet, Cobra, Jet Star, Match, Parks 656, and Trust. Growers have made adjustments in reducing amounts of nitrogen and potassium used. Also **goal #3**.
2. Eastern Equine Encephalitis and West Nile Encephalitis viruses are transmitted by mosquitoes. West Nile Encephalitis is spreading in the United States. Public health officials and veterinarians rely on results of surveillance programs. During this reporting period, 137,199 mosquitoes, collected at 90 sites in Connecticut, were tested for viruses. Of the 9,085 pools of mosquitoes analyzed, one pool of *Culex pipiens* contained EEE virus and 14 pools of *Culex pipiens*, *Culex restuans, Culex salinarius*, and *Culiseta melanura* contained West Nile virus. This information was given to the public through the media and to federal, state, and local health officials. Stakeholders in endemic areas took precautions by using insect repellents and minimizing exposure to mosquitoes.
3. A new mosquito species has been detected in Connecticut. *Ochlerotatus japonicus,* native to eastern Asia, was found at 87 locations in all 8 counties of Connecticut. This mosquito is a potential vector of West Nile Virus. Also **goals #3 & 5**.
4. Enzyme-linked immunosorbent assays were developed to detect IgM and IgG antibodies to the recently renamed *Anaplasma (Ehrlichia) phagocytophila*, the etiologic agent of granulocytic ehrlichiosis in humans, dogs, and horses. Physicians and veterinarians benefited, as well as owners of dogs and horses by having more sensitive and specific assays available. Also **goals #1, 3, & 5**.

5. The DNA of *Ehrlichia chaffeensis*, the causative agent of human monocytic ehrlichiosis, was discovered in lone star ticks (*Amblyomma americanum*) in Connecticut. This new record marks the northern distribution of this pathogen in eastern United States. Public health officials and the general public benefited by knowing that another tick-borne infection occurs in southern New England.
6. Field tests of insecticides were conducted to determine if the pyrethroid bifenthrin or entomogenous fungi would control ticks at residential sites. Bifenthrin was more effective than *Beauveria bassiana* or *Metarhizium anisopliae.* Pest control operators are now using bifenthrin.
7. To meet the immediate needs of stakeholders regarding unexplained bird deaths, internal organs and tissues from 129 birds were analyzed to determine if the birds contained pesticides. Gizzards from two birds contained diazinon, suggesting acute poisoning. Tissues from 55 other birds contained residues of chlordane, DDE, oxychlordane, and heptachlor. State officials in the Department of Environmental Protection were notified as to what the cause of death was.
8. Biosolids (sewage sludge) were tested as compost for use as a soil amendment. Chrysanthemums planted in potting media containing high and low concentrations of biosolids compost had satisfactory growth. Nursery and bedding plant growers benefited by knowing that biosolids can be used in compost form.
9. At the request of stakeholders, field studies on weed control in nurseries were conducted. The herbicide flumioxazin suppressed weeds without causing injury to yews. Nursery growers are now using flumioxazin.

Goal 4: Federal Hatch Funds ($139,394), State Funds ($1,721,621), Scientist years (16.5)

There are new accomplishments during this reporting period that benefited a broad and diverse group of stakeholders by helping to solve 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-164, NE-171, NE-183, NE-187, NE-1005, S-301, and W-082) allow for interaction of scientists from several states. The diverse backgrounds and expertise of these scientists facilitated research progress. 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 but also 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.

Introduction

In accordance with the Agricultural Research, Extension, and Education Reform Act (AREERA) of 1998, this third 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. Therefore, 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. Information on research findings was disseminated to extension personnel in accordance with the Station's approved Plan of Work. Efforts have been made to expand 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 collaborate with Station scientists. These and other extension specialists 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. The main mission of the Station to advance knowledge for agriculture, the environment, human health and well-being, and communities is consistent with that of CSREES.

The Station has a broadening outreach program and engagement with stakeholders, who are herein defined as those who are interested in and benefit directly or indirectly from agricultural research (including forestry). In addition to the general public, stakeholders include: scientists, legislators, business leaders, administrators, forestry officials, industry personnel, and state and federal workers. Therefore, publishing scientific results in peer-reviewed journals is an important venue for reaching scientists in the nation. Oral presentations and disseminating written materials are other mechanisms for reaching 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 two annual reports, this accomplishment update 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) 2002. 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 Station policy to respond to all public inquiries. 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 report. During the past fiscal year, input was received from a diverse base of citizens, including the media, legislators, and organized groups (eg., Connecticut Pomological Society, Connecticut Nursery and Landscape Association, Connecticut Tree Protective Association, Federated Garden Clubs of Connecticut, etc.) in an open and fair process that encouraged participation of diverse groups. A notice was sent to

members of 29 protected organizations (i.e., minority groups) announcing the institution's public events. There were several mechanisms used to receive citizen input on their needs, opportunities for stakeholders to see research plots and experimental results, and to encourage more customer 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.

A special listening session was held with officers of the Connecticut Pomological Society on February 15, 2002. These stakeholders requested Station assistance on solving plant disease and insect problems. There is continued interest in new cultivars of apples and plums. Station scientists and administrators agreed to plant new varieties of fruit trees, to evaluate crop yield, and to monitor for insect pests and plant diseases. Conducting these studies would help increase profitability and improve businesses.

In other new initiatives, groundskeepers requested a Turf Pest Guide to help control insect pests and plant diseases. The manual has been completed and was co-produced with extension specialists at the University of Connecticut. With the spread of the Asian longhorned beetle in New York State (within 25 miles of Connecticut), an intensive survey program was established in conjunction with USDA/APHIS and town officials in Greenwich, Connecticut.

During FY 2002, 684 oral presentations 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 2002. 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, and provided comments 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.

Alice Peck School/Brownie Troop (Hamden)

American Phytopathological Society

American Rhododendron Society

American Society for Horticultural Science

American Society of Plant Biologists

Association of Northeastern Herbaria

Bartlett Arboretum

Branford High School

Branford Inland Wetlands Commission

Branford Land Trust

Bristol Garden Club

Bridgewater Men's Fellowship Organization

Calvin Hill School (New Haven)

Centers for Disease Control and Prevention

Cheshire High School

Community Garden of New Haven

Connecticut Academy of Science & Engineering

Connecticut Agricultural and Natural Resources Foundation

Connecticut Association of Wetland Scientists

Connecticut Beekeepers Assoc.

Connecticut Butterfly Association

Connecticut Botanical Society

*Connecticut Chapter of the American Chestnut Foundation

*Connecticut Chapter of the American Society of Foresters

Connecticut Chapter of the Appalachian Mountain Club

*Connecticut Christmas Tree Growers' Association

Connecticut Daylily Society

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 Invasive Plant Working Group

Connecticut Maple Syrup Producers Association

Connecticut Master Gardeners

Connecticut NOFA (organic farmers)

*Connecticut Nursery & Landscape Association

Connecticut Nurserymen's Foundation

Connecticut Pomological Society

*Connecticut Tree Protective Association

*Connecticut Tree Warden School

*Connecticut Urban Forest Pest Council

Connecticut Valley Branch of the American Society for Microbiology

Connecticut Wine Council

Cooperative High School (New Haven)

Cornell University Cooperative Extension

Cub Scout Pack 31, Troop 6

Doolittle School (Cheshire)

Duck River Garden Club

Dutchess County (NY) Legislature

Eastern Plant Board

East Haven Landscaping

East Windsor Garden Club

Entomological Society of America

Environmental Industry Council

Evergreen Garden Club

Experiment Station Associates

Fairfield County Horticultural Society

Fairfield Woods Middle School

Farm Wine Development Council

Florence Griswold Museum (Old Lyme)

Foote School (New Haven)

Goodwin-Levine Adult Care Health Center (New Haven)

Governor's Council on Agriculture

Greenwich Garden Club

Hamden Grange

Hamden Rotary

Hartford Garden Club

Hermitage Village (Southbury)

Hopkins Vineyard

International Society For Interferon

Invasive Non-Native Plant Working Group

Johns Hopkins University

Lehigh University

Long Hill Garden Club

Lyme Disease Foundation

Madison Beach Club

*Manatoga Nature Preserve (NY)

Mansfield Middle School

*Massachusetts Nursery & Landscape Association

Mycological Society of America

Mystic Rotary Club

National Plant Board

Natural Resources Council

Naugatuck Garden Club

*New England Christmas Tree Growers Assoc.

*New England Plant Conservation Program

*New England Society of American Foresters

New England Vegetable and Berry Growers

New England Wildflower Society

New Haven Garden Club

Nichols Garden Club

Northeast Aquatic Plant Management Society

Northeast Integrated Pest Management Committee

*Northeast Forest Pest Council

Northeastern Mosquito Control Association

Northeast Organic Farming Association

Northeastern Weed Science Society

Northford Elementary School

*Northern Nut Growers Assoc.

Old Saybrook Garden Club

Outdoor & Environmental Education Association

Oxford Garden Club

Partnership Day Care Association

Prides Corner Farms

Purdue University

Quinnipiac Chapter of Sigma Xi

Quinnipiac University

Quinnipiac Valley Audubon Society

Regional Water Authority

Rutgers University

Saint Rita's High School

Sessions Woods Wildlife Center

Shoreline Garden Club

*Society of American Foresters

Society for Invertebrate Pathology

Society of Nematologists

Sound School (New Haven)

Southbury Garden Club

Southern Connecticut State University

Stafford Springs High School

Stamford High School

Stonington Rotary Club

Stratford Garden Club

Suffield Garden Club

Thomas Edison Middle School

Trinity Academy

Trinity College

Town of Greenwich

Trillium Garden Club (Groton)

University of Connecticut (includes Cooperative Extension)

University of Massachusetts

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

*USDA/APHIS/PPQ

*Vermont Christmas Tree Growers' Association

*Western Chestnut Growers Association

West Haven Garden Club

Westerly, RI Garden Club

Wethersfield Garden Club

Wilton Deer Committee

White Flower Farm

Wilbur Cross High School (New Haven)

*Yale University (includes forestry and public health)

Yale Peabody Museum

Diagnostic services remain available for citizens to bring insect pests and diseased plant tissues to Station scientists. This program coincides with a USDA management goal: enhancing customer service/satisfaction. Soil samples also were analyzed to assist farmers, landscapers, and homeowners. During state FY 2002, there were 25,907 total public inquires from stakeholders to all Station staff members. The problems varied. For example, scientists in the Department of Entomology answered 6,088 public inquiries. Of these, 1,520 (25%) were from persons who visited the department. Information obtained by growers and industry personnel enhanced their businesses. Questions on natural resources (75%) were most frequent followed by inquiries on pests of humans or persons' dwellings (23%) and on food crop insects (2%). Scientists at the Valley Laboratory in Windsor, Connecticut answered 9,401 inquiries from the public, including those from commercial growers and pest control operators. Questions about hemlock woolly adelgid, a forest-insect pest, and blue mold disease continued to be most frequent. Plant pathologists answered 7,036 inquiries. Scientists responded to special problems and visited commercial and private properties to diagnose more complex problems and to give stakeholders immediate assistance in solving problems. In addition, 10,788 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.

Station scientists also responded to questions from the media. During state FY 2002, 331 interviews were given to newspaper, television, and radio reporters regarding findings of Hatch and McIntire-Stennis research. In some instances, such as mosquito research and encephalitis virus outbreaks, there was continued national interest in research findings. West Nile encephalitis has spread westward to Ohio and south to Florida. An ambitious field research program on mosquitoes was expanded in response to stakeholders' concerns in Connecticut. Administrators in towns and cities were kept informed of weekly mosquito and bird surveillance test results. Other experimental findings on or surveys of ticks, three tick pathogens that cause human diseases, hemlock woolly adelgids, the small Japanese cedar longhorned beetle, composting, pressure-treated wood, and a variety of plant diseases continue to be of high interest to reporters and other stakeholders nationally.

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. Citizens 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.

During this reporting period, the Station held special public conferences and open houses. Over 65 nursery and landscape professionals attended the annual tour of the Valley Laboratory in Windsor, CT on July 17, 2002. Attendees were led on a tour of research plots and educational gardens. In addition, attendees heard short talks by staff members on hemlock woolly adelgids, landscape transplant survival, and managing turf insects. Stakeholders also saw displays on identification of weeds, insect pests of woody ornamentals, foliar nematodes on ornamentals, spray and granular weed management strategies for container production, and post-production strategies for container grown woody plants. After the outdoor program, attendees heard other research talks in the conference room on managing invasive plants, sudden oak death, plant disease problems, and updates on arthropods and pesticides. Discussions followed the talks. At a public meeting on April 9, 2002 (Plant Science Day In the Spring), scientists reported their findings on growing tomatoes, using compost to grow annual cut flowers, vegetable transplants, cloning plant genes, air transfer of persistent organic pollutants, and detecting serum antibodies to the tick-transmitted agents that cause Lyme disease, ehrlichiosis (anaplasmosis), and babesiosis. On August 7, 2002, an open house was held at the Station's farm in Hamden, Connecticut. About 1,520 persons attended this event, a record crowd, and were able to visit experimental plots, demonstrations, and exhibits to hear updated scientific reports on spray drift studies near agricultural fields, armyworms, mosquitoes, ticks, hemlock woolly adelgids, gypsy moths, forest management, biotechnology and plant science, new chestnut cultivars for Connecticut, and other topics. Demonstrations and exhibits included techniques for propagating plants; 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 use of salt to suppress root diseases in asparagus crops.

The Experiment Station Associates (ESA), with a growing membership (currently about 960 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 other citizens interested in Station research programs and events. In addition, a brochure on Station research programs was revised by the ESA for public distribution.

These citizens requested the assistance of Station personnel in the production of the brochures. Station scientists, including the Vice Director, gave oral presentations and reports to ESA members at their annual meeting on March 21, 2002 and at monthly Board of Directors' meetings. Members in attendance at the annual meeting heard a presentation by a Station scientist on chestnut blight research. All of these activities provided opportunities for stakeholder input on critical issues in Connecticut agriculture and related problems.

Station scientists worked closely with growers in research programs to solve specific problems. Special assistance was given to arborists, 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. Stakeholders were involved with the planning process and evaluation of scientific results. For example, the Asian longhorned beetle is a destructive pest of maple trees. In New York State (New York City and Long Island) and Chicago, Illinois, thousands of trees have been destroyed at a cost of about $35 million to control the beetle. Stakeholders in Connecticut have requested surveys for this pest and experiments on tree injections of pesticides or other methods as a preventive measure. These projects have started. 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 management practice can now be applied in other infested sites. During an outbreak of a West Nile encephalitis virus in Connecticut in the summer of 2002, stakeholders continued to assist the Director and other scientists at the Station by providing dead birds for analyses. The Director of the Station conducts research on encephalitis virus. Virus isolations were made from some birds, and information was given to the media and health officials so that public alerts could be made. Direct input from stakeholders was considered and greatly facilitated this research.

In a previous reporting period, strawberry growers requested assistance on determining the causes of declining fruit yield in fields. A Station' scientist responded and discovered that parasitic nematodes and a fungus, acting alone or in combination, reduced the strawberry yields. Interaction between the pathogens caused strawberry root rot. Control methods were applied to solve the problem and are currently being monitored for effectiveness.

The Station's McIntire-Stennis program focuses on forest insect pests, such as hemlock woolly adelgids (*Adelges tsugae*), gypsy moths (*Lymantria dispar*); breeding timber and nut-

producing chestnuts; the host/pathogen/parasite system of chestnut blight disease; and 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 and pine shoot beetles. These studies are being conducted to help preserve the $400 million annual timber production operations in Connecticut. There were 13 publications, 47 media interviews, 84 talks given, and 16 officership positions for Station staff in association with the McIntire-Stennis program.

The hemlock woolly adelgid, *Adelges tsugae*, is a destructive introduced pest of eastern hemlock and Carolina hemlock in 16 eastern states from Georgia to New England. With continued decline or death of hemlock trees, citizens request assistance on control (biological and chemical). Pesticides can control *A. tsugae* on ornamental hemlocks but not in forests where thorough ground treatment with pesticides is difficult.

In earlier studies, a Station scientist found that *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. The beetle was released in sites infested with *A. tsugae*. As a part of an ongoing effort over several years, about one million beetles have been released thus far in at least 100 sites in Connecticut and 15 other states. Beetles have been released in New Jersey and Virginia as a part of a cooperative multistate research program. Field research has demonstrated that the beetles are established at most sites. Therefore, there is good potential for this beetle in biological control. Current studies are designed to determine hemlock stand conditions, the patterns and timing of beetle release that will enhance the biological control effort, survival and dispersal of the beetles, and the impacts of pesticides on the predatory beetle. Applications are being made to minimize adverse effects of pesticides. Citizens now have a control program that may work in forests.

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 on specific infestations. 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 joint effort

with the USDA/Forest Service, a booklet on biological control of hemlock woolly adelgid was produced and distributed nationally. 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. 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 citizens' input and needs.

During this reporting period, a Station scientist contributed new information on adelgids and the predatory beetle for a web site 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., arborists) and USDA Forest Service personnel. Evaluations of the efficacy of beetle releases are being conducted for cooperators.

Gypsy moths continue to defoliate hardwoods in New England, albeit in localized patterns. In Connecticut, expansive defoliation of several thousand acres of forests occurred during the early 1970's and over a million acres were affected in the early 1980's. Mortality of economically important hardwoods, such as oaks and maples, occurred and had an impact on lumber production and forest ecosystems. Gypsy moths have been held at low populations by a pathogenic fungus, *Entomophaga maimaiga.* Although *E. maimaiga* has had an important overall impact on gypsy moths since 1989, it is unclear why this fungus does not totally keep the gypsy moth in check. Drought is an important limiting factor for fungus activity. Arborists and homeowners continue to ask questions about the long-term effectiveness of *E. maimaiga* in forests. There continues to be concern expressed by forest managers and lumber producers. In response, Hatch and McIntire/Stennis funds are being used in long-term field and laboratory investigations to (1) develop an accurate and simple method for determining the abundance of resting spores of *E. maimaiga* in forest soils before gypsy moth eggs hatch; (2) develop a sampling method to determine the relationship between resting spore load in forest soils and subsequent incidence of infection in gypsy moth larvae; (3) determine the effects fungal conidia from infected caterpillars have on initiating and sustaining epizootics of *E. maimaiga*; and (4) determine the importance of rainfall or lack thereof on fungus activity. The main goal of this research is to develop predictive models that could be used to estimate whether or not *E. maimaiga* would continue to keep gypsy moth populations in check and to

provide information to forest managers and arborists to integrate into their program planning process. Mathematical models are being evaluated to predict fungal activity on caterpillar populations.

In addition to the displays of research results at the Station's annual open houses for the public, other exhibits were presented at the Connecticut Nursery and Landscape Association, Connecticut Flower and Garden Show, Farm/City Week, and at annual meetings of arborists. In addition, research results were presented to the USDA Interagency Gypsy Moth Forum and regional forestry meetings. Comments received by attendees of meetings were useful in modifying experimental design.

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. Re-establishing stands of this tree will also enhance the diversity of forest ecosystems and provide other forest products. 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 research in Connecticut and other states in a USDA-approved, award-winning multistate McIntire-Stennis research project (NE-140) is to breed timber chestnuts for resistance to diseases and to introduce them into forests where native trees are preserved. The goal is to allow natural crossing to introgress the resistance genes into the native population.

A Station scientist heads the chestnut research program in Connecticut. During the past year, she has continued to interact with the following stakeholder groups: 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 and 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, citizens 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. 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 protects 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. At the request of state foresters and utility company officials, 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 White Memorial Forest, and Nature Conservancy are collaborating with a Station scientist and have had input on data collection methods. By participating in the research, these collaborators obtain current information.

Ticks are abundant in southern New England and transmit pathogens that cause Lyme disease, babesiosis, ehrlichiosis, and Rocky Mountain spotted fever. Males and females of the blacklegged tick (*Ixodes scapularis*) prefer deer as hosts. As deer herds grow, populations of these ticks increase. Citizens request Station assistance on the identification of ticks. Blacklegged ticks removed from citizens are tested for the DNA of the Lyme disease organism. Results are reported to health care professionals, and the establishment of new records for infected ticks in towns helps clarify the geographical distribution of the Lyme disease agent. Veterinarians request Station assistance on performing antibody tests to determine if horses and dogs were exposed to three ehrlichiosis agents. The Vice Director conducts research on ehrlichiosis, babesiosis, and Lyme disease.

Stakeholder input also was obtained when scientists served as members of advisory boards, committees, or officers of organizations. During FY 2002, Station scientists interacted with stakeholders in the following public organizations or state or national committees:

Agricultural Technology Development Advisory Board
Albert Einstein College of Medicine (Visiting Assistant Professor)
American Veterinary Lyme Disease Society
American Phytopathological Society
American Society of Horticultural Science Technical Program Committee
American Society of Plant Biologists
Animal Behavior Society
Association of Northeastern Herbaria
Bloomfield High School Advisory Board for Agri-Science
Branford Inland Wetland Commission
Branford Land Trust
Butterfly Atlas Project
Chestnut Marketing Association
Clay Minerals Society
Clear Lake Improvement Assoc.
Community Gardens, Knox Parks Foundation (Hartford)

Connecticut Academy of Arts and Science

Connecticut Academy of Science and Engineering

Connecticut Agriculture Science and Technology Education Advisory Committee

Connecticut Botanical Society

Connecticut Butterfly Association

Connecticut Butterfly Atlas Committee

Connecticut Christmas Tree Growers' Association

Connecticut Council on Soil and Water Conservation

Connecticut Endangered Species Committee

Connecticut Entomological Society

Connecticut Forest and Park Association

Connecticut Greenhouse Growers 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 Protection Examining Association

Connecticut Tree Protective Board

Connecticut Urban Forestry Council

Cornell University (Adjunct Professor)

Department of Agricultural Technology Development Advisory Board

Florida Department of Agricultural and Consumer Services (Research Associate)

Eastern Plant Board

Environment Committee, Mill River Watershed Association

Goodwin Forestry Scholarship Committee

Invasive Non-Native Plant Committee

IR-4 Berry Fungicide Working Group

Journals

Agricultural & Forest Meteorology (Editorial Board)

Compost Science & Utilization (Editorial Board)

Environmental Engineering Science (Editorial Board)

Environmental Pollution (Editorial Board)

Florida Entomologist (Associate Editor)

International Journal of Phytoremediation (Managing Editor)

Loosestrife Containment Committee

Lyme Disease Foundation

Madison Land Conservation Trust

National Christmas Tree Growers Association

Natural Resources Council of Connecticut

New England Pest Management Network

New England Plant Conservation Program

New England Society of American Foresters (Executive Committee)

New England Vegetable & Berry Growers' Assoc.

North American Blue Mold Warning System

Northeast Organic Farming Association of Connecticut

Northeast Regional Committee of the Workgroup on Environmental Toxicology and Chemistry

Northeast Wildlife Damage Management Research and Outreach Cooperative

Northeast Wildlife Management and Outreach Cooperative

Northeastern Regional IPM Committee

Northeast Soil Survey Committee

Northeast Soil Testing Committee

Northeastern Forest Pest Control Council

Northeastern Weed Science Society

Northern Nut Growers' Assoc.

Peabody Museum, Yale University (Curatorial Affiliate)

Plant Biology Working Group, American. Soc. of Horticultural Science

Quinnipiac University (Adjunct Assistant Professor)

RC & D Forestry and Stewardship Committee

Regional Hatch Turf Work Group

Sigma Xi (Quinnipiac University Chapter)
State of Connecticut Mosquito Management Program
Steward McKinney Wildlife Refuge
University of Connecticut, Department of Pathobiology (Adjunct Professor)
Urban Forestry Council
USDA Cooperative Agricultural Pest Survey Committee; USDA Natural Resource Conservation Service
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 closely 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 Vice 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 that 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 approval of project outlines and grant proposals was 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 interaction with stakeholders. There were 43 publications, 332 talks, and 82 media interviews recorded for state FY 2002 in association with this program goal. There were 62 officerships and memberships held by Station scientists in stakeholder organizations and national or state committees during state FY 2002. 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 fruits and vegetables, the control of apple scab, 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 are 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. Whenever possible, efforts were made to present

results summaries and impact statements in non-technical terms for clarity. In some cases, expected outcomes were realized early in the research effort (i.e., in the past two years or during this reporting period), while in other instances, more time is needed to complete research objectives and to meet expected goals within 5 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**

This workshop was held during the first reporting period. Details on stakeholder interactions with scientists and on publication of the conference proceedings were included in the first year's accomplishment report. This objective has been completed.

(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 audio tapes 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 last year's report. This objective has been completed.

(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, continues to cycle in biotic and abiotic processes in the environment. Persisting in the soil for almost 20 years, there is concern that the pesticide may enter food crops.

Accomplishment/Impact: a new analytical procedure (chiral gas chromatography with ion trap mass spectrometry) has been developed to quantitate chlordane residues in crops. This method will enable more sensitive analyses of produce, collected in marketbasket surveys. Chiral gas chromatography is being applied in laboratory analyses of coded samples to detect a range of chlordane concentrations in food crops.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

These accomplishments and impact also have application to goal #3 by ensuring a healthy, well-nourished population (**Theme: 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.

(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)**

Description: gypsy moth caterpillars continue to defoliate oaks, maples, and other hardwoods in localized settings in Connecticut and other states. Town officials and the public requested assistance from Station scientists in monitoring this pest and forecasting defoliation to determine if spray programs were needed. Field and laboratory studies continue on this pathogen to develop a computer model for predicting the effects of this fungus on gypsy moth caterpillar populations. The fungus' ability to infect caterpillars depends mainly on rainfall.

Accomplishment/Impact: the use of data-logging instruments in forest plots to record rainfall, humidity, and temperature was of great benefit in assessing the impact of the fungus on caterpillars. Laboratory work revealed that *E. maimaiga* conidia spores are produced from infected caterpillar cadavers when humidity is near 100%. Since the conidial spores infect other caterpillars, humidity as well as rainfall is a key factor in causing mortality of caterpillars. Fungus infection rates were highly correlated with rainfall and humidity. By obtaining daily information on rainfall and humidity in forest plots, a Station scientist was able to predict fungus infectivity rates of gypsy moth caterpillars. Consequently, spraying trees with pesticides was not needed. With reduced amounts of pesticides used, there was minimal impact on the environment.

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

Scope of impact: state-specific.

(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 is a serious problem in orchards. The annual value of the apple crop in Connecticut is estimated to be about $7.3 million. Efficient control depends on a grower's ability to accurately predict onset of new infections on apple leaves and fruit. New infections occur when weather conditions are suitable and when there are sufficient amounts of fungal spores present.

Fruitgrowers need information on precise times when apple scab infections are likely to occur so that fungicides can be applied.

Accomplishment/Impact: as a part of multistate, integrated activities (research/extension) to meet long-term critical issues of stakeholders, a scientist at The Connecticut Agricultural Experiment Station has synthesized results from several years of field studies and developed a model that estimates probability of apple scab infection. The model is based primarily on aerial dispersal of fungal spores that allow apple scab to spread within and among orchards. Applying information from the model enabled growers to use IPM practices, such as mulch mowing, to reduce apple scab inoculum and to minimize the need for pesticide sprays. This practice could save $3.5 million annually for apple growers nationally.

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. Results were reported in the past two 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: earlier studies have shown that chromated copper arsenate (CCA) preservative of wood products can contaminate the soil. The pressure treatment causes the preservative to deeply penetrate wood. Millions of board feet of CCA-treated wood are produced annually and are used in decks, picnic tables, garden borders, 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 wood products containing CCA.

Accomplishment/Impact: in laboratory experiments, romaine lettuce and Indian mustard greens, both of which are edible, were grown in soil containing CCA in the form of wood blocks, sawdust, or as a liquid spike of sodium arsenate. Based on atomic spectroscopic analyses, the dry weight of arsenic detected in lettuce grown near CCA wood or grown with CCA powder mixed into the soil ranged from 0.4 to 4.4 mg/kg, while lettuce grown in soil spiked with arsenic varied from 2.6 to 12 mg/kg. Mustard greens grown in similar spiked potting media had 21 to 96 mg/kg of arsenic. Mustard greens had 8-fold greater amounts of arsenic, compared to the lettuce. Concentrations of arsenic in plants increased proportionately as amounts of arsenic in soil rose. Results were released to the public so that stakeholders will not grow edible plants near CCA-treated wood.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

These accomplishments also apply to national USDA goal #2 by providing information on the **Theme: Food safety** and to goal # 5 by providing information which enhances 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: the small Japanese cedar longhorned beetle (*Callidiellum rufipenne*) is an exotic insect native to Japan, Korea, Taiwan, and eastern China. This pest of arborvitae, junipers, and cedar trees was discovered in Connecticut in 1998 and has recently been found in coastal areas from Massachusetts to North Carolina. In Connecticut, the beetle infested dead or weakened cedar trees predominantly in the southern part of the state. Stakeholders, such as owners of nurseries, requested Station assistance on determining the extent of host species affected so that all hosts can be included in management programs.

Accomplishment/Impact: new findings have revealed that *C. rufipenne* can successfully develop in 8 species of ornamental and wild plants in the family *Cupressaceae.* Astro (a permethrin-formulated insecticide) continues to be effective for beetle control. In addition to being a threat to the $400 million nursery industry, this insect has established itself in forested areas where eastern red cedar and Atlantic white cedar grow. Sampling and control methods developed in Connecticut, using Astro, have helped nursery growers, plant specialists, and plant regulatory officials in Connecticut and other states to monitor this insect and prevent economic losses.

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: black vine weevil, Japanese beetle, and oriental beetle larvae are major pests in container-grown and field-grown nursery plants. The presence of these grubs in containers can lead to rejection of plant shipments or added pesticide treatments required by states or countries that import Connecticut nursery stock. The nursery industry requested assistance from Station scientists to meet immediate critical needs.

Accomplishment/Impact: recent field tests revealed that a root dip of 600 ppm of bifenthrin protected transplanted nursery stock from a variety of white grub species. Root dip treatments with bifenthrin also protect transplants and has application and potential cost savings in Christmas tree production and for other field-grown nursery stock when placing plants into ground soil infested with beetle grubs. For example, in an intensive Christmas tree seedling nursery of 10 acres, there is a demonstrated savings of $33,168 per acre in plant value by protection from the oriental beetle. (Sources of funds, Scope of impact – see below).

Description: as a part of multistate integrated research/extension program (NE-187), field tests were conducted to evaluate the activity of imidacloprid, thiamethoxam, and acetamiprid on oriental beetle larvae.

Accomplishment/Impact: all 3 insecticides synergistically improved the infection of last-instar oriental beetle larvae with parasitic *Heterorhabditis bacteriophora* nematodes. This permitted curative control of white grub populations, particularly against last-instar oriental beetle larvae. Nursery growers are now using less insecticide to treat container-grown plants.

Sources of funds: Hatch and state.

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

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

(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: Annual vegetable production in Connecticut is valued at about $4.2 million. Many vegetable growers in the Northeast use cover crops, but little is known about which cover crops are most advantageous in pest management programs. Vegetable growers requested assistance on determining which cover crops provided the best option for controlling weeds.

Accomplishment/Impact: Rye, rye/vetch, crimson clover, and oats were planted in the fall of 2000 and 2001. In addition, the following spring cover crops were planted following a fall oat crop: spring oats, oat/field pea, annual ryegrass, and rape. Rye/vetch, rye alone, wheat cover crops, and winter-killed oats were most effective for weed control. Except for annual ryegrass, the spring cover

crops following oats did not substantially improve weed suppression. Vegetable growers are using rye/vetch and wheat cover crops to control weeds and have reduced amounts of herbicides used.

Sources of funds: SARE, Hatch and state.

Scope of impact: multistate integrated research (CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VT, WV).

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

Description: As a part of integrated multistate research and extension efforts (NE-9), 169 accessions of arugula (*Eruca sativa*) in the USDA germplasm collection were evaluated for resistance to flea beetles (*Phyllotreta cruciferae* and *Phyllotreta striolata*) as well as horticultural characteristics (earliness of harvest, yield, earliness of bolting, and leaf appearance). Arugula has become popular in restaurants and among certain ethnic groups. Vegetable growers, who want to grow arugula, have requested that tests be performed to locate a variety, which is resistant to flea beetles so that insecticide usage could be reduced or eliminated.

Accomplishment/Impact: there are several varieties with desirable horticultural characteristics, such as early harvest, delayed bolting, and yield, but no accessions were found to be resistant to flea beetles. Vegetable growers now know that dozens of arugula cultivars do not have resistance to flea beetles and that other management practices are needed to control this pest.

Sources of funds: Hatch and state.

Scope of impact: multistate integrated research (CT, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VT, WV, USDA/ARS) and extension.

Accomplishments also apply to goal #3 by providing a food source to ensure a healthy well-nourished population (**Theme: Human health**) and goal #4 (**Theme: Biological control; Integrated pest management**).

Description: Apple tortrix (*Archips fuscocupreanus*) is a new exotic leafroller pest in orchards. Native to eastern Asia, this insect has been found infesting 75 species of woody plants in the Northeast. To assist fruitgrowers, studies were conducted to determine ovipositional preferences and geographic distribution of apple tortrix in eastern United States.

Accomplishment/Impact: mated female apple tortrix moths laid eggs on potted trees of apple, pear, European plum, Japanese plum and sweet cherry. No distinct host preference was observed. New tests on pheromone-baited traps revealed moths in 16 coastal counties in Massachusetts, Connecticut, Rhode Island, New York State, and New Jersey. All positive trap locations are within 20 kilometers of the Atlantic Ocean. Pheromone traps are being used in IPM programs to monitor apple tortrix populations in fruit orchards. Efficient detection of this pest allows for more precise insecticide treatments in a $7.3 million apple production industry in Connecticut.

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: black vine weevil is a serious pest in strawberry fields and nursery crops. Damage caused by this insect in strawberry production can result in a loss of about $2,000 per acre. Previous work showed that native or naturalized populations of insect pathogenic nematodes were particularly important in maintaining low numbers of black-vine weevils in strawberry fields. At the

request of growers, surveys for nematodes and insect predators were continued to broaden IPM programs.

Accomplishment/Impact: a new species of *Heterorhabditid* nematode was discovered in strawberry fields. Predatory ground beetles were found to be especially important in yew production areas. The ground beetle can keep black-vine weevil populations at low numbers, whereas the pathogenic nematodes are most effective when there are outbreak conditions of weevils. In 230 acres of strawberry production in Connecticut, current control depends on frequent use of chemical insecticides, which add to production costs (about $150 per acre). Since the newly discovered species of parasitic nematode and activity of predatory ground beetles are controlling black-vine weevils, more precise applications of chemical insecticides can be applied in strawberry fields and nurseries to minimize impact on the predatory beetles.

Sources of funds: Hatch and state.

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

These accomplishments also apply to national goal #3 by providing a food source to ensure a healthy, well-nourished population. **Theme: Human health** and goal #4 **Theme: Biological control; Integrated pest management.**

Description: Early dying disease of potato is caused by a fungus, *Verticillium dahliae*, and a plant nematode, *Pratylenchus penetrans*. There are about 250 acres of potato production in Connecticut. As a part of integrated multistate research and extension efforts (NE-171), the effects of green manure rotation crops were assessed in microplots.

Accomplishment/Impact: nematodes were extracted from roots of a fall oat cover crop. Polynema marigold and sorghosudangrass rotations reduced lesion nematode densities. The marigold rotation

also increased marketable tuber yields by 56%, thus indicating that rotation to reduce nematodes may play an important role in managing early dying disease. It is estimated that short-term profits for growers could increase by about $1,000 per acre when the new management practice is implemented. Growers are enthusiastic about trying to reduce lesion nematodes with less use of pesticides.

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: lesion nematodes cause 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 a greenhouse to investigate the interactions of lesion nematodes, *Pratylenchus penetrans*, root-feeding insects (Asiatic garden beetles), and the fungus *Rhizoctonia fragariae* on the development of strawberry root rot.

Accomplishment/Impact: the presence of the pathogenic fungus with lesion nematodes increased amounts of black root rot, but activity of Asiatic garden beetles had no effect on black root rot severity. Therefore, strawberry growers, who must control black root rot, can now use fungicides without insecticides and, thereby, can increase profitabity by about $2,000 per acre.

Sources of funds: Hatch and state.

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

Description: verticillium wilt affects eggplants, potatoes, and tomatoes. Vegetable growers requested assistance on finding ways to reduce amounts of pesticides used.

Accomplishment/Impact: eggplants grown in Verticillium-infested field soil were healthy when cruciferous crop residues were present in the soil. In addition, the suitability of canola as a biological control for this disease was assessed in the field and greenhouse, and findings revealed that the use of either canola or mustard as a green manure was beneficial to tomato and eggplant growth and yield by decreasing Verticillium wilt. However, the incorporation of rye as a cover crop had deleterious effects on eggplant growth. Vegetable growers have begun to use canola or mustard in their crop production areas and can save about $250 per acre in costs of fungicide application.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

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

Description: Old asparagus fields often have elevated concentrations of *Fusarium* pathogens, which cause rapid infection and root rot of new asparagus crops. Another major problem is that allelopathic toxins from the previous crowns and roots inhibit young asparagus plants by restricting root growth and inhibiting beneficial vesicular-arbuscular-mycorrhizae (VAM) from colonizing the roots. Usable agricultural land for vegetable production is limited in Connecticut. To assist growers, a commercially available plant extract called formononetin was field tested to determine if there was enhancement of VAM associations with roots.

Accomplishment/Impact: results thus far indicate that when roots were assayed, formononetin increased the number of VAM vesicles in roots by 79%, compared to controls. Formononetin increased asparagus yield by 11%. In the long-term, the use of this product shows promise in re-establishing asparagus in abandoned fields. Growers have shown interest in the further testing of this product on a larger scale.

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).**

Description: the pathogen, *Phytophthora infestans*, causes disease of potato and tomato. Once responsible for the Irish potato famine, this fungus has re-emerged worldwide as new virulent strains developed. To manage this problem, growers requested information on predicting the risk of infection. Studies were conducted in the field to provide information for a mathematical model to predict the aerial transport of late blight spores.

Accomplishment/Impact: results thus far indicate that late blight spores are released into the air as the humidity decreases in the morning, normally between 8:00 AM and 11:00 AM. The chances that a new potato or tomato field will become infected decreases with increased distance from the inoculum source and with exposure to sunlight. It was also found that the spread of late blight depends strongly on the rate of release of *P. infestans* sporangia from a diseased crop canopy. With increased knowledge of risk for late blight, growers are now better able to control disease by

implementing integrated use of sanitation, scouting, weather forecasting, late-blight resistant potato varieties, and fungicides. With further improvements in forecasting disease, this new approach in the short-term could allow growers to reduce fungicide sprays by 10 to 20% and save about $12 per acre in fungicide materials alone.

Source of funds: Hatch and state.

Scope of impact: Multistate (CT, NY).

(12) Field testing of apples, grapes, raspberries, okra, leeks, and sweet potato 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: the growing wine industry in Connecticut (estimated annual cash receipts of $3 million) requires that selected grape cultivars survive winter conditions and have productive grape yields. At the request of growers, data are being collected in field plots in the Connecticut River Valley on the effects of cluster thinning on the ripening and yields of the French Hybrid wine grape cultivars “Villard Noir”, “Villard Blanc”, and “Seyval” and on the vinifera cultivar “Chardonnay”.

Accomplishment/Impact: all cultivars survived a late spring frost during early May of 2001 and produced acceptable yields after thinning, ranging from 8.51 to 22.29 tons per hectare. The highest yield was recorded for Villard Blanc in Windsor, CT in the northern part of the state. The Connecticut River Valley is a promising new area for wine grape production, and growers have planted new grape cultivars in this area.

Sources of funds: Hatch and state.

Scope of impact: state specific.

Description: cultivars of leeks, an ethnic crop, were evaluated in field plots to provide information to growers who are trying to supply this specialty crop to consumers.

Accomplishment/Impact: of the 10 cultivars tested at two farm sites in Connecticut, Jersey had the highest yields (12,990 lb/acre - 22,070 lb/acre). Yields of Carina, Electra, and Leefall exceeded 17,000 lb/acre and were suitable for growing in southern New England. Vegetable growers are including leeks in crop production.

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**).

Description: as a part of integrated multistate research and extension project NE-183, new apple cultivars were further evaluated for disease resistance, yield, and fruit quality to satisfy grower requests for information. There is continued interest among fruitgrowers to reduce pesticide applications and to provide high quality, high-yielding apple cultivars that are resistant to plant pathogens and insect problems.

Accomplishment/Impact: apple scab incidence was low (less that 2%) and localized for the following cultivars: Pioneer Mac, Braeburn, Creston, Fuji Red Sport #2, Gala Supreme, Golden Delicious, Senshu, Shizuka, and Sunrise. Cedar apple rust incidence was higher but also localized; the highest incidence was recorded for Goldrush (23.1%) and Yataka (22.1%). This information was

given to fruitgrowers to help them select the more desirable cultivars. Fruitgrowers at two major farms have planted cultivars that are resistant to apple scab.

Sources of funds: Hatch and state.

Scope of impact: multistate integrated research and 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: farmers' markets in major urban centers and densely populated suburbs are an important segment of direct sales of fresh fruits and vegetables to consumers. There is demand for locally grown produce. The notable increase in the Hispanic population in Connecticut has stimulated interest in certain niche crops. Statewide surveys indicate consumer and grower interests in calabaza (squash), a crop grown in southern United States, Puerto Rico, and Cuba. To meet immediate needs of stakeholders, field studies were conducted to determine which cultivars could be efficiently grown in Connecticut. Newly developed squash cultivars were selected to reduce the length of vines, which normally can reach 30 feet and have a yield of 2.3 marketable fruits per plant and an average weight of 6.4 lb per fruit.

Accomplishment/Impact: A test variety, started as transplants that grew to 18-foot vines, yielded 5.6 marketable fruits per plant (average weight = 6.9 lb/fruit). Another cultivar, with 12-foot vines, produced 4.8 fruits per plant (average weight = 6.4 lb/fruit). Therefore, crops requiring less space but having comparable yields as traditional varieties could be grown in Connecticut. Information was given to vegetable growers. At a retail price of $.69/lb and a yield of 36 tons/acre,

the potential market value of calabaza is $50,000/acre. Growers are considering calabaza as a niche crop for sales in farmers' markets.

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)**.

(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**

Description: information on the genetic factors that control photoprotective responses and photosynthesis is essential when attempting to increase plant production efficiency or to genetically

engineer plants for resistance to disease. Studies were continued on the biochemistry of photosynthesis in *Arabidopsis* mutants to investigate the light-harvesting apparatus (chlorophyll function) of plants deficient in certain pigment-binding proteins.

Accomplishment/Impact: genes of mutants (*lsr1* and *lsr5*) have been isolated, characterized, and mapped. There was a 90% reduction in a key pigment-binding protein (S protein) in the mutant *lsr1*, compared to that of a wild type. In addition, a sensitive method for detecting the S protein in leaf disks has been developed for more accurate measurements. The S protein plays an important role in photosynthesis and, in the long term, should be considered in future work on genetic engineering.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

Allocated Resources. Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 2002.

	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		2,417,000		17.8	
2004	447,704		2,417,000		17.8	

*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. 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 2002, there were 3 publications and 14 talks, and 3 media interviews 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 2002, 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 continued stakeholder concerns about pesticide residues in locally or foreign-grown produce and canned and frozen vegetables. Citizens and state officials requested assistance on analyzing foods for pesticide residues. One hundred and forty-five samples, submitted by the Connecticut Department of Consumer Protection as a part of marketbasket surveys or obtained in research studies, were analyzed for residues of pesticides, such as captan, dicofol, permethrin, chlorothalonil, endosulfan, iprodione, malathion, dieldrin, chlorpyrifos, and ninclozolin.

Accomplishment/Impact: when produce contained pesticide residues, concentrations were usually well below tolerance levels set by U.S. EPA. Sixty-two percent of all samples analyzed had no pesticide residues. Moreover, rinsing fresh fruits and vegetables under tap water helped reduce concentrations of pesticide residues for nine compounds. With public release of research findings, stakeholders were reassured that canned and frozen vegetables were safe to consume.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

Description: to meet specific requests of stakeholders, laboratory studies were conducted to determine if a 1% Palmolive solution and commercially available fruit and vegetable wash products (i.e., Fit, Fruit & Vegetable Wash, Organic lean, and Vegi-Clean) were effective in removing pesticide residues from produce.

Accomplishment/Impact: based on analyses of 196 samples, results thus far show that all commercial products provided little or no reduction in removing pesticide residues, compared to the use of tap water alone. The removal of wax and/or dirt was not a part of this study. Consumers now know that rinsing fruit and vegetables with tap water is as effective some commercialized wash products.

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**

Description: to meet stakeholders' requests, studies were continued on monitoring concentrations of lead in maple syrup. Maple syrup production, with estimated annual cash receipts of $400,000 in Connecticut, has had major problems with lead contamination. A Station scientist discovered that equipment (i.e., buckets and pumps) used in the production process was the source of lead. Analytical procedures, developed earlier to measure concentrations of lead in maple syrup, were relied on to further monitor maple syrup produced in facilities where equipment had been replaced.

Accomplishment/Impact: results thus far indicate little or no lead in maple syrup. When lead was found, concentrations were well below U.S. EPA standards. Maple syrup producers and stakeholders were reassured that maple syrup is safe to consume.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

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

This objective was completed and reported on in the first Annual Accomplishment Report.

(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**

Description: more sensitive and specific analytical procedures are needed to detect pesticides in food and drinking water. To more precisely determine quantities of chlordane residues in food produced in farm plots where this pesticide was once used, it was necessary to modify analytical procedures by developing an internal standard-based procedure.

Accomplishment/Impact: a new procedure utilizing three carbon-13 labeled chlordane compounds (trans-nonachlor, (+) trans-chlordane and (-) transchlordane) was developed. Results thus far show that when these compounds are added prior to extraction, they can account for measurable losses that occur during the analytical clean-up procedures for a large number of matrices included not only for food testing but in analyses of soil, air, and compost samples as well. More refined procedures are now available to accurately measure chlordane residues in food and water for short-term and long-term studies and to meet immediate stakeholder issues regarding food safety.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

(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**

Description: outbreaks of *Escherichia coli* in beef, lettuce, and apple cider have alarmed the public. To determine how cider becomes contaminated, new experiments were conducted to investigate *E. coli* O157:H7 growth on the surface of undamaged apples. The bacterium was spread

onto small areas of Golden Delicious and Red Delicious apples and incubated at room temperature (20 - 25° C) in arid (10 - 50% humidity) or humid (50 - 80% humidity) environments. Culturing techniques were used to monitor bacterial growth.

Accomplishment/Impact: *E. coli* O157:H7 was unable to penetrate the unbroken cuticles of apples. The microbe, however, readily grew on apple surfaces in high humidity but did not grow under arid conditions. Undamaged, contaminated apples can be a risk for cider contamination even when doses of the pathogen are low. This information adds further to why cider should be pasteurized.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

These accomplishments were conducted to meet the intermediate critical needs of stakeholders. Accomplishments also apply to goal #5 **(Theme: Human health)**.

Allocated Resources. Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 2002.

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		$341,700		3.1	
2004	114,550		$341,700		3.1	

*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 stakeholder interactions. During state FY 2002, there were 32 publications, 254 talks and 199 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 reworking 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: the demand for tomatoes during colder months has encouraged at least 40 growers to use greenhouses for production. Annual gross returns can reach $8,000 for one 30 x 96 ft. greenhouse. There are a number of cultivars of greenhouse tomato available, but it is unclear which varieties are most appropriate for production in Connecticut. Sensitivity to nitrogen fertilizer varies greatly among cultivars, and growers want to minimize the use of plant nutrients. To meet intermediate critical needs of stakeholders, different cultivars were tested in greenhouses under different fertilizer regimes.

Accomplishment/Impact: results thus far show that the following cultivars yielded 13 pounds of tomatoes per plant or more when low amounts of nitrogen and potassium were used:

Cabernet, Cobra, Jet Star, Match, Parks 656, and Trust. Yields per plant (14 lbs) were not significantly greater when high amounts of nitrogen and potassium were used. Stakeholders are now growing some of these cultivars and have reduced amounts of nitrogen and potassium nutrients.

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**

Description: dye wastewaters are difficult to treat by conventional methods. Fenton-and photo-assisted Fenton advanced oxidation processes (AOPs) have great potential for the remediation of dye wastewaters. Studies were conducted to investigate interactions of Fe (III) with hydroxyazo dyes and to determine if Fe (iron) formed complexes or reacted with the following dyes: Acid Orange Seven, Acid Orange Ten, and Acid Orange Twenty.

Accomplishment/Impact: there was degradation of certain azo dyes, and this process could be assisted by direct thermal oxidation by iron. However, the overall effectiveness of Fenton-based methods for treating other azo dyes that form insoluble ferris salts may be compromised by removal of the catalyst from solution. There is growing interest in the scientific community to continue research on Fenton-based methods to remediate dye wastewaters as a long-term goal.

Sources of funds: Hatch and state.

Scope of impact: multistate (AR, AZ, CA, CT, FL, HI, IA, IN, KS, MN, MT, NV, NY, WA).

(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: with the closing of landfills, there is a need to find ways of recycling plant matter. At least 80 municipalities in Connecticut are composting leaves. Town officials are also relying on farmers to dispose of leaves. The farmers layer undecomposed leaves on their fields and plow them under, a method called sheet composting. Nitrogen deficiency can be a problem in these soils because microorganisms involved in leaf decompostion use nitrogen more efficiently than plants do. It is unclear to the users of composted leaves whether the differences in the rates of decomposition between oak and maple leaves would lead to variations in plant response when these leaves are used in a sheet composting operation. Accordingly, to meet intermediate needs of stakeholders, experiments were conducted to determine if there were differences in plant growth (i.e., lettuce, eggplant, tomatoes, and peppers) in plots amended with either oak or maple leaves.

Accomplishment/Impact: results thus far show that differences in crop yields were insignificant. Findings have been released to municipalities, growers, and homeowners. Homeowners and farmers are using mixed composted leaf materials, which require less handling and management efforts at the composting facilities.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

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

(4) Laboratory analyses will identify which mosquito species are important in the transmission of 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: Eastern equine encephalitis (EEE) and West Nile encephalitis (WNE) are caused by different viruses that are transmitted by mosquitoes to birds and mammals, including humans and horses. The West Nile virus is new to North America. During 1999 and 2001, there were 149 human cases recorded nationwide, including 18 fatalities. Approximately 823 horses from 20 states were infected, of which one-third died naturally or were euthanized. To meet the immediate needs of the public and health officials, a statewide mosquito surveillance program was conducted to determine which mosquito species are important in the epidemiology of EEE and WNE.

Accomplishment/Impact: of the 137,199 mosquitoes tested from 9,085 pools, one isolation of EEE virus was made from one pool of *Culex pipiens,* whereas isolations of WNE virus were made from 14 pools of *Culex pipiens, Culex restuans, Culex salinarius*, and *Culiseta melanura*. Results thus far indicate that the West Nile virus is well established and extensively distributed in Connecticut. Involvement of *Culiseta melanura* in WNE is newly recognized. The majority of isolations were made in densely populated residential areas in southcentral and southwestern Connecticut. In addition, an exotic mosquito (*Ochlerotatus japonicus*) was discovered during these studies in Connecticut. Native to Asia, this mosquito was collected at 87 locations in all 8 counties. Since this mosquito feeds on a wide range of vertebrate hosts, its introduction in the United States is considered to be of great public health and veterinary significance. Results of surveillance programs

and virus analyses were released to the media, veterinarians, and public health officials so that precautions could be taken and mosquito control programs could be implemented. Upon learning where infected mosquitoes occurred in the state, citizens took precautions by using repellents and by minimizing their exposure to mosquitoes. Personnel in local health departments treated catch basins with larvicides.

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 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 citizens. **Themes: Integrated pest management; Pesticide application and management; Other (Emerging infections; Wildlife science)**

Description: *Anaplasma phagocytophila* (formerly *Ehrlichia phagocytophila*) causes granulocytic ehrlichiosis in horses, dogs, and humans in the United States and Europe. Pathogens are transmitted by *Ixodes scapularis* ticks in eastern United States and by related ticks in western United States and Eurasia. To meet immediate critical needs of veterinarians, physicians, and other

stakeholders, class-specific enzyme-linked immunosorbent assays (ELISAs) were developed to improve laboratory diagnosis.

Accomplishment/Impact: a recombinant fusion protein having a molecular mass of about 44 kilodaltons was produced and used in ELISAs to detect serum IgM and IgG antibodies. Test results for horses revealed antibodies to granulocytic ehrlichiae in samples collected in Connecticut, New York State, Virginia, and Georgia. This established that the disease occurs in widely separated tick-infested areas of eastern United States and is not restricted to the Northeast, as previously thought. New tests for humans were highly sensitive and specific. Based on new findings, veterinarians and physicians in eastern United States are considering granulocytic ehrlichiosis as a possible cause of febrile illnesses in tick-infested areas. These ELISAs have been helpful in assisting veterinarians and physicians in the diagnoses of unknown febrile illnesses.

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

Scope of impact: multistate (CT, GA, NY) 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 ehrlichiosis, 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)**.

Description: During studies on human granulocytic ehrlichiosis and equine granulocytic ehrlichiosis, health officials suspected that another unidentified ehrlichial agent was infecting hosts.

Antibody tests were showing what appeared to be cross-reactions with *Ehrlichia chaffeensis*, the agent that causes human monocytic ehrlichiosis. Accordingly, tests were performed on field-collected *Amblyomna americanum* (lone star tick) to detect the DNA of *E. chaffeensis.*

Accomplishment/Impact: eight of 106 (7.6%) adult ticks that had bitten people in Connecticut were indeed infected with *E. chaffeensis.* These findings confirmed antibody test results. Presence of *E. chaffeensis* in Connecticut marks the northern geographic distribution of this pathogen in eastern United States. Findings were reported to the media, physicians, and state and federal health officials. Physicians are requesting that human serum samples be tested for *E. chaffeensis* antibodies, particularly when there are declines in numbers of white blood cells or platelets.

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

Scope of impact: multistate (CT, RI).

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

(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 ehrlichiosis, and equine and canine ehrlichioses. Homeowners have requested assistance on developing methods of controlling these ticks in localized settings around homes. The pyrethroid insecticide, bifenthrin, and commercial products containing strains of the entomogenous fungi, *Beauveria bassiana* or *Metarhizium anisopliae*, were tested in the field (lawn perimeters near woodlands) at different residential sites.

Accomplishment/Impact: of the materials tested thus far, bifenthrin was most effective in controlling the nymphal and adult stages of the tick. Nymphs are most abundant in June and are the most efficient transmitters of human pathogens. The fungi killed ticks, but results were more variable. Registered pesticide applicators are using bifenthrin for tick control on homeowners' properties.

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 citizens living in rural and suburban areas (**Themes: Human health; Children, youth, and families at risk**).

Description: adults of the blacklegged tick, *Ixodes scapularis*, prefer deer as hosts. The rise in populations of this tick in eastern and upper midwestern United States is correlated with increases in numbers of deer. Deer also destroy nursery plants, tree saplings in forests, and homeowners' shrubs. New studies have been initiated to track deer movement in forests, estimate population densities, and to control deer by a sterilization method. Investigations in Connecticut are integrated

(research and extension) in a newly approved multistate project NE-1005. There are no accomplishments or impacts yet.

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, or soil samples submitted by state regulatory agencies. **Themes: Air quality; Hazardous materials; Pesticide application**

Description: samples of internal organs and tissues of dead birds were submitted by stakeholders to determine if pesticides were present. A total of 260 liver, gizzard, and brain tissues from 129 birds were analyzed for carbaryl, diazinon, malathion, resmethrin, and permethrin to determine if pesticide poisoning occurred.

Accomplishment/Impact: two gizzard samples contained diazinon at concentrations of 2.97 and 333 ppm, suggesting the strong possibility of acute poisoning. Of the 129 birds included in the study thus far, 55 (43%) contained residues of technical chlordane components, DDE (a metabolite of DDT), oxychlordane, and heptachlor, pesticides that had been applied to the environment several years ago before being banned. Therefore, the cause of deaths was determined for some birds. Findings demonstrated that pesticide residues still present in the environment affect the bird population. Wildlife specialists are more seriously considering pesticide poisoning as a possible cause of bird deaths.

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**

Description: microsporidia are protozoan pathogens that can infect mosquito larvae and, thereby, be used in pest management programs to reduce amounts of chemical insecticides used in aquatic habitats. To meet the long-term critical needs of stakeholders and research objectives in an integrated multistate research (S301) project, studies were conducted on the comparative phylogeny of *Amblyospora* species, which live in copepods as intermediate hosts.

Accomplishment/Impact: *Amblyospora* microsporidia are highly specific for their primary mosquito host. However, the same species of copepod may serve as an intermediate host for more than one species of microsporidia. Insect pathologists are now considering copepods as hosts for different microsporidia rather than hosts for a single microsporidian species in efforts to develop biological control programs in the long term.

Sources of funds: Hatch and state.

Scope of impact: multistate (AL, AR, CA, CT, FL, GA, ID, IL).

Accomplishments also apply to goals #3 **(Theme: Human health).**

(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)**

Results

Description: The biosolids (sewage sludge) compost facility in Farmington, CT recently gained approval to release its compost for use as a soil amendment. Biosolids are being viewed as a desirable replacement for conventional components of potting media used for container-grown ornamental plants. However, it is unclear whether plants can grow well in biosolids compost. Studies were conducted with two varieties of chrysanthemums in potting media containing 0, 25, 50, and 100%/vol Farmington biosolids compost.

Accomplishment/Impact: plant growth differed little regardless of the amount of compost contained in the media. It appears that Farmington biosolids compost can be used as an amendment to potting soil in the production of chrysanthemums. Some nursery growers have used biosolids compost.

Sources of funds: Hatch and state.

Scope of impact: state-specific.

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

Description: in a collaborative effort with extension specialists at the University of Connecticut, studies were continued at the request of stakeholders to determine if amounts of

pesticides used in nurseries have declined as a result of implementing IPM practices. Detailed pesticide records were available for three nurseries where on-site assistance was given to establish IPM programs.

Accomplishment/Impact: it was discovered that insecticide/miticide usage collectively increased by 69 pounds of product and 11 pounds of active ingredient because of unexpected resistance in the pest populations. This resulted in a $1,102 increase in costs for pesticide treatment at each nursery. Consequently, growers implemented more stringent monitoring programs for emergence of insect/mite problems as a part of their IPM efforts.

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: field studies on weed management in nurseries were continued at the request of stakeholders to meet their immediate critical needs. The herbicide flumioxazin was tested in granule and sprayable forms for effectiveness in nursery plots with holly and Japanese yew.

Accomplishment/Impact: flumioxazin suppressed the weed mugwort, large crabgrass, and common ragweed with no injuries to the yews and minor injury to holly. The holly recovered by July. Nursery growers are receptive to using flumioxazin. With further studies on the timing of herbicide treatments relative to weed emergence, flumioxazin may, in the long term, be an excellent preemergence and/or postemergence weed control method that can increase profitability.

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 2002.

	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		$1,410,000		16.5	
2004	205,373		$1,410,000		16.5	

*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 2002. The CRIS code for The Connecticut Agricultural Experiment Station is CONH.

Table 1. Multi-Institutional (FY 2002)

Hatch Project	CRIS Access.#	Collaborating institutions and businesses
CONH 133	0183165	CT Dept. of Consumer Protection
134	0183796	U.S. Environmental Protection Agency (EPA)
135	0187947	None
136	0188720	CT Dept of Consumer Protection, US EPA
239[c]	0177684	Yale University (New Haven, CT), Univ. of Oxford (UK)
240	0188383	Yale University, Univ. of Oxford (UK)
241	0191156	Yale University
242[b]	0191890	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)
358	0133614	Yale Univ.
360[d]	0133932	Dept. of Agriculture (MD and NJ), Univ. of Idaho, Cornell Univ.
365[a,d]	0163201	Cornell Univ. (Geneva Exper. Station)
371[d]	0179183	Univ. of Connecticut (Storrs), Cornell Univ.
372[d]	0179689	Univ. of Connecticut (Storrs), Cornell Univ. (NY), Univ. of Rhode Island
374	0185235	Yale Univ., CT. Dept. of Health
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
551[a,d]	0167653	Cornell Univ., W. Virginia (Univ.), Univ. of Georgia, Univ. of Arkansas, Virginia Tech. Univ., Michigan State Univ.

556[c]	0178482	Univ. of CT (Storrs), Hopkins and Stonington CT vineyards
557[c]	0180059	CT. Vegetable Producers, CT. Greenhouse Growers Assoc.
559	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,b,d]	0190494	Cornell Univ., Rutgers Univ., Penn. St. Univ., Univ. of Maryland, Virginia Polytechnic Inst., West Virginia Univ.
561[b]	0191645	CT. Dept. of Agriculture
562[a,b,d]	0191991	Cornell Univ., Univ. of CT, Michigan State, Univ. of Nebraska, Univ. of New Hampshire, Rutgers Univ., Ohio State Univ., Penn. State Univ.
563[b]		CT. Vegetable Producers, CT. Greenhouse Growers Assoc.
625[d]	0178255	Yale Univ., Univ. of CT (Storrs), Cornell Univ., Wageningen Agric. Univ. (Netherlands)
626[d]	0181858	Univ. of CT (Storrs), Univ. of Florida, Michigan St. Univ., Penn. State Univ., Washington State Univ.
627	0185405	Univ. of CT (Storrs)
628	0187597	USDA Forest Service
695[a,d]	0139748	Univ. of Mass., Cornell Univ. (Ithaca & Geneva), Penn. State Univ., Univ. of CT (Storrs), Michigan State Univ.
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	0187670	State of CT. Dept. of Transportation
770[a,d]	0184011	Several states cooperating on W-082
771	0188384	Univ. of CT (Storrs)
772[b]		Biolog. Bundesanstalt fuer land-und Forstwirtschaft (Germany)
804[d]	0179283	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 2002).

Hatch Project	Scientific Disciplines
CONH 133	analytical chemistry, toxicology
134	analytical chemistry, food production systems
135	analytical chemistry, food production systems
136	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
344	acarology, microbiology, immunology, molecular biology, epidemiology, human and veterinary medicine, wildlife diseases
358	insect pathology, molecular biology
360	entomology, horticulture, integrated pest management (IPM)
365[a]	plant genetics, entomology
371	acarology, entomology, IPM
372	agronomy, IPM, analytical chemistry, economics, entomology, insect and plant pathology
374	bacteriology, molecular biology
375[a]	entomology, plant pathology, IPM
377	entomology, ecology
551[a]	horticulture, plant pathology, plant genetics, entomology
556	horticulture, plant genetics
557	horticulture, plant physiology
559	animal behavior/ecology, deer management

560[a]	animal behavior/ecology, deer management
561	horticulture, waste management systems
562	horticulture, plant physiology
563	horticulture, plant physiology
625	meteorology, plant pathology, epidemiology, biophysics, biological control
626	mycology, plant pathology, horticulture, molecular biology
627	plant pathology, biological control
628	plant pathology, mycology
695[a]	nematology, plant pathology, entomology
766	environmental toxicology, soil chemistry
768[a]	protozoology, invertebrate pathology, entomology
769	soil microbiology, horticulture, composting
770	soil chemistry, environmental toxicology
771	soil and water chemistry, environmental toxicology
772	environmental toxicology, soil chemistry
804	analytical chemistry, horticulture, weed management

[a]USDA approved multistate research project.

Table 3. Multistate Collaborations (FY 2002).

Hatch Project	CSREES Multi-state Project Number	Participating states
CONH 133		
134		
135		
136		
239		
240		
241		
242		
344		CT*, GA, ME, IA, SC, TX
358		
360		MD, NJ, ID
365	NE-009[a]	CT*, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, WV
371		CT*, NY
372		CT*, NY, RI
374		
375	NE-187[a]	CT*, FL, ME, MD, MA, NJ, NY, PA, RI
377		CT*, MA, ME, NH, NJ, RI
551	NE-183[a]	AL, AR, CT*, ID, IN, MA, MI, NH, NJ, NY, NC, OH, OR, PA, UT, VA, VT, WA, WI, WV
556		
557		
559		MD, NJ, NY, PA, VA, WV
560	NE-1005[a]	MD, NJ, NY, PA, VA, WV
561		

562	NE-164[a]	CT*, MI, NE, NH, NJ, NYC, OH, PA,
563		
625		CT*, NY
626		CT*, FL, MI, PA, WA
627		
628		
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		
804		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, and 2002 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

Total funds available for entire Hatch program (FY 2002) at C.A.E.S.	$766,911
% Hatch funds dedicated to multi-institutional, multi-disciplinary, and multistate programs	45.1%

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, and 2002.

				SY units	
		Connecticut			Total
	Fed. Hatch Funds	State Funds	Total	Integrated only	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

Total funds allocated to entire Hatch program at C.A.E.S. in FY 2002	$766,911
% dedicated to all multi-categories and integrated activities with CT and other states	33.3%

The Connecticut Agricultural Experiment Station dedicated Hatch funds to integrated activities with extension systems in land-grant universities in different states. In Connecticut, $196,450 was dedicated to integrated activities in FY 2002 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, and 2002.

	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

*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, and FY2002.

	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

Progress Reports: Integrated Activities

(Hatch Act Funds)

Federal FY 2002

Program descriptions: As presented in form CSREES-PLAN (2/00), 11 programs (13 Hatch projects) were listed for integrated activities (Hatch Act Funds). In the previous pages of this Annual Report of Accomplishments and Results (including the Tables), descriptions are given regarding detailed progress made on the planned integrated program. Form CSREES-REPT (2/00) reporting expenditures for FY 2002 follows brief summary statements for these specific programs.

1. Tick-borne infections: New studies have been started on the development of enzyme-linked immunosorbent assays (ELISA) for detecting antibodies to *Borrelia burgdorferi*, the etiologic agent of Lyme borreliosis in humans and domesticated animals. A highly specific recombinant antigen (VlsE) produced at the University of Texas (Houston) is being evaluated with human, dog, horse, and cow sera previously tested by indirect fluorescent antibody staining and western blot analysis. Results thus far on human and horse sera indicate very high sensitivity and specificity.

2. Managing insects on vegetable crops: Various cover crops were field tested for effectiveness of weed control. Fall plantings of rye, rye/vetch, wheat, and winter-killed oats controlled weeds and were more suitable than fall plantings of crimson clover or most spring plantings. These results helped modify growers' management programs.

3. Plant genetic resources (NE-9): Arugula (*Eruca sativa*) has become a popular salad green and has attracted grower interest. Flea beetles, however, cause declines in crop quality and yield. Organic farmers do not want to use insecticides. Accordingly, 169 accessions of arugula in the USDA germplasm collections were evaluated for resistance to this insect. Although there were many positive features (i.e., early harvest and yield), no varieties were resistant to flea beetles.

4. Managing insects in apple orchards: Apple tortrix, an exotic leafroller pest in orchards, attacks 75 species of woody plants in the Northeast. The insect's geographic range is expanding but seems to be concentrated in coastal areas. Preliminary results indicate that pheromone traps are useful for monitoring this pest in orchards.

5. Integrated pest management (IPM) for Connecticut nurseries: Predatory ground beetles, representing about 50 species, were found to be important in controlling black vine weevils in nursery plantings of yews. Precise timing of insecticide treatments was required to minimize impact on the predatory ground beetles in IPM programs.

6. Management of insects in soil and other pests (includes NE-187): Work continued on field testing imidacloprid, thiamethoxam, and acetamiprid for the control of oriental beetle grubs. All three insecticides were effective control measures in nurseries and did not affect activity of a parasitic nematode (*Heterorhabditis bacteriophora*) in attacking beetle larvae.

7. Evaluation of new apple cultivars (NE-183): The following cultivars of apple had resistance to apple scab: Pioneer Mac, Braeburn, Creston, Fuji Red Sport #2, Gala Supreme, Golden Delicious,

Senshu, Shizuka, and Sunrise. Fruitgrowers are planting some of these cultivars. In new experiments, other cultivars of apple were planted but drought caused tree mortality.

8. Suppression of soil-borne diseases: Early dying disease of potato, caused by the fungus *Verticillium dahliae* and a parasitic nematode *Pratylenchus penetrans*, was reduced by planting polynema marigold and sorghosudangrass as cover crops. The nematode was extracted from the roots of a fall oat cover crop, which was unsuitable in potato fields.

9. Analysis of risk for plant diseases: Apple scab remains a serious problem in orchards. Weather data and biological information on the fungus, collected over several years, have been synthesized to develop a model for predicting apple scab infection. This advance has helped to more accurately determine aerial dispersal of fungal spores so that precise fungicide treatment can be applied.

10. Integrated pest management of plant parasitic nematodes (NE-171): The fungus *Rhizoctonia fragariae* causes strawberry root rot after lesions are created by a parasitic nematode *Pratylenchus penetrans.* It was suspected by growers that a root-feeding insect (Asiatic garden beetles) accelerated the effects of the fungus. Greenhouse experiments revealed that the garden beetles had no effect on black root rot severity. Growers can control black root rot by applying fungicides. Insecticide treatments for Asiatic garden beetles are unnecessary.

11. Herbicides/weed control: Weed management studies in nurseries are costly and challenging. Herbicide treatments can cause damage to yews and other commercial plantings. Field tests of the herbicide flumioxazin showed that this compound suppressed mugwort, large crabgrass, and common

ragweed with no damage to yews. Current studies are being conducted to determine if this herbicide can be used more effectively as a pre-emergence or post-emergence treatment.

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		
Managing insects on vegetable crops	6,367	7,294	5,503		
Plant genetic resources (NE-9)	9,117	2,581	1,672		
Managing insects in apple orchards	68,890	61,222	58,148		
IPM for Connecticut nurseries	4,649	2,511	2,603		
Management of insects in soil (NE-187)	1,722	9,915	11,277		
Evaluation of new apple cultivars (NE-183)	1,699	4,346	58,992		
Suppression of soil-borne diseases	44,279	8,875	9,657		
Analysis of risk for plant fungal disease	17,989	54,833	8,017		
IPM for management of plant nematodes (NE-171)	69,690	63,654	55,098		
Herbicides/weed control	13,171	3,133	17,623		
Total	$298,777	$260,671	$255,442		

_____ _____
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 revised and distributed a Policy Statement on nondiscrimination and revised its Affirmative Action Plan in accordance with Connecticut regulations (46a-68-31 through 46a-68-74). Modifications were required to change "mental disorder" to "mental disability" to be consistent with recent legislation. During this reporting period, the Policy Statement was given to employees and their unions and 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 2002 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 29 organizations serving protected groups to invite minorities to apply for positions and participate in existing research programs. Important objectives 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 new initiative began 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 established. An entomologist (White Female) at the Station assisted on writing a grant proposal for USDA funds with a focus on plant science and horticulture. The program was awarded, and five junior or senior students (three White females, one Black female, and one Hispanic female) living in urban settings were interns under the mentorship of six scientists (five White males and one White female) at the Station. The goals are to encourage minority student participation in Station programs, promote workforce diversity at the Station, provide specialized training for the interns, and to stimulate interest in agricultural sciences.

A new building (Johnson-Horsfall Laboratory) is under construction. When finished, there will be an elevator for physically challenged persons. The old building, Johnson Laboratory, will be refurbished and 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, has been refurbished to allow small citizens' groups to meet. The remodeled facility meets all code regulations, including those for physically challenged persons. The intent is to attract stakeholders to the experimental farm so that they would have more frequent contact with Station staff and 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 for nurseries, 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. A Station forester (White male) taught two courses on arboriculture in Spanish to a total of 60 attendees so that they could broaden their educational backgrounds and eventually obtain arborist licenses. The courses included topics on tree structure and biology and on pruning techniques.

Goal 1: Annual public events will be scheduled to meet the needs and interest of all citizens, 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.

Results: Open house events occurred regularly during this reporting period. Plant Science Days were held in the spring (April 9, 2002) and summer (August 7, 2002) in the main auditorium and Lockwood Farm, respectively. Notifications of these events were made as described above.

About 1,520 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 citizens better access to research plots. Wheelchair accessible paths exist in the improved bird/butterfly demonstration garden plot to allow better access for all persons. About 125 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. Hundreds of students, including Blacks and Hispanics from area high schools, attended these events and saw Station exhibits. Citizens of diverse racial and ethnic backgrounds had opportunities to become familiar with the Station's research program, 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 citizens will be invited to see experimental plots on Station-owned farms.

Results: 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. They learned about agriculture, became familiar with Station staff, and brought home fresh produce to their families. Entomologists and plant pathologists gave assistance, as needed, on 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.

Results: 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 at a fall event to elderly citizens.

Results: 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 of the general public of 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, and mailed to members of organizations representing protected persons in Connecticut. 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 and Vice 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.

Results: All procedures described in the Plan of Work and the first two Annual Accomplishment Reports were followed during this reporting period.

Results of 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. Three White females were granted educational leaves to improve their skills. One of these persons is seeking her Ph.D. One White male, one Other male, and two Other females were hired as Postdoctoral Research Scientists in FY 2002. In addition, one Hispanic male was hired as a technician. 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), 28 newly hired permanent or temporary Station employees received a minimum of 3 hours of diversity training and education. Dr. Louis A. Magnarelli, Vice Director and Affirmative Action Officer, conducts a diversity training program, which has received approval by the State Commission on Human Rights and Opportunities. 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 Vice Director and Chief of Services, have been in contact with career specialists in area high schools and with other community leaders to reach minorities in urban settings. A teacher at the Sound School in New Haven continued to cooperate with Station administrators by recruiting five

high school students during the summer of FY 2002 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.

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 2002, two Black females were hired to learn new skills.

A volunteer program is available for students to work part-time during the summer and school year. One White female assisted entomologists and learned new skills. Results gained by this person strengthened her 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 and six Other females were employed as Postdoctoral Research Scientists. The training these minorities received from two 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 as Postdoctoral Research Scientists in FY 2002 under the direct mentorship of established scientists.

Results of Special Crops Program

Stakeholders of different ethnic groups have received the Station's assistance on growing specialized crops, such as arugula, okra, jilo, leeks, artichokes, sweet potatoes, Calabaza (squash), and Chinese cabbage. Sweet potatoes have become very popular at farmers' markets. Jilo is in demand in Connecticut and New York City markets. A Station scientist field-tested these crops to determine quality and yield. There is increasing interest among vegetable growers to raise ethnic crops, which represent an emerging "niche market". In response to stakeholder requests, another Station scientist is conducting field studies to find ways of reducing flea beetle damage by applying organic farming practices.

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. Three Station scientists continue to cooperate with tribal officials in finding ways to 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.

Results of 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 on 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 portion of the budget is available for outside bidders. During state FY 2002, $2,131,083 was expended for outside purchases. Of this amount, $323,251 (15%) was awarded to small contractors. This amount greatly exceeded the state-approved goal ($112,818). There were 22 Minority Business Enterprise set-aside purchases and contracts worth $256,999, which also greatly exceeded the state-approved goal of $28,205. Contracts were awarded to businesses owned by African Americans, Asian Americans, women, and a person who has a disability.

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, nearly all 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 scientists and are not mandated by administrators. The Director and Vice Director encourage collaborative work, however. These joint efforts are sometimes successful in obtaining grant

funds. Some statutory requirements require 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 37 active Hatch projects, 17 (46%) have multistate collaborations. Scientists at The Connecticut Agricultural Experiment Station continue to interact with colleagues in at least 42 other states. The 8 USDA-approved multistate projects (NE-009, NE-164, NE-171, NE-183, NE-187, NE-1005, 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.

As in past accomplishment reports, there are four key questions that need to be re-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? Good progress continues to be made regarding all of these key questions. We affirm that our program is meeting the stakeholders' needs as described in the Plan of Work and in this Annual Accomplishment Report. Contact with stakeholders is a continual process, and research programs are modified based on public needs. Solutions have been found for some problems, but other problems emerge. Expanding the clientele of stakeholders and increasing their involvement in research programs is a high priority goal. Farmers who work along with scientists on solving problems provide space for experimental plots and benefit 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. Efforts are being made to determine economic impact (i.e., dollars saved, increased profitability measures, adoption of more efficient farming practices, etc).

The critical issues stated in each of the program goal sections of the Plan of Work are based on stakeholder input. The expected outcomes and impacts were listed accordingly. In this Annual Accomplishment Report, a description of the problem and specific results were listed for each item demonstrating the progress being made in research. Brief impact statements are included to demonstrate the relevance of the scientific findings and to ensure accountability. This new format facilitates reporting. It was useful to see how other institutions report impact statements. The USDA/CSREES website was helpful.

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 and small farm production; finding new and more efficient uses for plant materials; 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.

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 ethnic

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. 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. Produce from state and Hatch-supported research projects were donated to charitable organizations, food-sharing programs, and senior citizen groups. Minorities received training when hired to assist on 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. 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 resources of participating institutions within and outside Connecticut. Scientific collaborations often accelerate progress. Examples of improved efficiency discussed in this report include the use of improved analytical procedures for testing food items, the development of atomic spectroscopy methods for detecting chromate copper arsenate in plants, the use of IPM practices to monitor or reduce costs of controlling plant pathogens and insects, 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 budgets are under pressure. Moreover, the impact statements for multistate projects, approved by the northeastern Experiment Station Directors, have greatly facilitated the communication of research findings. 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. Good progress is being made on identifying desirable apple cultivars (NE-183). Many new varieties, developed at Cornell University, are being field-tested for resistance to disease and yield in Connecticut and other states. Scientists from 20 states are working together, and there is a strong extension component in the project. Fruitgrowers in Connecticut are planting suitable cultivars. Moreover, nursery and vegetable growers are using new control methods and IPM practices to reduce costs of operations. The inclusion of research/extension specialists in other USDA-approved projects, such as NE-009, NE-164, NE-171, NE-183, and NE-187 and NE-1005, has made these programs more effective in meeting stakeholder needs by providing a more concentrated and coordinated effort. 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 turf manual produced in one of our integrated programs is very popular among landscapers and groundskeepers. More stakeholders need to be encouraged to access national databases for results of USDA-approved multi-programs. Greater public awareness of USDA internet programs is needed. During 2000, a homepage was established 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 research results and other group activities. The feedback from growers continues to be positive. Finally, there is growing public concern over possible terrorist attacks. Citizens have asked questions about how we are protecting our food supply. Efforts are needed to accelerate the linking of diagnostic laboratories in federal and state institutions to quickly detect and report introduced plant and animal pathogens.

In conclusion, the Station's multi-programs with joint research/extension activities have been making progress in solving stakeholders' problems on farms and in homes and businesses. Although applied research activities dominate, there remains a strong core program for basic research.

Certification

This third Annual Report of Accomplishments and Results was prepared by Dr. Louis A. Magnarelli, Vice Director, 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. John F. Anderson, Director