2001 Annual Report of Accomplishments and Results

The Connecticut Agricultural Experiment Station

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TABLE OF CONTENTS

Executive Summary (Overview)

The Connecticut Agricultural Experiment Station ("Station") is dedicated to the needs of all citizens. Special efforts are made to inform the public of research findings. Outreach programs exist to meet the needs of the under-served and under-represented. Collaborations between the institution's scientists and extension specialists at the University of Connecticut and other land-grant universities continue to improve efforts to disseminate new findings to a broader base of stakeholders. Although state appropriations exceed amounts of federal Hatch funds, the latter continue to be crucial in our efforts to respond quickly to new problems, conduct relevant research, and to meet the needs of society.

Similar to last year, we are pleased to report many successes that benefit citizens. In many instances, 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 program at The Connecticut Agricultural Experiment Station is strongly supported by stakeholders, who are given numerous 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, and, 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 FY2001. The research results and impact statements are linked to FY2001 activities.

To continue to improve the competitiveness of our agricultural system in the global economy, many research initiatives are directed at adding value to new and old agricultural products, increasing

profitability, and improving plant health and production efficiency. Multistate and integrated activities continue to strengthen our ability to make progress on a wide range of problems. Stakeholders have requested assistance in identifying plant cultivars that are resistant to plant diseases and insect infestations, treating diseased and infected plants with minimal amounts of pesticides or by cultural practices, and on growing vegetables organically. It is important to develop more sensitive and specific analytical methods to determine if food and drinking water are contaminated with unwanted chemicals. Finally, with expanding global markets and greater amounts of imported goods, there is a need to monitor 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 solid phase microextraction procedure was developed by an analytical chemist to analyze volatile organic compounds in liquid and solid samples such as cookies, candy, baby formula, sunflower seeds, salad dressing, and potato chips. Consumers benefited by knowing that their food is safe.
2. A bioassay has been used to determine resting spore load of *Entomophaga maimaiga*, a natural fungus disease of gypsy moths. Infection rates of caterpillars in forests correlated positively with physical counts of spores in the soil. This assay can be used to predict future fungus activity. Homeowners benefited by not having to spray trees.
3. As a part of integrated (research/extension) activities on apple scab, results showed that the first ascospores are mature and ready to be released from diseased dead apple leaves on the ground when the first green tissues of McIntosh leaves appear. It was also found that the ascospores are carried by the wind to developing fruit and shoot buds and cause primary infections that can lead to lesions. The critical time for chemical control has been identified, and fruitgrowers benefited by knowing when to spray. Results also apply to national **goal #3**.
4. A method using atomic spectroscopy was developed to test treated wood surfaces (eg., decks, picnic tables, etc.) for dislodged chromated copper arsenate preservatives. Consumers benefited by knowing whether or not there was contamination.
5. New sampling methods were developed to more efficiently detect a new exotic wood-boring insect, the smaller Japanese cedar longhorned beetle on arborvitae, other cedar trees, and wood

products.

Nursery growers, garden centers, and homeowners benefited by knowing if this pest was present and if chemical control was needed.

6. In a multistate research effort to improve monitoring of flea beetles in organic farms, a Multigard trap baited with mustard powder effectively trapped the insect pest. This method can now be used as a part of integrated pest management programs to determine population changes of flea beetles in plots containing cole crops. Vegetable growers benefited by knowing how to monitor these pests. Results also apply to **goal #3**.
7. As a part of integrated activities, field investigations were conducted on two exotic insect pests (apple tortrix and the green pug) in fruit orchards in northeastern United States. The apple tortrix caterpillars fed on 50 species of wild or cultivated plants in 9 families; 40 species were in the apple family. The green pug larvae also have a broad host range. They selected 18 species of plants in the apple family and fed primarily on blossoms of the fruit trees. Fruitgrowers benefited by knowing where these pests occur, which crops are attacked, and when to control the insects. Also **goal #3**
8. The root lesion nematode, *Pratylenchus penetrans*, reduced strawberry yields in microplots. The multistate, integrated research effort (NE-171) aided strawberry growers by identifying more precise times when nematicides were needed for control. Also **goal #3**.
9. In a multistate, integrated project, sodium chloride treatment of asparagus suppressed *Fusarium* crown and root rot. Salt had no direct effect on the fungal pathogen but affected the plant host, physiologically, and indirectly resulted in disease suppression. Vegetable growers benefited by not having to use fungicides. Also **goal #3.**
10. As a part of multistate (NE-183) and integrated research, evaluations of new apple cultivars identified two cultivars, Enterprise and Pristine, that had the least amount of scab (fungus) damage. 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 Blanc (a french hybrid cultivar) had high yields, produced high sugar content, and demonstrated hardiness. Grape growers benefited by knowing that Villard Blanc is a suitable cultivar to grow.

12. Field evaluations of sweet potato cultivars showed that the varieties Beauregard and Carolina Ruby had high yields. Sweet potato, considered an ethnic crop, is popular in farmers' markets. Consumers and vegetable growers benefited by having produce available for sale. Also **goal #3**.
13. At the request of ethnic stakeholders, cultivars of jilo (a type of eggplant) were field tested for crop yield and quality. Two cultivars, Teresopolis Gigante and Comprido Verde Claro, grew well in Connecticut and, despite drought conditions, produced acceptable yields. This is a new niche crop for growers. Vegetable growers and consumers benefited by having produce available for sale. Also **goal #3**.
14. Parasitic nematodes have been found to keep black vine weevil larvae, pests of strawberry plants, under control. The action of these beneficial nematodes has resulted in savings to strawberry growers by reducing costs of applying chemical nematicides.

Federal Hatch Funds ($418,616), State Funds ($2,490,608), Scientist Years (18.3)

Citizens remain concerned about food safety issues, particularly pesticide and other chemical residues in the food supply. Widely publicized instances of contamination or outbreaks in the past have led to more marketbasket surveys and analyses of food items.

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

1. In pesticide analyses, residues of captan, a fungicide used on a variety of fruits and vegetables, can be nearly eliminated by rinsing the produce with water. In other analyses of 160 samples of vegetables, fruits and juices, concentrations of pesticide residues were generally below tolerance levels established by the U.S. EPA. The general public benefited by knowing that rinsing produce removes some pesticide residues and that foods were safe to eat.
2. Lead was detected in maple syrup, a premium value-added product. Substantial decreases in lead concentrations were observed in analyses when sources of lead (eg. galvanized buckets, bronze gear pumps and lead-soldered buckets) were replaced. The general public and maple syrup producers benefited by learning how to prevent lead contamination.
3. In analyses of fish taken from a polluted river, concentrations of polychlorinated biphenyls,

synthetic organic chemicals, and polychlorinated dibenzofurans were generally below tolerance levels. The State Department of Environmental Protection benefited by knowing that certain chemicals in polluted rivers do not accumulate in fish to unacceptable concentrations..

Federal Hatch Funds ($141,277), State Funds ($419,336), Scientist Years (3.9)

Research activities in program **goal #4** are designed to address a variety of environmental problems and issues that are of interest to stakeholders. Citizens frequently encounter ticks and mosquitoes and are concerned about the pathogens they transmit and the pesticides used to control the pests. Many human pathogens, such as the Lyme disease agent, other bacteria that cause ehrlichiosis, and the West Nile encephalitis virus, are also veterinary pathogens of dogs, horses, and cattle. In addition, there is rising interest in composting and in finding ways to decontaminate soil and water of unwanted agricultural and industrial chemicals. Also, tomato growers asked for assistance on amounts of nutrients to be used in greenhouses.

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

1. The greatest tomato yields in greenhouses resulted when plants were given nitrogen fertilizer at a low rate. Tomato growers benefited by increasing efficiency of production and lowering costs in greenhouse production facilities. Also **goal #3**.
2. The highest yields of field-grown peppers occurred on plots receiving leaf compost and the full rate of fertilizer. Vegetable growers and consumers benefited by knowing how much leaf compost and fertilizer to use.
3. In studies of biosolids compost, tests indicated that when clay was used as an additive to the plant growth medium, it was effective in abating the leaching of all metals except arsenic. The general public and nursery growers benefited by knowing the advantages and limitations of using biosolids compost.
4. West Nile encephalitis viruses were isolated from four species of mosquitoes. Health officials and the general public in towns where infected mosquitoes were found benefited by being

alerted to an emerging infectious disease and by being able to conduct mosquito control programs. Also **goal #5**.

5. West Nile encephalitis viruses were isolated from brain, heart, or kidney tissues of birds and a striped skunk. Genetic analyses of the virus isolates revealed differences and that there were at least 10 unique strains. National and state public health officials and scientists benefited by learning that different strains of the virus exist. Also **goal #5**.
6. As a part of multistate project S-301, a microsporidian parasite (*Amblyospora stimuli*) of a mosquito (*Ochlerotatus stimulans*) persisted at a very low prevalence and had minimal impact as a biological control agent. Researchers who are trying to develop biological control programs for mosquitoes benefited by learning that the microsporidian parasite had low potential for being an effective biological control agent.
7. Chemical analyses using Fenton reactions revealed that the pesticides methyl parathion and atrazine could be removed from contaminated soil. Soil chemists benefited by learning about the newly developed methods.
8. A highly specific surface protein found on all North American bacterial strains of the human granulocytic ehrlichiosis agent (HGE) has been cloned and purified to be used as a reagent in antibody detection assays. Humans infected with HGE and owners of infected animals (dogs, horses, and cattle) benefited by having new diagnostic tests.
9. White-tailed deer in Connecticut were found carrying antibodies to and the DNA of the human granulocytic ehrlichiosis agent. It is hypothesized that deer may be infecting ticks in northeastern United States. Health officials, physicians, veterinarians, and the general public benefited by learning that deer are probably important reservoirs for infection. Also **goal #5**.
10. Studies on integrated pest management (IPM) programs in four nurseries demonstrated a reduction of 296 pounds of insecticide used as a result of following IPM practices. Growers benefited by reducing costs, and the neighbors living near the nurseries benefited by having lower amounts of pesticides being used in their communities.
11. A joint research/extension activity resulted in the production of a turf grass manual for homeowner and lawn care professional use on controlling insects, weeds, and diseases.

Federal Hatch Funds ($207,127), State Funds ($1,600,558), Scientist years (18.6)

Similar to last year, there were numerous 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 research projects (NE-009, NE-171, NE-183, NE-187, S-301, and W-082) encouraged greater interaction of scientists from several states. The blend of talent in these groups facilitated research progress. Other less formal multistate collaborations, albeit with fewer participants, also 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 (available upon request). 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

To comply with the Agricultural Research, Extension, and Education Reform Act (AREERA) of 1998, this second 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 results reported herein are based on the Station's research program, the main mission of the institution. Some research efforts, however, continue to be linked to extension programs at universities. Information on research findings were disseminated to extension personnel in accordance with the Station's approved Plan of Work. Efforts have been made to develop 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, received research findings that can be incorporated in educational programs directed at all five national USDA goals and, thus, reach many more diverse audiences of stakeholders.

The Station has a broadening outreach program and engagement with stakeholders, who are herein defined as those who benefit directly or indirectly from agricultural research (including forestry). In addition to the general public, stakeholders include : scientists, legislators, administrators, forestry officials, and industry personnel. Therefore, publishing scientific results in peer-reviewed journals is an important venue for reaching stateholders in the nation. The multistate, multi-institutional, and multi-disciplinary approach to research (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 annual report, 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) 2001. Station scientists, administrators, and other staff members seek stakeholder input on a regular basis to identify problems so that critical issues in Connecticut can be addressed. Oral and written stakeholder comments 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 broad 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 22 protected organizations (i.e., minority groups) inviting citizens to attend the institution's public events. Sample letters received from stakeholders are available upon request. There were several mechanisms used

to receive citizen input on their needs, opportunities for stakeholders to see research plots and experimental results, and to foster 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 January 5, 2001. These stakeholders requested Station assistance on improving an educational forum held annually. Of particular importance, was inviting a speaker to inform growers about plum pox, a disease caused by a virus that could reduce production of plums and peaches. Other issues discussed related to research. 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, forest owners, harvesting practitioners, and public officials asked for Station assistance on producing a Forest Regeneration Handbook. Similarly, groundskeepers asked for a turf pest guide. Station scientists agreed to work with these stakeholders and to produce the handbook and guide to enhance businesses.

During FY 2001, 484 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 2001. 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 (question and answer sessions). These persons were, therefore, considered direct beneficiaries of agricultural research in Connecticut and elsewhere. An asterisk marks stakeholder interactions in the McIntire-Stennis research programs.

American Association for Laboratory Animal Science

American Chemical Society

*American Chestnut Foundation

American Lyme Disease Foundation

American Phytopathological Society

American Society for Horticultural Science

American Veterinary Lyme Disease Society

Amity High School

Animal Behavior Society

Annie Fisher School

Bartlett Arboretum

Beecher Road School

Branford Garden Club

Bridgeport Garden Club

Brooklyn Botanical Garden

*Canadian Chestnut Council

Casimir Pulaski Elementary School

Centers for Disease Control and Prevention

Certified Organic Associated Growers of Connecticut

Cheshire Grange

*Chestnut Marketing Assoc.

Childrens New School

*Christmas Tree Growers Assoc.

Connecticut Academy of Science & Engineering

Connecticut Agricultural and Natural Resources Foundation

Connecticut Beekeepers Assoc.

*Connecticut Chapter of The American Chestnut Foundation

*Connecticut Chapter of the American Society of Foresters

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 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 NOFA (organic farmers)

*Connecticut Nursery & Landscape Association

Connecticut Office of Policy and Management

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 Valley Garden Club

Connecticut Wine Council

Cornwall Conservation Trust

Council of the American Phytopathological Society

Council on Soil & Water Conservation

Darien Health Department

DelMarvelous Farms

Deep River Garden Club

East Haven Garden Club

Entomological Society of America

Environmental Industry Council

Experiment Station Associates
Fairfield County Horticultural Society
Fairfield Historical Society
Fairfield Woods Middle School
Farm Wine Development Council
Future Farmers of America
Governor's Council on Agriculture
Greenwich Garden Education Center
Hopkins Vineyard
Lyme Disease Foundation
Lyme Disease Task Force
*Middletown Parks & Recreation
Middletown Regional Vocational Agric. Center
Mill River Watershed Assoc.
Monroe Garden Club
National Academy of Sciences
National Geographic Society
National Organic Farmers of America
National Plant Board
Nature Conservancy
*Naugatuck Wetlands Commission
New Britain Garden Club
New Canaan Nature Center
*New England Christmas Tree Growers Assoc.
*New England Society of American Foresters
New England Vegetable and Berry Growers
New Haven Garden Club
New Haven Homeless Garden Project
New Haven Land Conservation Trust
New Haven Sound School

New York City Parks Natural Resources Group

*Northeast Forest Pest Council

*Northeast Utilities

Northeastern Mosquito Control Association

Northeastern Weed Science Society

Northford Elementary School

*Northern Nut Growers Assoc.

Portland Garden Club

Prian Vineyard

*Oxford Garden Club

Quinnipiac University

Quinnipiac Valley Health District

Regional Water Authority

Sessions Woods Conservation Center

Shoreline Christian School

*Society of American Foresters

Society of Professional Journalists

Southern Connecticut State University

Stamford Health Department

*Stone Museum (People's State Forest)

Suffield High School

Trinity College

Tolland Agricutural Center

Tolland County Soil Conservation Service

Torrington High School

*Treasure Forest Assoc.

Uniroyal Corporation

University of Connecticut (includes Cooperative Extension)

University of Massachusetts

*Urban Forestry Council

*US Forest Service
*USDA/APHIS/PPQ
Vegetable Growers Assoc.
Wallingford Health Department
Weed Science Society of America
Westport Nature Center
White Memorial Nature Center
*Yale University (includes forestry and public health)
Yale Peabody Museum
*Yankee Division of the Society of American Foresters

Diagnostic services were made available to citizens to identify insect pests and plant diseases and to offer suggestions on control. This program coincides with a USDA management goal: enhancing customer service/satisfaction. Soil samples also were analyzed to assist farmers and homeowners. During state FY 2001, there were 30,824 total public inquires from stakeholders to all Station staff members. There was a broad range of inquires. For example, scientists in the Department of Entomology answered 6,595 public inquiries. Of these, 1,443 (22%) were from persons who visited the department. Information obtained by growers and industry personnel enhanced businesses. Questions on natural resources (80%) were most frequent followed by inquiries on pests of humans or persons' dwellings (16%) and on food crop insects (4%). Scientists at the Valley Laboratory in Windsor, Connecticut answered 9,743 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 were most frequent. Scientists visited commercial and private properties to diagnose more complex problems and to give stakeholders immediate assistance in solving problems. 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 2001, 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 spread into northern New York State and was reported in the Boston, Massachusetts area, northern New Jersey, metropolitan New York City area, and throughout Connecticut. This disease also emerged in the District of Columbia, Florida, Georgia, and Maryland. 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, and a variety of plant diseases continue to be of high interest to reporters and other stakeholders nationally. During June of 2001, an outbreak of armyworm caterpillars occurred in the northeast. Lawns and hayfields were damaged, and studies were quickly started to obtain information.

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 "one on one" or attended public talks and were able to address issues during question and answer sessions. 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 the past year, the Station held special public conferences and open houses. On February 28, 2001, a meeting was held for fruitgrowers in Connecticut to hear about the latest Station research findings that would help solve insect and plant pathogen problems . Plum pox was a featured topic. At an April 3, 2001 public meeting, scientists reported their findings on deer in gardens, medicinal herbs and how they grow, and on butterflies in Connecticut. On August 1, 2001, open houses were held at the Station's farm in Hamden, Connecticut. About 1,226 persons attended this event and were able to visit experimental plots, demonstrations, and exhibits to hear scientific reports including armyworms, mosquitoes, ticks, hemlock woolly adelgids, gypsy moths, forest management, biotechnology and plant science, and new chestnut cultivars for Connecticut. 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), a membership of about 1,025 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 Director, gave oral presentations and reports to ESA members at their annual meeting on March 15, 2001 and monthly Board of Directors' meetings. Members in attendance at the annual meeting heard presentations by Station scientists on humane control of deer and controlling weeds in lakes. 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 the nursery industry, fruitgrowers, and vegetable growers. Many experiments were conducted in nursery fields and greenhouses and other farmers' properties at the request of these citizens. Stakeholders were involved with the planning process and evaluation of scientific results. For example, beetle larvae (white grubs) are pests in nurseries and strawberry production. These insects are very difficult to control, even with the use of chemical pesticides. Responding to stakeholder requests and input, station scientists promptly performed experiments to find an efficient and economical method of control. The use of pathogenic nematodes has improved the control of black vine weevil grubs and serve as an alternative to chemical pesticides. Nematode activity resulted in less chemical insecticide 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 2001, stakeholders continued to assist the Director and other scientists at the Station by providing dead birds for analyses. 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. For example, the West Nile virus was recovered from the brain of a red-tailed hawk that died in New York in midwinter. This demonstrated survival of the virus beyond the mosquito season and indicated another possible pathway of transmission: prey to predator.

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. These findings were made available to scientists nationally via a scientific article published in the Journal of Nematology.

The Station's McIntire-Stennis program focuses on forest insect pests, such as hemlock woolly adelgids (*Adelges tsugae*), gypsy moths (*Lymantria dispar*), hemlock loopers (*Lambdina athasaria*); 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.

The hemlock woolly adelgid, *Adelges tsugae,* is a destructive introduced pest of eastern hemlock and Carolina hemlock in 11 eastern states from North Carolina to southern New England. With continued 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 impossible. Native natural enemies are ineffective control agents.

In view of the limitations of chemical control in forests, there was a need to find predators that could be imported and released into areas where *A. tsugae* was established. Earlier studies demonstrated 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. After federal permits were secured, the beetle was released in sites infested with *A. tsugae*. As a part of an ongoing effort over several years, about 180,000 beetles have been released thus far at 18 sites in Connecticut. Thousands more have been released in New Jersey and Virginia as a part of a cooperative multistate program. Field research has demonstrated good potential for this beetle in biological control. Current studies are designed to determine hemlock stand conditions and the patterns and timing of beetle release that will enhance the biological control effort. Moreover, the impacts of pesticides on the predatory beetle and how applications can be made to minimize adverse effects are being investigated. Citizens now have a control program that can work in forests.

The hemlock woolly adelgid is widely distributed in Connecticut and other eastern states and continues to be of great concern to federal, state, local government officials, and to arborists who are called upon to treat infested trees. Consequently, 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 collaborated with other scientists in the Virginia Department of Forestry on a related adelgid: balsam woolly adelgid. Stakeholder input was also received from questionnaires 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.

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 Long Island and Westchester County, New York offices 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 in 10 eastern states.

Requests were made by stakeholders to identify caterpillars that might be causing damage to conifers. Station scientists responded by initiating extensive field investigations. Conifers were sampled in the following states: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. Pheromone studies were continued in 2001 on hemlock loopers to develop trapping methods for surveillance. Results of recent investigations were reported to water company officials, state foresters, and park officials in different states at annual regional meetings of the Northeast Forest Pest Council and USDA Forest Service. A color atlas of caterpillars that attack jack pine, white pine, pitch pine, balsam fir, cedars, and red and white spruce is being developed. Station scientists continue to make progress in preparing the atlas with the assistance of the USDA Forest Service, Forest Health Technology Enterprise Team in Morgantown, West

Virginia. At the request of these and other stakeholders, talks and interviews have been given to provide annual progress reports.

Gypsy moths have been a concern of citizens in New England since the early 1900's. Major defoliation of several hundred acres of forests occurred during the early 1970's and 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 to low populations by a pathogenic fungus, *Entomophaga maimaiga.* Although *E. maimaiga* has had an important impact on gypsy moths since 1989, it is unclear whether or not this fungus will continue to be an important biological control agent, particularly during years of drought. Reporters and other citizens 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. The requests were made by arborists and homeowners on whether trees should be sprayed preventatively for protection. In response, long-term field and laboratory investigations were designed to (1) develop an accurate and simple method for determining the abundance of resting spores of *E. maimaiga* in forest soils before the hatch of gypsy moth eggs; (2) use this sampling method to determine the relationship between resting spore load in forest soils and subsequent incidence of infection in gypsy moth larvae; (3) determine what effect fungal conidia from infected caterpillars had 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 was 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 developed to predict fungal activity on caterpillar populations. Recent findings indicate that viability of fungal spores is greatly reduced after 7 years of dormancy.

In addition to the displays of research results at the Station's annual open houses for the public, other displays were presented at the Connecticut Flower Show, Farm/City Week, and at annual meetings of arborists, nursery owners, and landscapers. Technical presentations also have been given at national meetings, such as the Entomological Society of America, for scientists to review findings. In addition, research results were presented to the USDA Interagency Gypsy Moth Forum and published in peer-reviewed journals, such as Environ. Entomol. Comments received by attendees of meetings were useful in modifying experimental design.

In the early 1900's, the American chestnut population in eastern United States suffered a severe epidemic caused by an imported fungal pathogen, *Cryphonectria parasitica.* 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 for nut production, enhancing the diversity of forest ecosystems and for lumber and 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. A continued focus of research in Connecticut and other states in a USDA-approved multistate 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, 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 tree regeneration in some Connecticut forests. Oak, an economically important tree for lumber production, has been affected along with eastern hemlock. Foresters and water authority officials have requested that research be conducted to find ways of protecting oak conifer seedlings in areas of high deer density. Initially, experiments were conducted in state forests, water company properties, and on lands owned by a power company (Northeast Utilities). Research cooperators in these organizations 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 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. 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. Additional plots are being investigated 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 continue to be a major concern of the public. These arthropods transmit pathogens that cause Lyme disease, babesiosis, ehrlichiosis, and Rocky Mountain spotted fever. Citizens in southwestern Connecticut noticed an unusual tick and sent specimens to the Station for identification and analyses. The ticks were identified as lone-star ticks (*Amblyomma americanum*), common in southern states. DNA analyses revealed that the ticks were carrying *Ehrlichia chaffeensis*, the causative agent of human monocytic ehrlichiosis. This is a new distribution record for this bacterium in Connecticut, which marks the northern boundary of its geographic range.

Stakeholder input also was obtained when scientists served as members of advisory boards, committees, or officers of organizations. During FY 2001, 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
Bloomfield High School Advisory Board for Agri-Science
Branford Inland Wetland Commission
Butterfly Atlas Project
Certified Organic Associated Growers, Inc.
Chestnut Marketing Association
Clay Minerals Society
Clear Lake Improvement Assoc.
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 Farm Wine Development Council
Connecticut Forests Forever

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

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

Gypsy Moth Management Committee, Cooperating States

Homeless Garden Project, New Haven

Invasive Non-Native Plant Committee

Japanese Beetle Domestic Harmonization Agreement Review Committee

Journals

- Agricultural & Forest Meteorology (Editorial Board)
- American Phytopathology Society (Editor-in-Chief; Publications Board)
- Compost Science & Utilization (Editorial Board)
- Entomological Science (Subject Editor)
- Environmental Engineering Science (Editorial Board)
- Eukaryotic Microbiology (Board of Reviewers)
- Florida Entomologist (Associate Editor)
- Plant Health Progress (Senior Editor)

Lyme Disease Foundation

Mill River Watershed Assoc.

National Christmas Tree Growers Association

Natural Area Preserves Advisory Committee, Dept. of Environ. Protection

Natural Resources Council of Connecticut

New England Plant Conservation Program

New England Society of American Foresters (Executive Committee)

New England Vegetable & Berry Growers' Assoc.

Northeastern Forest Pest Council

Northeast Organic Farming Association of Connecticut

Northeast Regional Committee of the Workgroup on Environmental Toxicology and Chemistry

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

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

Quinnipiac University (Adjunct Assistant Professor)

Regional Hatch Turf Work Group

Resource Development & Conservation Committee

Sigma Xi (Quinnipiac University Chapter)

State Survey Committee Cooperative Agricultural Pest Survey, USDA

Society of Nematologists

State Coordinator, North American Blue Mold Warning System

State of Connecticut Eastern Equine Encephalitis Working Group

Urban Forestry Council

USDA State Survey Committee

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, all scientific proposals of the Station were subjected to merit and peer review following federal register guidelines and the National Science Foundation model (http://www.eng.nsf.gov/pet/review-2.htm). Merit review for proposals 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' 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. These critical reviews are important in ensuring quality science. 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 conferences and meetings. 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 would be tabulated annually and reported to document interaction with stakeholders. There were 45 publications, 189 talks, and 99 media interviews recorded for state FY 2001 in association with this program goal. There were 42 officerships and memberships held by Station scientists in stakeholder organizations and national or state committees during state FY 2001. 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 results summaries are presented under the respective outcome indicators listed and are an extension of the Plan of Work. Impacts for results are indicated in each section, and when research is in an advanced stage, a short impact statement for stakeholder use follows. Titles for these impact statements are in bold type. 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., last year 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**

Results

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

(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**.

Results

A book of proceedings on the workshop was prepared in FY 2000, as reported in last 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. **Impact:** a survey of conference participants indicated that the meeting and proceedings were well-received by participants and other stakeholders. **Sources of funds:** Hatch, SARE grant, and state. **Scope of impact:** multistate integrated research and extension.

Successful Workshop on Organic Farming. A survey was conducted during this reporting period to determine impact of the conference on farmers. Of the 16 conference participants contacted, 14 responded and all but one person indicated that they are now using organic farming practices learned

during the meetings and that they implemented changes in their farm operations. All persons requested that additional conferences be held.

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

Results

A solid-phase microextraction procedure was tested and incorporated by Station scientists to analyze volatile organic compounds, such as petroleum-based hydrocarbons and oxidized materials, in liquid and solid samples. The procedure allows for a rapid comparison between a consumer sample with a reference sample (standard). **Impact:** The method has been successfully applied in analyses of 29 samples including products such as cookies, candy, baby formula, sunflower seeds, salad dressing, and potato chips. No residues of contaminants, however, were above federal tolerance levels. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These results also have application to goal #3 by ensuring a healthy, well nourished population (**Theme: human health)**.

Improved Analyses for Food Contaminants. Chemical contaminants in foods are of major concern to consumers. Traditional testing procedures are time-consuming. A solid-phase microextraction procedure, used by scientists at The Connecticut Agricultural Experiment Station, has improved analyses of liquid and solid samples for volatile organic compounds. This advancement allows for more-efficient analyses of food items.

(4) field trials of six cultivars of sweet corn will reveal a cultivar 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**

Results

This objective was accomplished, and results were discussed in last year's annual report. New trials were conducted, however, on different cultivars for further evaluation. **Impact:** SWEET BREED cultivars had higher germination rates than white supersweet cultivars. In addition, the average weight of ears of Sweet Symphony and Sweet Chorus exceeded 8 ounces in two of three plantings in northern Connecticut. Growers on small farms are including the Sweet Breed cultivars in their operations. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These results also apply to goal #3 by providing food to ensure a healthy, well nourished population (**Theme: Human health).**

(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)**

Results

Entomophaga maimaiga, a pathogenic fungus of Asian origin has kept gypsy moth populations at low levels since 1989 in southern New England forests. Major outbreaks of gypsy moths in the early 1970's and 1980's caused extensive defoliation of oak, maple, and other hardwood trees. As reported last year, laboratory studies were conducted to determine resting spore viability (i.e., ability to infect caterpillars in the forest) to meet intermediate critical issues. In recent studies, laboratory bioassays of resting spore load in soils from different sites in Connecticut were conducted by collecting soils and exposing them to gypsy moth larvae in the laboratory to assess infectivity. **Impact:** infection rates were highly correlated with physical counts of spores in the soil. Forest areas defoliated most recently had the highest numbers of resting spores in the soil, but drought conditions in a previous year caused fungus inactivity. The useful and accurate bioassay can be used to predict future fungus activity and enable scientists to develop computer models. **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**

Results

Apple scab is a serious disease of apples and must be controlled to produce marketable fruit. The disease is caused by a fungus *Venturia inaequalis*, that infects the leaves and fruit of apple trees and survives the winter primarily in diseased apple leaves on the ground. New findings are available on the seasonal maturation and release of fungal ascospores. 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 found that the first ascospores are mature and ready to be released into the air at a time roughly corresponding to the emergence of the first green tissues of McIntosh apple leaves. Ascospores are carried by the wind to developing fruit and shoot buds, where they cause primary infections that can lead to lesions. **Impact:** to prevent explosive buildup, precise chemical control of apple scab is focused on greatly reducing primary infections caused by ascospores. This information was given to apple growers and to extension specialists at The University of Connecticut and will benefit fruitgrowers in their efforts to reduce amounts of chemical pesticides used in apple orchards and to produce a quality product. **Source of funds:** Hatch and state. **Scope of impact:** multistate integrated research and extension (CT, NY). These results also apply 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**

Results

All aerobic organisms produce highly reactive oxygen radicals as by-products of normal metabolism. These by-products must be quickly eliminated to avoid cellular damage. As reported last year, catalase was found to be one of the crucial enzymes serving this function in both plants and animals. Recent research focused on studying the biochemistry of proteins involved in the binding and stabilization of chloroplast pigments in the light harvesting complex of higher plants, using *Arabidopsis* as a model genetic system. Mutant plants were investigated because they are defective in sensing the transthylakoid pH gradient, which signals exposure to excessive light. **Impact:** results thus far have not revealed significant differences in reduced levels of primary pigments among the mutant plants. Tests are being conducted on the characterization of the proteins that position the secondary pigments of the light harvesting complex of the chloroplast. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

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

Results

Copper chromium arsenate is a widely used wood preservative, which has potential to contaminate surface soil around decks and gardens in homeowners' properties and in public

playgrounds. We reported last year that concentrations of copper and chromium decreased rapidly in the soil with depth. However, better methods of analysis were needed. **Impact:** A method using atomic spectroscopy was developed to test treated wood surfaces (eg., from decks, picnic tables, etc.) for dislodged copper chromium arsenate preservatives. Utilizing a surface wiping technique, the new assay was reliable in quantitating this compound. Investigations are underway to determine the effects of long-term weathering on amounts of copper chromium arsenate dislodged from wood. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These results 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**).

New Method of Detecting Copper Chromium Arsenate. Copper chromium arsenate, widely used as a wood preservative, can contaminate soil around decks and gardens on private properties and in public playground or picnic areas. New methods of quantitating concentrations of this compound were developed by scientists at The Connecticut Agricultural Experiment Station to enable further studies on assessing the degree of soil contamination and if vegetables uptake this contaminant. This information will assist consumers and state and local governments.

(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**

Results

A new wood-boring insect pest, the small Japanese cedar longhorned beetle (*Callidiellum rufipenne*), was discovered in Connecticut 3 years ago. This insect is native to Japan, Korea, Taiwan, and eastern China, but there were previous records of its presence at numerous ports in the United States and at a site in North Carolina. *Callidiellum rufipenne* invades the branches of arborvitae, junipers, and cedar trees and is a borer of living as well as dead or stressed trees. Recent studies have revealed that adult beetles emerge from infested wood in April. After mating, the females lay eggs under bark and in cracks and crevices of stems. When the larvae bore into the cambium and phloem cells of plants, they make winding tunnels just under the bark and cause considerable stem damage. In the fall, the full-grown larvae burrow into the center of stems, form pupal chambers, and overwinter as adults. **Impact:** with new knowledge of the biology of this pest, new sampling methods using trap logs were developed to more efficiently detect beetles around infested garden centers and to enable prompt control with permethrin-formulated insecticides. The beetle also has been found in natural stands of eastern red cedar. Counties of infestations are Fairfield, Middlesex, and New Haven in Connecticut and Suffolk and Westchester in New York State. **Sources of funds:** Hatch, McIntire Stennis, and state. **Scope of impact:** multistate (CT, MA, NJ, NY, RI). Results also apply to goal #4 (**Theme: Pesticide application**).

New Sampling Method for Beetle Pest Protects Nursery Stock. The small Japanese cedar longhorn beetle (*Callidiellum rufipenne*) is an exotic wood-boring insect that attacks arborvitae, junipers, and cedar trees in northeastern United States. This insect is native to Asia but is a threat to the $400 million nursery industry in Connecticut. A scientist at The Connecticut Agricultural Experiment Station determined that a “traplog” sampling method was effective in determining the beetle’s presence in or near garden centers and nurseries. With early detection of the beetle, permethrin-formulated insecticides can be used to protect nursery stock and prevent economic losses. For example, one large nursery in Connecticut has 355,403 arborvitae trees growing. At a wholesale value of $13 per plant, early detection of the beetle and prompt control would save this grower’s $4.6 million crop.

(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

Results

Black vine weevil, Japanese beetle, and the oriental beetle are major pests in container-grown and field-grown nursery crops and turf. The presence of larvae in pots can lead to rejection of plant shipments by states or countries that import Connecticut nursery stock. Stakeholders requested assistance from Station scientists to meet intermediate critical issues. **Impact:** recent test results indicated that prepot potting mix incorporation of bifenthrin at a concentration of 10 ppm was extremely effective (100% control) in container-grown nursery crops against Japanese beetle and oriental beetle grubs. This concentration was lower than that determined last year. These studies were conducted in cooperating nurseries and had stakeholder input and involvement. **Impact:** in a multistate integrated research/extension program (NE-187) on turf pests, replicated trials of halofenozide confirmed effective control of Japanese beetle but also revealed limitations for control of other white grubs. Golf course personnel have been informed of these results. A research/extension activity resulted in the production of a turf manual for homeowner and lawn care professionals to control insects, weeds, and diseases. **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research (CT, FL, MA, MD, ME, NJ, NY, PA, RI) and extension. Results also apply to goal #4 (**Theme: Pesticide application**)

More Efficient Control of Japanese Beetles. Quarantines against Connecticut and other states where Japanese beetles are present require pesticide treatments before shipment of nursery stock. Finding the minimal amount of pesticide needed for effective control decreases costs for growers and

reduces risks to the environment. A prepot potting mix incorporating bifenthrin at a concentration of 10 ppm resulted in 100% control for Japanese beetle larvae. Nursery growers are now using this treatment method. One large nursery grower ships 1,396,400 containers of nursery stock annually to other states and Canada. For an insecticide treatment cost of $0.02 per container, this grower is able to satisfy contracts worth $12,304,360 on the wholesale market.

(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**

Results

Trapping insects on visually attractive sticky traps with plant-derived chemical lures may be useful both as an alternative control method and as a way of monitoring insect populations to meet short-term critical issues of stakeholders. In previous experiments on trapping flea beetles (*Phyllotreta cruciferae*) in cole crops, mustard oil (allyl isothiocyanate) was used as an attractive chemical lure. Because mustard oil is difficult and dangerous to handle, mustard powder (used in oriental cooking) mixed with water was tested as a lure instead. Sticky traps (Multigard) were placed in a kale plot at canopy height with or without a plastic container of the mustard powder/water mixture. **Impact:** the traps with the mustard powder lure caught significantly more flea beetles than those without a lure. Experimental results were given to extension personnel at The University of Connecticut and shared with growers, who, in some cases, are now using Multigard traps in IPM programs. **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research (CT,

MD, NJ, ID) and extension. Results also apply to goal #3 by maintaining a food source to ensure a healthy, well-nourished population (**Theme: Human health**).

Results

A parasitoid, *Pediobius foveolatus* has been used for biological control of Mexican bean beetle in soybeans in the mid-Atlantic states for many years. However, the details on how to use the parasitoid on small acreages of snap beans rather than on soybeans and on farms where multiple plantings are made each growing season are not available. In order to study these questions, releases of *P. foveolatus* were made at three organic farms, an experiment station farm, and in four community gardens in Connecticut. Mexican bean beetle populations were monitored at these sites and at two organic farms where the wasp was not released. Inoculative releases were made in late June and early July using the rates and timing recommended for soybeans. **Impact:** although the wasp was successfully established at all sites, it did not bring the Mexican bean beetle populations under control until mid- to late August. Third and fourth-instar larvae and pupae were reduced to very low or zero densities at all the farms after the end of August. An influx of the adult pests at one site might be due to migration from outside the area. The overall level of control was helpful to these growers, however, who continued harvesting late plantings into October, but in sites where the initial beetle density was high, the Mexican bean beetles did substantial damage to early plantings. Other growers who did not participate in field experiments, are now interested in releasing parasitic wasps. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. Results 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**).

Biological Control of Mexican Bean Beetles. A scientist at The Connecticut Agricultural Experiment Station found that a wasp parasitoid (*Pediobius foveolatus*) established itself after

inoculative releases in snap bean plots and controlled Mexican bean beetles late in the season for the first time in many years. The wasp can be used in integrated pest management programs on small acreage organic farms and community gardens. Interest in releasing parasitic wasps on bean farms is increasing.

Results

Two exotic pests of apple have been discovered in orchards. The apple tortrix, *Archips fuscocupreanus*, is a leafroller pest accidentally introduced from eastern Asia. The green pug, *Chloroclystis rectangulata*, is a European geometrid moth. **Impact:** field studies revealed that larvae of apple tortrix comprised 9.8% of 306 tortricid leafrollers in unsprayed apple trees. Its abundance rated fourth among the 9 insect species encountered. In southern New England, apple tortrix larvae fed upon 50 species of wild or cultivated plants in 9 families. Of these, 40 (80%) species were in the apple family (*Rosaceae*). Larvae attacked all cultivated fruit trees except peach, *Prunus persica*. As in Japan, the apple tortrix has a broad host range. The green pug larvae fed on the buds, young leaves, and blossoms of apple and pear. Hosts included 18 plant species in the apple family. The green pug apparently moved southward from Nova Scotia, Canada and is probably distributed throughout the northern part of northeastern North America. Fruitgrowers are now monitoring for both insect species, and new knowledge on the life histories of these pests has been useful in implementing precise chemical control programs. **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research (CT, MA, NJ, NY, RI) and extension.

New Exotic Pests of Apple. A scientist at The Connecticut Agricultural Experiment Station discovered two new exotic pests of apple trees in southern New England. The apple tortrix (*Archips fuscocupreanus*) and green pug (*Chloroclystis rectangulata*) were accidentally introduced from eastern Asia and Nova Scotia, Canada. The leafroller and geometrid moth have broad host ranges,

which include several plant species in the apple family (Rosaceae) and cause damage to fruit crops. Both insect pests are being monitored in orchards and controlled with insecticides when necessary.

Results

Black vine weevil grubs cause damage in strawberry fields. The annual retail market value for strawberry production in Connecticut is about $2.8 million for about 278 acres of operation. Lost revenue per acre can be at least $2,000 due to this insect's affect on plant health. As a part of integrated multistate research and extension efforts, a scientist at The Connecticut Agricultural Experiment Station found that native or naturalized populations of insect pathogenic nematodes (i.e., beneficial organisms in strawberry production) kept black vine weevil populations low. **Impact:** a strawberry grower in Connecticut has introduced the beneficial nematodes into his strawberry fields, and the nematodes have become established. With activity of beneficial pathogenic nematodes, there have been savings in the costs of applying chemical insecticides amounting to about $100 per acre in the second year after nematode introduction. **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research (CT,MA,NY,RI). These results 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.**

Beneficial Nematodes Reduce Operation Costs for Strawberry Growers. Strawberry plants are attacked by black vine weevil larvae, a common beetle pest in production areas. Control has relied heavily on the use of chemical insecticides, which add expense and may be detrimental to the environment. A scientist at The Connecticut Agricultural Experiment Station found that beneficial parasitic nematodes can keep black vine weevil populations low, and once established, these nematodes can have continued positive effect in insect management programs. A strawberry grower

saved $100 per acre in annual costs for control of black vine weevils by using parasitic nematodes instead of chemical insecticides.

Results

Plant parasitic nematodes are microscopic roundworms which attack plants and cause stunting and yield losses. Infestations may increase the severity of other diseases, such as black root rot of strawberry. An estimated annual retail market value of strawberry production in Connecticut is $2.8 million. As a part of integrated multistate research and extension efforts (NE-171), field microplot and small plot experiments were conducted to determine the effects of *Pratylenchus penetrans*, a root lesion nematode, on strawberry yields. **Impact:** presence of these nematodes alone or in combination with the black root rot fungal pathogen, *Rhizoctonia fragariae,* reduced strawberry yield in microplots. On a per acre basis, economic loss was about $13. The interaction of the two pathogens appears to be additive rather than synergistic. In field plots infested with *P. penetrans* alone, plant vigor and yield were increased when carbofuran and fenamiphos nematicides were applied. Pesticide treatments corrected the problem. **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research (CT, FL, MA, MD, MI, NY, PA, WV) and extension. These results also apply to national goal #3 by providing a food source to ensure a healthy, well nourished population (**Theme**: **Human health**).

Results

Soil-borne pathogens, such as *Fusarium* species, cause serious losses each year to vegetables and small fruits. Many times the damage is unavoidable because effective fungicides and/or resistant cultivars are unavailable. Sodium chloride was applied to asparagus plots in efforts to control fungal

infections and meet intermediate critical issues of stakeholders. The market value of asparagus in Connecticut is about $245,000 annually for 50 acres of total production. **Impact:** applications of rock salt at a rate of 500 pounds per acre to asparagus beds suppressed a disease called *Fusarium* crown and root rot caused by two soil-borne species of *Fusarium*: *F. exysporum* and *F. proliferatum* and boosted crop yields by 15-55%. New findings indicated that sodium chloride had no direct effect on the fungal pathogens, however. Salt affected the plant host by increasing osmotic potential of the cells, altering root exudation, and by increasing the uptake of micronutrients. These changes suppressed disease and allowed for better crop yields. Five hundred pounds of salt costs about $30.00. An investment of $30.00 could result in $880 to $2,750 greater value of crop per acre. **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research and extension (CT, FL, MI, NJ, PA, WA). These findings also apply to national goal #3 by providing food sources to ensure a healthy, well nourished population. **(Theme: Human health).**

Results

Dispersal of fungal sporangia of *Phytophthora infestans* is the main process involved in causing potato and tomato late blight epidemics. Survival of sporangia and amount of exposure to sunlight are critical for spreading the disease. The effect of solar irradiance on the survival of detached *P. infestans* sporangia was assessed. **Impact:** after one hour of exposure on sunny days, the viability of sporangia decreased by about 95%. On overcast days, survival after three hours was only slightly reduced. This supports an earlier hypothesis regarding the correlation of cloudy conditions and late blight development. **Sources 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**

Results

Appropriate French Hybrid and American grape cultivars can produce excellent yields in Connecticut, but the wineries prefer to grow grapes of Vinifera cultivars. Wine grape production is primarily located along the coast or in ideal sites in the western and eastern highlands. The focus of wine grape cultivar trials in Connecticut is to test for disease resistance, productivity, and juice quality and to identify growing areas favorable for wine grape production. The Connecticut River Valley in the interior of the state has been identified as a new area where French or American hybrid grape and hardy Vinifera cultivars can yield high quality juice and possibly a longer growing season than in coastal Connecticut. **Impact:** at Windsor, Connecticut, Villard Blanc (a french hybrid cultivar) had the highest yields and produced higher brix (sugar) juice than normally seen in coastal Connecticut. However, use of this cultivar is restricted because of late maturity. Similarly, Seyval and Villard Noir were productive and equal in juice quality, compared to grapes produced along the coast. Chardonnay, White Riesling, and possibly Cabernet Franc were the only Vinifera cultivars shown, along with Cabernet Sauvignon, to have adequate hardiness and minimal disease problems for further field evaluations in interior Connecticut. Several of these cultivars are now being grown in Connecticut vineyards. **Sources of funds:** Hatch and state. **Scope of impact:** state specific.

Excellent Juice Quality of Wine Grapes Produced In The Connecticut River Valley. A scientist at The Connecticut Agricultural Experiment Station found that hybrid and some Vinifera wine grape cultivars planted in the deep sandy loam soil of interior, central Connecticut had equal or higher

yields than in coastal Connecticut and had earlier fruit maturity as measured by fruit sugar content. Villard Blanc, a french hybrid cultivar, has been the highest-yielding cultivar. Seyval and Villard Noir also were productive and comparable in juice quality to grapes produced along the coast. These results have been provided to growers to help with cultivar selection for new plantings in Connecticut.

Results

Surveys conducted at farmers' markets in Connecticut indicated that okra is in demand. Stakeholders requested information on the highest yielding cultivars and susceptibility to fungal diseases. **Impact**: of the 7 cultivars evaluated, emerald had the greatest yield at two sites. Verticillium wilt disease and powdery mildew infected crops in late August and early September, however. Cultivars less affected by these diseases were Emerald, Burgundy, Clemson Spinless, and Green Best. Some cultivars of okra are now being grown in Connecticut. **Sources of funds:** Hatch and state. **Scope of impact:** state specific. These findings also apply to national goal #3 by providing food to ensure a healthy, well nourished population (**Theme**: **Human health**).

Results

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. **Impact:** Pioneer McIntosh, Orin, Shizuka, and Honeycrisp had the highest incidence of scabbed leaves caused by fungi, while NY 75414-1, Gala Supreme, Enterprise, and Pristine had the least scab damage. Rust infection was highest in Braeburn and lowest in Gala Supreme and Enterprise. Cultivars that had good fruit size and yield were Fortune, Gala Supreme, and Fuji Red Sport #2 at about 18 pounds of fruit per tree and Enterprise at 17 pounds per tree. Fruitgrowers have planted some of these cultivars in Connecticut. **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 findings also apply to national goal #3 by providing food to ensure a healthy, well nourished population (**Theme: Human health**).

Results

Sweet potatoes are in high demand at farmers' markets. This vegetable is high in nutritive value and is appealing to certain ethnic groups. Studies were conducted to evaluate yield and quality of two cultivars: Beauregard and Carolina Ruby. Plants were grown to determine the effect of hilling and (or) mulching with black plastic to heat the soil. **Impact**: the greatest yield (5.0 lb/plant) of Beauregard was from unhilled plants without plastic mulch. Carolina Ruby produced 4.9 lb/plant when grown with plastic mulch. Growers are planting the Beauregard cultivar. At a crop yield of 5,000 pounds per 0.5 acre and average retail market value of $.69 per pound, a gross return of $3,450 can be attained by planting the Beauegard cultivar. **Sources of funds**: Hatch and state. **Scope of impact**: state-specific. These findings also apply to national goal #3 by providing food to ensure a healthy, well-nourished population. **(Theme: Human health)**.

Results

Jilo (a type of eggplant) is a major crop of Nigeria and a minor crop in Brazil. Ethnic groups in Connecticut requested Station assistance on evaluating cultivars for local production. The average retail market value is about $3.75 per pound. Current statewide production is about 2,000 pounds. Two cultivars, Teresopolis Gigante and Comprido Verde Claro, were tested for yield and quality at the Station farms in Hamden and Windsor, Connecticut. **Impact:** both cultivars grew well in Connecticut, but drought caused abortion of some flowers. Nonetheless, even under these conditions, yields ranged between 1.6 lb/plant to 1.0 lb/plant. More vegetable growers have shown an interest in planting jilo in Fairfield County. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

These findings 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**

Results

This project was completed, and results were presented in last year's 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**

Results

Laboratory studies were conducted to develop more efficient methods of extracting taxanes from *Taxus* (yew) plants to meet intermediate critical issues of stakeholders. Taxanes are the source of taxol, a compound used in cancer treatment. The needles from ornamental shrubs, members of the genus *Taxus*, are a renewable resource for Taxol. In order to determine if taxanes have potential as an agrochemical, relatively large quantities of the partially purified mixed taxane fraction are needed for evaluation. **Impact:** biomass can be harvested and freeze-dried for preservation of paclitaxel. Reconstitution of the biomass with water, followed by microwave assisted extraction with ethanol provided quantitative extraction of the active compounds. Results were given to stakeholders via

scientific publications. This project is now completed. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These results also apply to national goal #3 by utilizing medicinal plants to ensure a healthy population (**Theme: Medicinal plants**).

More Efficient Extraction of the Anti-Cancer Compound, Paclitaxel. In the course of conducting analyses, laboratory personnel must minimize their generation of hazardous waste. A method based on microwave assisted extraction (MAE) was developed by a scientist at The Connecticut Agricultural Experiment Station for extracting the anti-cancer compound, paclitaxel (Taxol ®), from yew needles. The new MAE method was qualitatively and quantitatively equivalent to the original solvent-based method. In addition, the MAE method uses 1/10 of the amount of organic solvent, a less expensive solvent, and takes about 1/20 the time of the original method.

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

Results

The light-harvesting apparatus in plants is highly susceptible to damage under adverse conditions, such as a water deficit. Plants have developed protective mechanisms to alleviate the problem, however. Cloning genes involved in photoprotection will lead to enhancement of primary productivity, and allow engineering of crop plants adapted to marginal environments. The biochemistry of proteins involved in the binding and stabilization of chloroplast pigments in the light-harvesting complex of higher plants is being investigated by using *Arabidopsis* as a model genetic system. Mutant plants are being studied to determine if they have reduced levels of primary pigment (chlorophyll a,b) or secondary pigments of the xanthophyll cycle. **Impact:** bold mutants examined thus far do not show significant differences in the levels of neoxanthin, violaxanthin, antheraxanthin,

lutein, zeaxanthin, carotene, or chlorphylls relative to wild-type plants when exposed to conditions of excess light. This indicates that the genetic lesion is not the pathway for synthesis of any of the primary or secondary pigments. **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 2001.

	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		2,417,000		17.8	
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 2001, there were 2 publications and 5 talks, and 11 media interviews recorded in association with this program goal. As stated in the Plan of Work, excerpts of letters from stakeholders regarding services rendered, media reports, and narratives of scientific accomplishments are on file at the Station.

Output Indicators (2). The Department of Analytical Chemistry is responsible for testing agricultural products for pesticide residues. During FY 2001, 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**

Results

Stakeholders frequently ask questions about the effects of household food preparation methods on removing pesticide residues from produce. Washing, peeling, and cooking were investigated for effectiveness in removing pesticide residues from crops containing pesticides grown and treated on Station farm plots. **Impact**: residues of captan, a fungicide registered for use on a wide variety of fruits and vegetables, can be nearly eliminated by a simple water rinse of the produce. The insecticides permethrin and endosulfan, however, were not removed by any household procedure. **Sources of funds**: Hatch and state. **Scope of impact**: state-specific.

Results

Personnel in the Connecticut Department of Consumer Protection submitted 160 samples to the Station's Department of Analytical Chemistry for pesticide residue analyses to meet short-term

critical needs of stakeholders regarding food safety. Although most samples were from produce grown in Connecticut, some samples represented food grown in other states or countries. Canned frozen vegetables, fruits, and juices were included in a marketbasket survey for testing. **Impact**: results indicated that when produce offered for sale in Connecticut contains pesticide residues, the concentrations are generally well below tolerance levels established by the U.S. Environmental Protection Agency. Results were released to the public in Station publications and at Station meetings and open houses. **Sources of funds**: Hatch and state. **Scope of impact**: state-specific.

Results

As a part of general market-basket surveys requested by consumers and the Department of Consumer Protection, it was suspected that certain crops selectively absorbed persistent organochloride pesticide residues. The insecticide chlordane was banned in the United States in 1988. This insecticide, however, persists in the ground and can appear in vegetables. Produce samples from an organic farm contained chlordane, but the grower did not use this pesticide. Vegetables were grown on land, which had been treated with chlordane in 1960, to determine if a wide variety of plants absorbed this chemical. **Impact**: chlordane was found in (1) root crops, such as carrots, beets, and potatoes and (2) in the edible parts of vegetables like spinach, lettuce, and zucchini. Chlordane residues were not detected in edible tomatoes, corn, or peppers, but small amounts of material were found in the non-edible parts of plants. **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

Results

The annual market value of maple syrup production in cash receipts is about $400,000 in Connecticut. The detection of lead in maple syrup in 1994 became a well publicized public health issue in New England. Maple syrup producers in Connecticut requested Station assistance on determining sources of lead contamination in maple syrup and on developing corrective measures to produce a safer food product. To meet the short-term critical needs of stakeholders, amounts of lead in maple syrup samples were monitored. A scientist at The Connecticut Agricultural Experiment Station identified the sources of lead contaminants previously. In cooperation with the State Department of Agriculture, 52 samples from finished products were analyzed for lead during this reporting period. **Impact:** a substantial decrease in lead was observed when there was replacement of equipment (i.e., galvanized buckets, bronze gear pumps, and lead-soldered buckets), which served as the source of lead contamination. A safer product is now available for the public. **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 last year.

(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**

Results

The Quinnipiac River in Connecticut has been cited as one of the most toxic rivers in the nation. High levels of organic and inorganic contaminants occur in sediment. Despite this information, people eat fish from the river. A study was conducted to analyze fish, taken from the river, for heavy metal contaminants, polychlorinated biphenyls (PCBs), 3 classes of synthetic organic

chemicals and polychlorinated dibenzofurans. A microwave extraction procedure was modified to detect polychlorinated biphenyls. **Impact:** metals did not exceed regulatory limits for samples from any of the 60 fish included in the study. One fish sample had PCBs at a concentration of 3.4 ppm, while PCBs in all other fish ranged between 0.02 and 1.4 ppm. Concentrations of 2.0 ppm or less do not trigger FDA advisories. Results were released to the public. **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**

Results

Laboratory studies were conducted to determine if *Escherichia coli* O157:H7 can grow in bruised apple tissues. This pathogenic bacterium contaminates beef, lettuce, and apple cider and can cause severe illnesses in humans. Following bruising, apples of different cultivars were injected with this *E. coli* strain. **Impact:** except for the McIntosh cultivar, *E.* coli O157:H7 grew in bruised tissues of Golden Delicious, Red Delicious, Macoun, and Melrose, independent of date of harvest or source (picked fruit or dropped fruit). Bruised tissue of the McIntosh cultivar had an inhibitory effect on the growth of the bacterium. The cause of inhibited growth is unknown. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These studies were conducted to meet the intermediate critical needs of stakeholders. Results also apply to goal #5 **(Theme:Human health)**.

Allocated Resources. Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 2001.

	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		$341,700		3.1	
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 2001, there were 49

publications, 290 talks, and 324 interviews recorded in association with this program goal. The number of officerships and memberships in stakeholder organizations and national or state committees was 51 during state FY 2001. Excerpts of 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**

Results

At least 40 growers use greenhouses in Connecticut to extend the production season for tomatoes. Annual gross returns vary with yield and quality of tomatoes but can reach $8,000 for one 30 x 96 ft. greenhouse. Numerous fertilizer combinations have been suggested for greenhouse tomato production, but the optimal concentrations of nitrogen and potassium for fruit production and high yield are unknown. Experiments were conducted in Station greenhouses to determine which fertilizer treatments efficiently produced the highest yields. **Impact:** results thus far show that the greatest tomato yields resulted when plants were supplied nitrogen at a low rate. The potassium supply had no significant effect on yield. The average size of tomatoes was less affected by the

fertilizer treatments than was the total yield. These studies were conducted to meet the intermediate critical needs of stakeholders and results were given to growers. The major benefit of using lower amounts of nitrogen in greenhouses is that there is a reduction or elimination of amounts that enter groundwater or surface water supplies. **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**

Results

Field and laboratory investigations were performed to determine if pesticides and other contaminants in water and soil could be degraded by using modified Fenton reactions. **Impact:** Results of mineralization of methyl parathion insecticide in soil by hydrogen peroxide activated with iron complexes and on competitive sorption between atrazine (an herbicide) and polar and apolar compounds in soils showed that there is potential for removing these pesticides from soil. This work led to a U.S. patent, helped meet the long-term critical needs of stakeholders, and was a part of multistate project (W-082). **Sources of funds:** Hatch and state. **Scope of impact:** multistate (AR, AZ, CA, CT, FL, HI, IA, IN, KS, MN, MT, NV, NY, WA).

Removal Of Pesticides From Soil. A scientist at The Connecticut Agricultural Experiment Station found that a modified Fenton chemical reaction degrades methyl parathion in soil. This and other procedures may be useful in degrading pesticides and other compounds that have entered groundwater in agricultural fields and other locations.

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

Results

Currently, over 80 municipalities in Connecticut compost their leaves. Utilization of the large amounts of compost requires finding safe and effective uses on agricultural and other lands to meet the long-term critical needs of stakeholders. Homeowners also recognize a need to compost plant materials. Studies were conducted to investigate the use of undecomposed leaves and compost on the yield of field-grown peppers. Pepper plants were chosen as a model. **Impact:** highest yields were found on plots receiving leaf compost and the full rate of fertilizer. The lowest yields were noted in plots amended with leaf compost and no fertilizer. Although the use of compost did not reduce the amounts of fertilizers applied in pepper plots, the addition of compost did support high yields of crops. There was a beneficial cumulative effect of annual additions of undecomposed leaves and compost on pepper yields. These findings allow for more efficient use of composted materials in garden plots and vegetable-producing fields. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. **Results also apply to goal #1 (Theme: Home lawn and gardening; Plant production efficiency).**

Leaf Compost Supports Pepper Production. A scientist at The Connecticut Agricultural Experiment Station tested leaf compost in pepper plots and found that the highest pepper yields occurred when leaf compost was used with fertilizer. Gardeners and farmers are using compost in vegetable production.

(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)**

Results

In addition to Eastern Equine Encephalitis and Jamestown Canyon Viruses, the West Nile encephalitis virus has become a major public concern in northeastern United States. During this reporting period, the West Nile virus has spread along the eastern seaboard to Florida. At the request of citizens and local health directors in Connecticut, a statewide mosquito surveillance program was established to meet immediate critical needs. From the 73 surveillance sites in Connecticut, 137,199 mosquitoes were collected and analyzed for West Nile virus. **Impact:** West Nile virus was isolated from members of 4 mosquito species: *Culex pipiens, Culex restuans, Culex salinarius*, and *Culiseta melanura*. These species are primarily bird feeders. Infected mosquitoes were detected in 8 towns. Results were released to health officials to warn residents and to plan for mosquito control. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These findings also apply to national goals #1 **(Theme: Animal health; Risk management)** and to goals #3 and #5 by providing important information on emerging human 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**).

Results

Isolations of West Nile encephalitis virus from brain, heart, or kidney tissues of birds and a striped skunk were available for genetic characterization. This virus, new to North America, is known to occur in Africa and Europe. **Impact:** results thus far, based on nucleotide sequence

analyses of 33 virus isolates from the tissues of an American crow, American robin, blue jay, brown-headed cowbird, Canada goose, house sparrow, mourning dove, and red-shouldered hawk, indicate differences that identify 10 unique types of virus. It is unknown if certain strains of virus are linked to more severe human or equine disease. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These results also apply to national goals #1 **(Theme: Animal health; Risk management)** and to goals #3 and #5 by providing important information on emerging human 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**).

(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)**

Results

Granulocytic ehrlichiosis is a disease caused by a bacterium in the *Ehrlichia phagocytophila* genogroup. The agent, transmitted by *Ixodes* ticks in northeastern, upper midwestern, and western United States and in Europe, attacks white blood cells and platelets of humans, horses, cattle, and dogs. About 100 persons contract granulocytic ehrlichiosis each year in Connecticut. At the request of state health officials and veterinarians to meet intermediate critical issues, antibody tests were developed to improve laboratory diagnosis. **Impact:** a highly specific surface protein (p44), found on all North American strains of *E. phagocytophila* agents, has been cloned and purified as a maltose-binding-protein fusion peptide to be used as antigen in enzyme-linked immunosorbent assays (ELISA). Of the 38 serum samples tested from humans who had granulocytic ehrlichiosis, 34 (89%)

were positive in the new ELISA. Specificity was also high (98%); one of 59 sera from persons who had other bacterial diseases reacted falsely. The new test for humans is now being used in the State of Connecticut Department of Health and the University of Connecticut (Farmington). As a part of new research/extension activities, cow sera continue to be tested for antibodies to granulocytic ehrlichiae by immunofluorescence staining or immunoblotting methods. Prevalence of exposure to this pathogen in cattle occurs in widely separated areas of Connecticut. Veterinarians are being assisted. **Sources of funds:** Centers for Disease Control and Prevention, Hatch, National Institutes of Health, and state. **Scope of impact:** multistate (CT, GA, MD) and integrated research and extension. These results also apply to national goals #1 **(Theme: Animal health)** and to #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)**.

New Diagnostic Test for Granulocytic Ehrlichiosis. Scientists at The Connecticut Agricultural Experiment Station and Yale University have developed a new antibody test for human granulocytic ehrlichiosis, a disease caused by a bacterium transmitted by ticks. The new test, an automated and easily standardized enzyme-linked immunosorbent assay, is highly sensitive and specific and is an improvement over other test methods utilized for laboratory diagnosis. The new technology has been transferred to the State of Connecticut Health Department, the University of Connecticut Medical School, and the New York State Health Department.

Results

To more efficiently diagnose granulocytic ehrlichiosis in dogs and horses, an enzyme-linked immunosorbent assay (ELISA) was developed to detect total antibodies. The recombinant p44

antigen used successfully in human diagnosis was incorporated in tests of serum samples from domesticated animals. **Impact:** results of an ELISA, indirect fluorescent antibody staining, and western immunoblotting were in complete agreement for 91% of 29 canine sera and 70% of 30 equine samples tested in comparative analyses. The newly developed polyvalent ELISA is suitable for detecting antibodies to *Ehrlichia phagocytophila* genogroup organisms in dogs and horses and to determine the geographic distribution of this disease. Veterinarians are receiving assistance on special cases. **Sources of funds:** Centers for Disease Control and Prevention, Hatch, National Institutes of Health, and state. **Scope of impact:** multistate (CT, NY). These findings 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**).

Results

Horses are bitten by ticks and exposed to infectious agents that cause equid borreliosis and granulocytic ehrlichiosis. A study was conducted in Connecticut and New York State to determine prevalence of horses that had been exposed to both pathogens. An enzyme-linked immunosorbent assay (ELISA), western immunoblot analysis, and DNA analyses were used to document infections. **Impact:** of the 82 serum samples tested, 37 (45.1%) and 13 (15.9%) had detectable antibodies to the agents that cause equid borreliosis or granulocytic ehrlichiosis, respectively. Twelve horses had been exposed to both pathogens over several weeks or months, although most infections were probably not concurrent. **Sources of funds:** Centers for Disease Control and Prevention, Hatch, National Institutes of Health, and state. **Scope of impact:** multistate (CT, NY). These findings also apply to

national goals #1 **(Theme: Animal health)** and to goals #3 and #5 by providing geographical information on granulocytic ehrlichiosis and Lyme borreliosis 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).**

Results

Serum or whole blood samples were obtained from 141 white-tailed deer (*Odocoileus virginianus*) in tick-infested areas of Connecticut and analyzed to detect past or current infections caused by the following human and veterinary pathogens: a granulocytic ehrlichia and the Lyme disease agent. **Impact:** in analyses for antibodies to ehrlichiae, seropositivity rates varied from 25 to 64% for samples collected in different years. Prevalence of seropositives for the Lyme disease agent also differed (23 to 53%). There were antibodies to both infectious agents in 20 (49%) of 41 sera. In addition, DNA analyses were conducted to confirm granulocytic ehrlichial infections. In polymerase chain reaction studies of blood samples from 63 deer, 11 (18%) specimens were positive for 16S ribosomal DNA and 23 (37%) were positive for the DNA of the 44 kilodalton gene of the agent that causes human and equine granulocytic ehrlichiosis. Public health officials and veterinarians received results. **Sources of funds:** Centers for Disease Control and Prevention, Hatch, National Institutes of Health, and state. **Scope of impact:** state-specific. These findings also apply to national goals #1 **(Theme: Animal health; Risk management)** and goals #3 and #5 by providing geographic information on the presence of 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).**

Deer Infected By Multiple Tick-Transmitted Bacteria. Scientists at The Connecticut Agricultural Experiment Station and Yale University discovered that white-tailed deer can be infected by different bacteria that cause granulocytic ehrlichiosis and Lyme disease, illnesses also reported for humans and domesticated animals. Deer can be used as indicators of both infections in or near forested habitats to identify sites where these tick infections occur.

(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)**

Results

Lyme disease is caused by a spirochete (*Borrelia burgdorferi*), which is transmitted in eastern and upper midwestern United States by the blacklegged tick (*Ixodes scapularis*). Field and laboratory studies were continued to determine prevalence of ticks infected with the Lyme disease agent. Infection rates for nymphal ticks over several years and incidence of human cases of Lyme disease were positively correlated. The number of Lyme disease cases was influenced, in part, by annual changes in populations of the tick vector, *Ixodes scapularis*, and presumably a corresponding change in risk of contact with infected ticks in or near forested settings. Public health officials were informed. **Impact:** epidemiological data accurately reflected tick-infection rates. In related experiments, the impact of burning vegetation on tick abundance was investigated to answer stakeholders' inquiries. **Impact:** results indicated that burning vegetation had temporary and limited effects on controlling ticks and was not a suitable method for reducing tick populations. These studies were conducted to satisfy stakeholders' requests. **Sources of funds:** Centers for Disease Control and Prevention, Hatch, and state. **Scope of impact:** multistate: CO(CDC), CT. These results 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**).

Burning Vegetation is Ineffective For Tick Control. With the rise in tick-associated diseases, such as Lyme disease, babesiosis, and ehrlichiosis, there is a need to reduce tick populations in or near forests. The rise or fall of human cases of Lyme disease is directly correlated with infection rates for the nymphal stage of the blacklegged tick, *Ixodes scapularis.* It has been suggested that controlled burning of vegetation in tick-infested areas might significantly reduce tick populations and, thereby, decrease human risk of infection. A scientist at The Connecticut Agricultural Experiment Station found that burning vegetation had a temporary, limited impact on tick abundance and was, therefore, an ineffective control method.

(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**

Results

Personnel at the University of Connecticut, Department of Pathology submitted 7 samples, consisting of avian or bat tissues for pesticide residue analysis to meet short-term critical needs of stakeholders. **Impact:** Tissues from a pigeon, suspected of poisoning, contained avitrol (a bird repellent) at 2.8 ppm. Results were given to the University of Connecticut. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These results 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. **Theme: Biological control; Integrated pest management**

Results

Mosquitoes are major pests of public health and veterinary importance. The social and economic impacts for control of mosquitoes and mosquito-associated diseases are considerable. The high cost and difficulty of implementing effective control programs and concern for environmental quality have indicated that alternative methods of control that involve the use of natural enemies must be developed whenever possible. Studies were conducted to meet long-term critical issues of stakeholders. Microsporidia (protozoans) are among the most common and widely distributed microbial pathogens associated with mosquitoes in nature, but their life cycles are largely unknown. As a part of a USDA-approved multistate research (S-301) project, studies were performed on the epizootiology of the microsporidium, *Amblyospora stimuli* in natural populations of the woodland mosquito, *Ochlerotatus stimulans.* **Impact:** results thus far indicate that the microsporidium persists at a very low level and has minimal impact on *Ochlerotatus stimulans* populations at the study sites. **Sources of funds:** Hatch and state. **Scope of impact:** multistate (AL, AR, CA, CT, FL, GA, ID, IL). Results 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. **Theme: Agricultural waste management; Ornamental /green agriculture; Biobased products; Recycling; Other (Biosolids compost)**

Results

Few growers of nursery crops are utilizing the biosolids compost produced in Connecticut. Most of the biosolids compost (about 50,000 yd^3) produced annually in the state remains stockpiled, and storage area is dwindling. Increased usage by local nurseries could help solve the problem. Studies were conducted on the leachability of arsenic and other heavy metals from field containers filled with plant growth medium amended with biosolids compost. Water percolating through the experimental potted plant containers was quantitatively collected in receptacles and analyzed by spectrometry. **Impact:** tests indicated that when clay was used as an additive to the plant growth medium, it was effective in abating the leaching of all metals except arsenic. Concentrations of cadmium, chromium, and lead decreased in leachates from clay-contained potted plants. **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. **Theme: Integrated pest management; Pesticide application**

Results

Studies were conducted by a research scientist at the Station with an extension specialist at the University of Connecticut to assess economic impact of integrated pest management (IPM) practices and effectiveness and perform cost/benefit analysis of non-chemical weed control. This work was needed to meet intermediate critical issues of stakeholders. Five nurseries received intensive on-site assistance with the establishment of IPM programs to reduce amounts of insecticides used. Detailed pesticide records were available for four nurseries. Data were analyzed during this reporting period to calculate pesticide-related reductions attributed to IPM strategies. When compared to amounts of insecticides used in the year before IPM was used, there was a reduction of 296 pounds of insecticide

(valued at $852) in these nurseries. **Impact:** IPM practices, such as monitoring pest populations and better timing of insecticide applications, helped improve the efficiency of insect control in nurseries. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific, integrated research and extension. These results also apply to national goal #1 **(Theme: Agricultural competitiveness; Agricultural profitability; Ornamental/Green agriculture; Precision agriculture; Small farm viability).**

Insecticide Reductions in Connecticut Nurseries. A scientist at The Connecticut Agricultural Experiment Station provided 5 nurseries with intensive on-site assistance to establish IPM programs. Pesticide use records were compared to those of another year (pre-IPM adoption). A total of 296 pounds of insecticide valued at $852 were reduced from operations due to IPM practices, such as monitoring pest populations and better timing of insecticide applications.

Results

Black vine weevil and white grubs of various species are major insect pests in field-grown nurseries. Studies on parasitic nematodes were conducted to determine their effectiveness as biological controls. **Impact:** field studies thus far revealed that a dose of 100 infective juvenile nematodes (Heterorhabditid species) per insect larvae was highly pathogenic to Asiatic garden beetles. Nursery growers in Connecticut have begun to reduce insecticide use in their efforts to manage Asiatic garden beetles and black vine weevils by relying on established populations of pathogenic nematodes in their fields. Use of nematodes improved IPM programs. **Sources of funds:** Hatch and state. **Scope of impact:** multistate NE-187 (CT, FL, MA, ME, MD, NJ, NY, PA, RI) integrated research and extension.

Results

Weed management is a difficult problem for large and small nurseries that grow plants in containers. Information is limited regarding individual tolerances of the hundreds of ornamental plants to herbicides used to prevent weeds. A study was conducted to evaluate several herbicides for ornamental plant tolerance and herbicidal efficacy. **Impact:** results thus far show that the perennials dwarf periwinkle, pachysandra, astilbe, and ribbon grass were not injured by the herbicides isoxaben, oryzalin, prodiamine or trifluralin when applied at dosages up to twice the recommended label rate. However, roots of the ornamental grass blue fescue were severely stunted by each of these herbicides except isoxaben. A treatment containing isoxaben plus prodiamine provided the greatest reduction in weed emergence. This information is being used by nursery managers to improve their efforts to control specific weed problems in IPM programs. **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 **(Theme: Agricultural profitability; Plant health; Ornamental/Green agriculture; Plant production efficiency; Small farm viability).**

More Efficient Weed Control. In terms of dollar value produced, the 400 million dollar Connecticut nursery industry represents the largest agricultural sector in the state. Because weeds compete with plants for water, nutrients and light and also detract from the beauty of ornamental plants, nurseries have a low tolerance for weeds. Weed management options, especially for ornamentals grown in containers, are limited. Scientists at The Connecticut Agricultural Experiment Station have evaluated herbicides used by nurseries for safety to several ornamental plants and for efficacy in preventing weed emergence in containers. This information is being used by nursery owners to improve their management of specific weed problems, protecting the health of their plants, and enhancing the quality of plants for state, national, and international sales.

Allocated Resources. Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 2001.

	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		$1,410,000		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 2001. The CRIS code for The Connecticut Agricultural Experiment Station is CONH.

Table 1. Multi-Institutional (FY 2001)

Hatch Project	CRIS Access.#	Collaborating institutions and businesses
CONH 131[c]	0173195	None

132	0177218	CT Dept. of Consumer Protection
133	0183165	CT Dept. of Consumer Protection
134	0183796	U.S. Environmental Protection Agency (EPA)
135[b]	0187947	None
136[b]	0188720	CT Dept of Consumer Protection, US EPA
237[c]	0174732	Yale University (New Haven, CT)
238[c]	0174788	Rutgers Univ., Univ. of Gent (Belgium)
239[c]	0177684	Yale University, Univ. of Oxford (UK)
240[b]	0188383	Yale University, Univ. of Oxford (UK)
344[d]	0078445	Centers for Disease Control (Atlanta, GA), Georgia Southern Univ. (Statesboro), Yale Univ., Univ. of Connecticut (Farmington and Storrs), 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)
369[d]	0177208	Otis, Mass. Development Center, Simon Frasier Univ. (British Columbia, Canada), Cornell Univ., Univ. of CT (Storrs), Rutgers Univ., Univ. of Maine, Univ. of Mass., Univ. of New Hampshire, Univ. of Rhode Island
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.
551[a,d]	0167653	Cornell Univ., W. Virginia (Univ.), Univ. of Georgia, Univ. of Arkansas, Virginia Tech. Univ., Michigan State Univ.
555[c]	0177791	CT. Dept. of Agriculture
556	0178482	Univ. of CT (Storrs), Hopkins and Stonington CT

		vineyards
557	0180059	CT. Vegetable Producers, CT. Greenhouse Growers Assoc.
559	0186018	CT. Dept. of Environmental Protection, CT. Nursery & Landscape Assoc.
560[a,b,d]	0190494	Cornell Univ., Rutgers Univ., Penn. St. Univ., Univ. of Maryland, Virginia Polytechnic Inst., West Virginia Univ.
622[c,d]	0168962	Univ. of Connecticut (Storrs), Michigan State Univ., Washington State Univ.
625[d]	0178255	Yale Univ., Univ. of CT (Storrs), Cornell Univ., Wageningen Agric. Univ. (Netherlands)
626[b,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.
762[c]	0168386	Univ. of Mass., Univ. of CT, Cornell Univ., TRI/Princeton, NJ
766[b]	0181763	Biolog. Bundesanstalt fuer land-und Forstwirtschaft (Germany)
767[a]	0184011	USDA/ARS, Cornell Univ., Washington State Univ.
768[a]	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]	0184011	Several states cooperating on W-082
771	0188384	Univ. of CT (Storrs)
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 2001).

Hatch Project	Scientific Disciplines
CONH 131	analytical chemistry, horticulture
132	analytical chemistry, food production systems
133	analytical chemistry, toxicology
134	analytical chemistry, food production systems
135	analytical chemistry, food production systems
136	analytical chemistry, toxicology
237	plant biochemistry, molecular genetics
238	plant biochemistry, molecular genetics, plant physiology
239	plant biochemistry, molecular genetics, plant physiology, immunology
240	plant biochemistry, molecular genetics, plant physiology
344	acarology, microbiology, immunology, molecular biology, epidemiology, human and veterinary medicine
358	insect pathology, molecular biology
360	entomology, horticulture, integrated pest management (IPM)
365[a]	plant genetics, entomology
369	plant biochemistry, organic chemistry, surveillance technology
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
551[a]	horticulture, plant pathology, plant genetics, entomology

555	horticulture, waste management systems
556	horticulture, plant genetics
557	horticulture, plant physiology
559	animal behavior/ecology, deer management
560[a]	animal behavior/ecology, deer management
622	plant pathology, mycology, horticulture, soil bacteriology, agronomy
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
762	organic chemistry, environmental toxicology, environmental engineering, soil chemistry
766	environmental toxicology, soil chemistry
767[a]	organic chemistry, environmental toxicology
768[a]	protozoology, invertebrate pathology, entomology
769	soil microbiology, horticulture, composting
770	soil chemistry, environmental toxicology
771	soil and water chemistry, environmental toxicology
804	analytical chemistry, horticulture, weed management

[a]USDA approved multistate research project.

Table 3. Multistate Collaborations (FY 2001).

Hatch Project	CSREES Multi-state Project Number	Participating states
CONH 131		
132		
133		
134		
135		
237		
238		CT*, NJ
239		
240		
344		CT*, GA. IA
358		
360		MD, NJ, ID
365	NE-009[a]	CT*, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT, WV
369		CT*, MA
371		CT*, NY
372		CT*, NY, RI
374		
375	NE-187[a]	CT*, FL, ME, MD, MA, NJ, NY, PA, RI
551	NE-183[a]	AL, AR, CT*, ID, IN, MA, MI, NH, NJ, NY, NC, OH, OR, PA, UT, VA, VT, WA, WI, WV
555		
556		
557		

560	NE-1005[a]	MD, NJ, NY, PA, VA, WV
622		CT*, MI, NJ, WA
625		CT*, NY
626		CT*, FL, MI, PA, WA
628		
695	NE-171[a]	CT*, FL, MA, MD, MI, NY, PA, WV
762		CT*, MA, NY
766		
767	W-082[a]	AZ, AR, CA, FL, HI, IA, IN, KS, MN, MT, NV, NY, WA
768	S-301[a]	AL, AR, CA, FL, GA, ID, IL, KY, LA, ME, MN, MS, NJ, NY, NC, SC, TN
769		
770		AR, AZ, CA, CT, FL, HI, IA, IN, KS, MN, MT, NV, NY, WA
771		
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, and 2001 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

Total funds available for entire Hatch program (FY 2001) at C.A.E.S.	$767,020
% Hatch funds dedicated to multi-institutional, multi-disciplinary, and multistate programs	46.2%

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

				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

Total funds allocated to entire Hatch program at C.A.E.S. in FY 2001	$767,020
% dedicated to all multi-categories and integrated activities with CT and other states	34.0%

The Connecticut Agricultural Experiment Station dedicated Hatch funds to integrated activities with extension systems in land-grant universities in different states. In Connecticut, $256,325 were dedicated to integrated activities in FY 2001 with extension at the University of Connecticut, an institution which is unaffiliated 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, and FY 2001.

	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

*Funds distributed to all "multi" categories and 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, and FY2001.

	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

Progress Reports: Integrated Activities

(Hatch Act Funds)

Federal FY 2001

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 progress made on the planned integrated program. Form CSREES-REPT (2/00) reporting expenditures for FY 2001 follows brief summary statements for these specific programs.

1. Tick-borne infections: In addition to indirect fluorescent antibody staining methods developed earlier, an enzyme-linked immunosorbent assay (ELISA) and western immunoblotting procedures have been applied to detect antibodies to *Ehrlichia phagocytophila* genogroup organisms in dairy and beef cattle in Connecticut. There was good agreement in assay results obtained by all 3 methods. Moreover, there was reactivity of positive cattle sera to a recombinant protein having a molecular mass of about 44 kilodaltons in an ELISA. This confirmed immunoblotting results and indicated that antibody reactivity to this key immunodominant protein in cattle, like reactions in humans and horses, is a good marker for diagnosing granulocytic ehrlichiosis.

2. Managing insects on vegetable crops: In efforts to improve monitoring of flea beetles in organic farm plots, sticky traps were evaluated. Mustard powder was used as a lure in traps placed in plots containing cole crops. The traps with the lure caught more flea beetles than traps without mustard

powder. These findings assist vegetable growers who are implementing integrated pest management (IPM) practices. Efficient monitoring of insect pests is crucial to successful IPM programs.

3. Plant genetic resources (NE-9): The susceptibility of flea beetles (*Phyllotreta cruciferae* and *P. striolata*) of 28 varieties and species within the plant family Brassicaceae was tested by planting seeds in pots and putting a randomized array of pots into the field with a population of flea beetles. The plant materials chosen included weed and ornamental species as well as many edible species. Most plant species tested sustained damage from flea beetles. The only exceptions were the ornamental species *Iberis umbellata, Cheiranthus allionii, Draba aizoides*, *Lunaria* sp., *Malcomia maritima*, and *Mathiola bicornis*. All edible species sustained damage and showed little or no resistance.

4. Managing insects in apple orchards: Two exotic insect pests, apple tortrix and the green pug, infest stakeholders' apple orchards in northeastern United States. Field studies revealed that apple tortrix larvae fed on 50 species of wild or cultivated plants in 9 plant families. Of these, 40 (80%) plant species were in the family Rosaceae. Larvae attacked all cultivated trees except peach, *Prunus persica*. The green pug also has a broad host range and feeds on at least 18 plant species in the apple family.

5. Integrated pest management (IPM) for Connecticut nurseries: In experiments conducted in 4 stakeholders' properties, IPM programs helped reduce amounts of insecticide used by about 296 pounds. Also, the use of infective juvenile pathogenic nematodes (*Heterorhabditid* species) helped control Asiatic garden beetle and black vine weevil larvae in nursery fields.

6. Management of insects in soil and other pests (includes NE-187): At the request of the nursery and turf managers, experiments were conducted as a part of two separate research projects to control black vine weevil, Japanese beetle, and oriental beetle larvae in root systems of plants. Recent test results re-affirmed that potting mix incorporation of bifenthrin was very effective for the control of root weevils and white grubs. To achieve 100% control, a preplanting dip treatment of containerized soil in a suspension of bifenthrin at 10 ppm is being used. In other work, replicated trials of halofenozide confirmed effective control of Japanese beetle and oriental beetle grubs in turf.

7. Evaluation of new apple cultivars (NE-183): New apple cultivars were further evaluated for fungal disease resistance. Rust infection was highest in Braeburn and lowest in Gala Supreme. Other cultivars (Pioneer McIntosh, Orin, Shizuka, and Honeycrisp) had the highest incidence of scab infection in leaves. Cultivars NY75414-1, Enterprise, and Pristine had minimal damage due to scab infection.

8. Suppression of soil-borne diseases: Sodium chloride was applied to asparagus plots in efforts to control fungal (*Fusarium*) infections. Results indicated that salt had no direct effect on the fungus, but disease was suppressed because the material increased osmotic potential of plant cells, altered erudition, and caused a greater uptake of micronutrients in the plant.

9. Analysis of risk for plant diseases: Studies were continued to control apple scab, a serious fungal disease. New findings indicate that the first ascospores of the fungus are mature and ready to be released into the air at a time corresponding to the emergence of the first green tissues of McIntosh leaves. Therefore, chemical control is needed for a short duration to effectively reduce primary

fungus infections and to prevent an explosive buildup of ascospores in orchards. Precise fungicide applications are required.

10. Integrated pest management of plant parasitic nematodes (NE-171): Field microplot and small plot experiments were conducted to determine if the root lesion nematode, *Pratylenchus penetrans*, affected strawberry yields and plant health. Presence of these parasitic nematodes alone or in combination with the black root rot fungal pathogen, *Rhizoctonia fragariae*, reduced strawberry yields in microplots. When carbofuran and fenamiphos nematicides were applied, strawberry plant vigor and fruit yield increased.

11. Herbicides/weed control: In weed management studies in nurseries, new results indicate that the perennials dwarf periwinkle, pachysandra, astilbe, and ribbon grass were not injured when the following herbicides were used at dosages up to twice the recommended rate: isoxaben, oryzalin, prodiamine, or trifluralin. However, these herbicides (except isoxaben) stunted the roots of the ornamental grass blue fescue. Therefore, isoxaben plus prodiamine (in lower dosages) provided the greatest reduction in weed emergence.

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)

itution The Connecticut Agricultural Experiment Station (New Haven)
e Connecticut

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

e of Planned Program/Activity	Actual Expenditures FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
k-borne infections	$ 61,204	$42,307	_____	_____	_____
naging insects on vegetable crops	6,367	7,294	_____	_____	_____
nt genetic resources (NE-9)	9,117	2,581	_____	_____	_____
naging insects in apple orchards	68,890	61,222	_____	_____	_____
M for Connecticut nurseries	4,649	2,511	_____	_____	_____
nagement of insects in soil (NE-187)	1,722	9,915	_____	_____	_____
luation of new apple cultivars (NE-183)	1,699	4,346	_____	_____	_____
pression of soil-borne diseases	44,279	8,875	_____	_____	_____
alysis of risk for plant fungal disease	17,989	54,833	_____	_____	_____
M for management of plant nematodes (NE-171)	69,690	63,654	_____	_____	_____
bicides/weed control	13,171	3,133	_____	_____	_____
al	$298,777	$260,671	_____	_____	_____

_____ _____
Director Date

m CSREES-REPT (2/00)

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

The Station 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). During each reporting period, the Policy Statement is given to employees and their unions and posted in several locations 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 employment 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 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 2001 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

Although the Station's mission of research is designed to meet the needs of all citizens, special efforts were made to reach under-served and under-represented groups. A notice was sent to members of 22 organizations serving protected groups to invite minorities to attend Station events, to join the Experiment Station Associates, and to solicit stakeholder comments on existing programs. An important objective is 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 increase minority participation in Station activities.

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. Tours of Station facilities will be planned.

Results: Open house events occurred regularly during this reporting period. Plant Science Days were held in the spring (April 3, 2001) and summer (August 1, 2001). Agricultural Chemistry Night occurred on October 24, 2000. Notifications of these events were made as described above.

About 1,226 persons, including minorities, attended the Plant Science Day event held in August during the past federal fiscal year at the Station's main research farm (Lockwood Farm) in Hamden, Connecticut. 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 bird/butterfly demonstration garden plot to allow better access for all persons. About 50-75 citizens attended the Plant Science Day in the spring and Agricultural Chemistry Night held in the fall at the Station's main auditorium at the New Haven facilities. Selected laboratories were opened for public inspection. To reach other minorities, the Station participated in Farm/City Week, Connecticut Flower 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 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, a Station farm manager 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. In a new initiative, minority students from New Haven were allowed to grow vegetables at the Station farm in Hamden, Connecticut. 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. An entomologist, who conducts research on insect pests of vegetable crops, also assisted on the further development of garden plots for the homeless in New Haven. 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 several charities, including food-sharing programs in the New Haven and Hartford metropolitan areas. Additional Station produce (apples and potatoes) were distributed at a fall event for elderly citizens. Station-grown jilo was donated at a Brazilian fair.

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 first annual accomplishment report 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-protective groups. One Other female and two other males were hired as Postdoctoral Research Scientists in FY 2001. Civil rights training for current and newly hired staff members is included with programs to improve employee relations. Pursuant Connecticut regulations (Public Acts 99-180, 00-72, and 01-53), all newly hired Station employees received a minimum of 3 hours of diversity training and education within 6 months after being hired. 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 6 high school students to work during the summer of FY 2001 to improve plantings on Station grounds. Outside funding was provided for 1 Black female, 1 White female, 1 White male, and 3 Black males. These students learned about agricultural research at the Station and participated in Plant Science Day held 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 2001, 1 Black female, 1 Hispanic male, and 1 Other female were hired to learn new skills.

A volunteer program is available for students to work part-time during the summer and school year. Two White females assisted entomologists and learned new skills. Results gained by these persons strengthened their educational backgrounds by providing "hands-on" experience.

To assist the under-served and under-represented in more advanced research, 7 minorities were employed as Postdoctoral Research Scientists. The training these individuals received improved their qualifications for future permanent employment and upward mobility. Funds from federal grants, including those from USDA, enabled 1 Hispanic male, 4 Other males, and 2 Other females to work as Postdoctoral Research Scientists in FY 2001. One Other female Postdoctoral Research Scientist was promoted to Assistant Scientist I.

Results of Special Crops Program

Stakeholders of different ethnic groups have received the Station's assistance on growing specialized crops, such as 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". There is also current interest in growing arugula. In response, a 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 assistance on composting, forest/wetlands management, and control of hemlock woolly adelgids. Three scientists are 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 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 activities 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 2001, $1,679,348 was expended for outside purchases. Of this amount, $217,678 (13%) was awarded to small contractors. This total greatly exceeded the state-approved goal ($60,434). There were 18 Minority Business Enterprise set-aside purchases and contracts worth $96,241, which greatly exceeded the state-approved goal of $15,109. Contracts were awarded to businesses owned by African Americans, Asian Americans, women, and persons who had disabilities.

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 are 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 at the administrative level. Administrators encourage collaborative work, however. 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 35 Hatch projects listed, 19 (54.3%) have multistate collaborations. Scientists at The Connecticut Agricultural Experiment Station continue to interact with colleagues in at least 40 other states. The 7 USDA-approved

multistate projects (NE-009, NE-171, NE-183, NE-187, NE-1005, S-301, and W-082) include an extensive blend of scientific expertise.

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 last year's evaluation of the multi-programs and joint activities, there are four key questions that need to be re-addressed: (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 continuous process. There is a need to expand the clientele of stakeholders and to increase their involvement in research programs. Farmers who work along with scientists on solving problems benefit by receiving early results. There is also a need to obtain financial data to more clearly show profitability and impact of our research programs. Efforts are being made to quantify economic impact (i.e., dollars saved, increased profitability measures, etc) whenever possible. An assessment of multi-programs and joint activities as they relate to the key questions listed above follow.

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, specific results were listed for each item demonstrating the progress being made in research. A brief impact statement is included in each progress report. An impact summary is provided in those instances when research has progressed to an advanced stage. These summaries were written for public release to show the relevance of the scientific

findings. 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 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 pesticide use and fertilizers in agricultural systems; finding ways to utilize farm wastes (i.e., plant materials); and the issue of emerging human and veterinary pathogens transmitted by ticks and mosquitoes have been addressed.

Efforts are being made to meet the needs of the under-served and under-represented. Being located in New Haven has helped staff members meet and work with minority groups. Other initiatives have assisted us in addressing the needs of the under-served and under-represented in Hartford and in farming areas where ethnic populations are increasing. Recent census data indicate a dramatic rise in the Hispanic population in Connecticut. By growing ethnic crops, we are attempting to reach these people. Also, 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. Produce from state and Hatch-supported research projects were donated to charitable organizations, food-sharing programs, and senior citizens. 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-programs of research and outreach efforts are successful in addressing the needs of the under-served and under-represented. 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 reducing unnecessary duplication of research experiments and by better utilizing resources of participating institutions within and outside Connecticut. Scientists who work collaboratively receive fresh ideas and constructive criticism

from peers. 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 soil, the use of IPM practices to 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. Moreover, the impact statements for multistate projects, approved by the northeastern Experiment Station Directors, have greatly benefited the communication of research findings. These impact statements are available to all on the northeast regional association's (NERA) home page.

In conjunction with the multi-programs, integrated activity (research/extension) remains successful. Good progress is being made on identifying desirable apple cultivars (NE-183). Many new varieties, developed at Cornell University, are being field-tested in Connecticut and other states. Scientists from 20 widely separated states are working together, and there is a strong extension component in the project. Fruitgrowers in Connecticut anxiously await new findings. Moreover, nursery and turf managers are using new control methods and IPM practices to reduce costs of operations. The inclusion of research/extension specialists in other USDA-approved projects (NE-009, NE-183, and NE-187) has made these programs more effective in meeting stakeholder needs by providing a more concentrated 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. Stakeholders need to be informed of how 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 has been positive.

In conclusion, the Station's multi-programs with joint research/extension activities has 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 second Annual Report of Accomplishments and Results, associated impact statements, and financial summaries were prepared and assembled by Dr. Louis A. Magnarelli, Vice Director at The Connecticut Agricultural Experiment Station. Input was received from Station scientists and the Chief of Services. This document is submitted as a part of specified reporting requirements, as mandated by the Agricultural Research, Extension, and Education Reform Act of 1998 and as allowed under the USDA's guidelines for preparing accomplishment reports.

Director _____ Dr. John F. Anderson Date _____