# Annual Report of Accomplishments and Results

The Connecticut Agricultural Experiment Station

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Fiscal Year 2000

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## Executive Summary (Overview)

The Connecticut Agricultural Experiment Station, the nation's first Agricultural Experiment Station, celebrated its 125th anniversary in October of 2000. The "Station" is unaffiliated with a university; is governed by an eight-member board, which includes the Governor; and is dedicated to the needs of all citizens. Research is the primary mission, but the dissemination of factual information to the public has always been a high priority. Specific 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 have improved 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 conduct relevant research and to meet the needs of society.

We are pleased to report many successes, all supported by Hatch funds, that benefit citizens. In many instances, the research accomplishments reported herein align with some focus areas of the FY2001 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 opportunities to see experimental plots, comment on research findings, and to request new research initiatives as the need arises.

As indicated in the Plan of Work, 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"). There is overlap with the three goals listed in the Plan of Work. Details on how all 5 national goals are being met are described in the Planned Program sections. This Annual Report of Accomplishments and Results includes separate financial data for FY1999 and FY2000 for comparison. The research results and impact statements, however, are mainly linked to FY2000 activities. There is some unavoidable overlap with

FY1999 activities regarding stakeholder input. Future reports will reflect findings only for the recently completed fiscal year.

In efforts 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. The multistate and integrated activities have strengthened our ability to make progress on a wide range of problems. Stakeholders have requested assistance 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 also recognized that there is a need to develop new 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 orchards, vegetable crops, and forests for exotic, invasive species.

Highlights of major accomplishments in program **goal #1** are as follows:

1. A farmer/scientist workshop was held to discuss major issues in organic farming. There were participants from 12 states and open discussion concerning organic farming techniques. A book of proceedings was published to have a permanent record and to provide a framework for future conferences where many more persons can participate. The conference benefited scientists and organic farmers by allowing a forum to exchange ideas.
2. An analytical method was developed to detect carbamate pesticides in food and drinking water. The new procedures were applied to analyses of well water, and no residues were found above federal tolerance levels. Citizens were reassured that their drinking water was safe.
3. Two cultivars of sweet corn, normally grown in southern states and having desired characteristics of sweetness and flavor, could be grown in Connecticut. Both cultivars are now being grown by farmers in southern New England.
4. Fungal resting spores of *Entomophaga maimaiga*, a natural fungus disease of gypsy moths discovered in 1989 by Station scientists, can still infect caterpillars after seven years of dormancy. With natural control of gypsy moths, preventive spraying of trees was avoided.
5. As a part of integrated (research/extension) activities, more precise periods of risk were determined for apple scab fungus in orchards. Chemical control measures (ie., amounts of fungicides used) could be limited to more precise window periods, thereby reducing amounts of pesticides used. Results also apply to national **goal #3**.

6. New information on genes controlling detoxifying enzyme systems in plants has aided the development of new molecular tools for future genetic engineering of crops adapted to stress environments. These tools can be used in research of other crop systems.
7. Chromate copper arsenate, a widely used wood preservative, was found to leach from lumber in decks and other outdoor structures.
8. A permethrin-formulated insecticide was found to be effective in reducing numbers of adults of a new exotic wood-boring insect, the smaller Japanese cedar longhorned beetle on arborvitae.
9. A new method of treating Japanese beetle larvae was developed to control this pest in container-grown nursery stock. The procedure, a pre-plant potting mix incorporating the insecticide bifenthrin, was accepted by the National Plant Board to certify plants for shipments to Canada and states where Japanese beetle quarantines are in effect. This discovery greatly assisted nursery growers by increasing profitability.
10. As a part of multistate NE-187 and integrated activities, an insect growth regulator (halofenozide) was found to control Japanese beetle and oriental beetle larvae in turf. The treatment decreased damage to turf and the costs associated with replacing turf.
11. In a multistate effort, predators of caterpillars feeding on cabbage, cauliflower, broccoli, and other cole crops were more effective on cultivars with glossy leaves than on normal waxy leaves. This discovery aids farmers who are trying to implement integrated pest management programs. Also **goal #3**.
12. A wasp parasitoid, *Pediobius foveolatus*, controlled Mexican bean beetles on small farms where snap beans were grown and extended the growing season. On one small farm, bean production increased from 58 to 72 bushels and resulted in increased sales of $4,000.
13. As a part of integrated activities, two exotic insect pests (apple tortrix and the green pug) were detected in fruit orchards in northeastern United States. Specific monitoring for caterpillars assisted fruitgrowers in implementing integrated pest management programs. Also **goal #3.**
14. Saia oats and sorgho-sundangrass, used as cover crops, reduced plant parasitic nematode populations and early dying disease of potato. The multi-state, integrated research effort (NE-171) aided potato farmers by reducing amounts of nematicides used in fields. Also **goal #3**.
15. In a multistate, integrated project, nitrate salts suppressed root diseases of asparagus and beets and reduced crop losses. Also **goal #3**.
16. As a part of multistate (NE-183) and integrated research, evaluations of 22 new apple

cultivars revealed four varieties (NY75414-1, Enterprise, Gala Supreme, and Sansa) as having disease resistance to multiple pathogens. Gala Supreme is now a popular new grower planting. Also **goal #3**.

17. In evaluations of 55 fiber flax cultivars, six varieties were found to have high fiber yields when grown in Connecticut. Fiber flax is now an alternative crop for growers. Also **goal #5**.
18. A microwave assisted solvent extraction procedure was developed to improve the extraction of taxanes from *Taxus* (yew) plants. Taxanes are used to produce taxol, a drug used in cancer treatment of humans. Also **goal #3**.

**Federal Hatch Funds ($407,429), State Funds ($2,380,683), Scientist Years (17.6)**

Citizens remain concerned about food safety and request information on pesticide residues and pathogens, such as *E. coli*, in the food supply. Widely publicized instances of contamination or outbreaks in the past have led to more market-basket surveys and analyses of food items.

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

1. In pesticide residue analyses, a violative residue of vinclozolin was detected in imported canned peas. The results were reported to The Connecticut Department of Consumer Protection, which eventually led to a voluntary recall of the product by the distributor. The general public benefited.
2. Lead was detected in maple syrup, a premium value-added product. Sources of the lead contamination were discovered in research studies and guidelines were established to help producers correct the problem. The general public benefited.
3. *E. coli* O157:H7, a pathogenic bacterium, was isolated from deer meat after a possible human case was reported. Partially cooked deer meat, like beef, is a potential source of infection. The general public, particularly deer hunters and their families, benefited.

**Federal Hatch Funds ($138,764), State Funds ($296,896), Scientist Years (2.6)**

Research activities in program **goal #4** are designed to address a variety of environmental problems and issues. Stakeholders 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, bacteria that cause ehrlichiosis, and the West Nile

encephalitis virus, are veterinary pathogens of dogs, horses, and cattle. There is rising interest in composting and in finding ways to decontaminate soil and water of unwanted agricultural and industrial chemicals. In addition, growers who use hydroponic methods have asked for assistance on nitrate use for commercial lettuce production.

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

1. Studies in nutrient management of nitrate in hydroponic lettuce production determined minimal amount requirements and helped to avoid overuse. Lettuce growers benefited by increasing efficiency of production and lowering costs. Also **goal #3**.
2. Use of leaf compost in vegetable plots as a soil amendment reduced fertilizer requirement and resulted in less nitrate leaching from fertilizers into the groundwater supplies.
3. Large amounts of biosolids compost can be used in potting media to grow ornamental plants in nurseries. The general public benefited when scientists found a use for biosolids compost, which is being stockpiled, and nursery growers benefited by increasing plant growth in a less expensive potting media.
4. Eastern equine encephalitis viruses were isolated from two species of mosquitoes. Health officials and the general public 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 virus was isolated for the first time in North America from two species of mosquitoes and from crows and a Cooper's hawk. The general public benefited by being alerted to a new infectious disease and by being able to conduct mosquito control programs. Also **goal #5**.
6. As a part of multistate project S-265, a microsporidian parasite of a mosquito known to carry the Eastern equine encephalitis virus was found to overwinter as an active infection in the last larval stage of the mosquito. Researchers who are trying to develop biological control programs for mosquitoes benefited.
7. A new antibody test was developed to diagnose granulocytic ehrlichiosis in dogs. Veterinarians and dog owners benefited.
8. White-footed mice in Connecticut, Florida, Georgia, and Maryland were found carrying antibodies to the human granulocytic ehrlichiosis agent. This disease organism, thought to be present in

northern United States, has an extensive distribution along the east coast. Health officials, physicians, veterinarians, and the general public benefited. Also **goal #5**.

9. Studies on integrated pest management programs for the control of rhododendron leafminer in a Connecticut nursery revealed that $77,000 could be saved in production costs by reducing amounts of pesticides used. Growers benefited by reducing costs and the neighbors living near the nursery benefited by having less amounts of pesticides being used in their areas.

**Federal Hatch Funds ($222,192), State Funds ($1,510,458), Scientist years (17.1)**

During this reporting period, there were numerous accomplishments that benefited a broad base of stakeholders. It was a particularly productive period where meaningful results were reported to clientele and stakeholders in meetings, via the media, in written reports, on the institution's web site (http://www.caes.state.ct.us) or by other means described later. There was good balance in the scope of impact, with a nearly equal number of multistate and state-specific projects.

The USDA-approved multistate research projects (NE-009, NE-171, NE-183, NE-187, S-265, 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 of their gratitude and satisfaction of the services and research programs provided.

Introduction

In accordance with the Agricultural Research, Extension, and Education Reform Act (AREERA) of 1998, this annual report of accomplishments and results (with accompanying impact statements) included in the Planned programs sections is submitted to comply with federal requirements. Although The Connecticut Agricultural Experiment Station (also 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. Therefore, the accomplishments and results reported here are based on the Station's research program, the main mission of the institution. Some research efforts, however, are linked to extension programs at universities, and information on research findings were disseminated to extension personnel as described in 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 the Northeast collaborate with Station scientists. These and other extension specialists hear oral presentations given by Station scientists, receive 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 an extensive 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 professionals: scientists, legislators, administrators, forestry officials, and industry personnel. 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. This accomplishment report provides supportive information and documentation for the aforementioned statements. As proposed in the Plan of Work, this report is based on data compiled and published annually in the Station's Record of the Year, a public document available to all upon request. 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 years (FY) 1999 and 2000. Station scientists, administrators, and other staff members seek stakeholder input on a continual basis to identify problems so that critical issues in Connecticut can be addressed. Oral and written stakeholder comments were seriously considered by Station personnel. Letters and other inquiries received responses. Examples of how the collected stakeholder input was considered in the design, execution, and shifting of research goals of various projects are given throughout this report. During the past two fiscal years, 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, etc.) in an open and fair process that encouraged participation of diverse groups. A survey was sent to members of protected organizations (i.e., minority groups) requesting feedback on Station research programs and 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 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.

The Station celebrated its 125th anniversary in 2000. The nation's first agricultural experiment station had reached an important milestone. A conference was organized on "Imported Pests and Pathogens". Fifteen speakers, representing 19 institutions, gave presentations to scientists and the general public. In addition, a banquet was held at night, and about 300 stakeholders attended at maximum capacity to join the celebration. They heard comments from scientists, the Mayor of New Haven, Connecticut, a representative of the Governor's office, and from other participants about the long history of accomplishments.

During FY 1999 and 2000, 469 and 436 oral presentations were given by Station scientists in Connecticut, respectively. 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 research results. In addition, Station scientists organized or attended 124 and 375 stakeholder meetings in FY 1999 and FY 2000, respectively. 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.

ABB Engineering
Academy Elementary School
Active Retirees of Local 48
*Allegheny Society of American Foresters
American Chemical Society
*American Chestnut Foundation
American Lyme Disease Foundation
American Phytopathological Society
American Society of Agronomy
American Society for Horticultural Science
Amity High School

Ansonia Garden Club

Aquaculture School

Arnold Arboretum (Harvard Univ.)

Bartlett Arboretum

Bethany Garden Club

Bethel Health Department

Bielfield Elementary School

Bloomfield High School

Bradley Point Garden Club

Branford Evening Garden Club

Branford Garden Club

Branford High School

Branford Land Trust

Bridgeport Hydraulic

Bridgeport Men's Garden Club

Bridgeport Rotary Club

Brooklyn Botanical Garden

Burroughs Wellcome, Inc.

*Canadian Chestnut Council

Centers for Disease Control and Prevention

Certified Organic Associated Growers of Connecticut

Cheshire Energy Commission

Cheshire Grange

Childrens New School

Choate School

*Christmas Tree Growers Assoc.

Clark Mosquito Control Company (Chicago)

Comstock Ferree

Connecticut Academy of Science & Engineering

Connecticut Agricultural Education Foundation

Connecticut Audubon Coastal Center

Connecticut Beekeepers Assoc.

*Connecticut Chapter of The American Chestnut Foundation

*Connecticut Chapter of the American Society of Foresters

Connecticut College

Connecticut Department of Agriculture

Connecticut Department of Consumer Protection

*Connecticut Department of Environmental Protection

Connecticut Department of Health

Connecticut Entomological Society

Connecticut Environmental Health Organization

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 Wine Council

Cornell University

Council of the American Phytopathological Society

Council on Soil & Water Conservation

Cub Scout Pack 192

Darien Audubon Society

Darien Health Department

Dartmouth College

Deep River Garden Club

Donald Harris Agricultural Science School

Doolittle School

Eastern Connecticut State College

East Hampton Public Library

East Haven Garden Club

Emmett O'Brian School

Entomological Society of America

Environmental Industry Council

Environment and Human Health Inc.

Experiment Station Associates

Fairfield County Horticultural Society

Fairfield Men's Garden Club

Farm Wine Development Council

First Congregational Church (Wetherfield)

Gaylord Hospital

Glastonbury Garden Club

Gledhill Nursery

Goodwin Levine Senior Center

Goodwin Elementary School

Governor's Council on Agriculture

Greenwich Health Department

Greenwich League of Women Voters

Greenwich United Way

Griffin Hospital

Guilford Fields Committee

Guilford Garden Club

Harriet Beecher Stowe Elementary School

Hamden Grange

Hamden High School

Hamden Land Conservation Trust

Hanmer School

Helena Company Growers (Chicopee, MA)

Heritage Village Environment Committee

Hopkins Vineyard

Island Avenue School

Jackie Robinson Middle School

John Holbrook Farm

Kellogg Nature Center

Kelly Middle School

Killingworth Elementary School

Killingworth Garden Club

Lebanon Garden Club

Lillinonah Audubon Society

Loomis Chafee School

Lyme Disease Foundation

Lyman Hall High School

Madison Garden Club

Mario's Italian Imports

Metacomet Elementary School

Middletown Parks & Recreation

Middletown Regional Vocational Agric. Center

Mill River Wetland Committee

Monroe Garden Club

Morris Cove Garden Club

National Academy of Sciences

National Organic Farmers of America

National Plant Board

Natural Resources Council

Nature Conservancy

*Naugatuck Valley Audubon Society

Naugatuck Valley Community & Technical College

New Britain Garden Club

New Canaan Country School

*New England Christmas Tree Growers Assoc.

New England/New York Poultry Pest Management Assoc.

*New England Society of American Foresters

New England Vegetable and Berry Growers

New Hampshire Landscape Assoc.

New Haven County Soil & Water Conservation District

New Haven Garden Club

New Haven Homeless Garden Project

New Haven Land Conservation Trust

New Haven Sound School

*Northeast Forest Pest Council

Northeastern Mosquito Control Association

Northeastern Weed Science Society

*Northern Nut Growers Assoc.

Office of Naval Research (Annapolis)

Orange Rotary Club

Otis Elevator Company

*Oxford Garden Club

Quinnipiac University

Quinnipiac Valley Audubon Society

Quinnipiac Valley Health District

Redding Garden Club

Redding Health Department

Regional Water Authority

Rhode Island Nursery & Landscape Assoc.

Roaring Brook Nature Center

Rockefeller University

Seymour Garden Club

Shoreline Garden Club

Sikorsky Garden Club

Southbury Garden Club

Southern Connecticut State University

Stamford Garden Club

Stamford Health Department

Stratford Garden Club

St. Ann's School

St. Catherine of Siena School

Stonington Rotary Club

*Stone Museum (People's State Forest)

Southern Connecticut State University

Suffield Garden Club

Trinity College

Trumbull Grange

Tyler Cove Assoc.

Uniroyal Sigma Xi Chapter

University of Connecticut (includes Cooperative Extension)

University of Delaware

University of Hartford

University of Massachusetts

Uniroyal Chemical Co.

*US Forest Service

*USDA/APHIS/PPQ

Vegetable Growers Assoc.

Webelos Cub Scout pack 149

Weed Science Society of America

Wesley School

Wesleyan University

West Hartford Hebrew High School

West Haven Garden Club

West Haven Public Library

Weston Garden Club

Westport Nature Center

West Rock Ridge Park Assoc.

Western Connecticut State University

West Hartford Gladiolus Society

Westport/Weston Health Department

Westville Garden Club

White Memorial Nature Center

Wilbur Cross High School

Wilton Garden Club

Windsor African Violet Society

Windsor High School

Windsor Rotary Club

Wintergreen School

*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 1999 and FY 2000, there were 27,572 and 26,863 public inquires, respectively, from stakeholders. There was a broad range of inquires. For example, scientists in the Department of Entomology answered 7,554 public inquiries during state FY 1999. Of these, 25% were from persons who visited the department. Questions on natural resources (87%) were most frequent followed by inquires on pests of humans or persons' dwellings (10%) and on food crop insects (3%). Scientists at the Valley Laboratory answered 3,891 inquiries from the public and 3,315 questions from commercial growers and pest control operators during state FY 1999. Inquiries by subject category were: insect pests (33%); fertilizers, soils and water issues (13%); general horticultural information (18%); plant diseases (20%); weed control (9%); pesticide use (3%); mammals, birds, and reptiles (2%); and others (2%). Questions about hemlock woolly adelgid (n=950), a forest-insect pest, and blue mold disease (n=810) were most frequent. There were 1,414 field visits by scientists to commercial and private properties to diagnose more complex 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 1999 and 2000, 245 and 566 interviews were given, respectively, 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 extensive national interest in research findings. United States Senator Joseph I. Lieberman from Connecticut held a public hearing, and a Station scientist gave a presentation. An ambitious field research program on mosquitoes was expanded in response to stakeholder concerns including administrators of towns and cities. Results of other experiments on or surveys of ticks, three tick pathogens that cause human diseases, hemlock woolly adelgids, the small Japanese cedar longhorned beetle, composting, arsenic in pressure-treated wood, and a variety of plant diseases also were of high interest to reporters and other stakeholders nationally.

Public meetings and open houses, announced in newspapers and newsletters, were held at the Station to allow stakeholders to meet scientists, see experimental plots, visit research laboratories, and to review and discuss research findings. Citizens met with scientists and discussed research "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 39 organizations that serve protected individuals, trade groups, commodity associations, and with other state agencies to reach under-served populations. During the past 2 years, the Station held special public conferences and open houses. At an April 7, 1999 public meeting, scientists reported their findings on gardening practices, growing raspberries, and on a new exotic insect pest (the small Japanese cedar longhorned beetle) of arborvitae, junipers, and cedar trees. On August 4, 1999 and on August 2, 2000, open houses were held at the Station's farm in Hamden, Connecticut. More than 1,200 people attended each of these events and were able to visit experimental plots, demonstrations, and exhibits and to hear scientific reports on hemlock woolly adelgids, gypsy moths, forest management, arsenic in pressure-treated wood, 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, a new exotic beetle pest of cedar trees, reducing deer browse damage, and use of salt to suppress root diseases in asparagus crops. On February 15, 2000, a meeting was held for fruitgrowers in Connecticut to hear about the latest Station research findings.

The Experiment Station Associates (ESA), a membership of about 850 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 developed and 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 and Vice Director, gave oral presentations and reports to ESA members at their annual meeting and monthly Board of Directors' meetings. This Board was provided copies of the Station's Plan of Work for review purposes before submission to help meet federal requirements. 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 problems. Special assistance was given to the nursery industry and pests of vegetable crops. 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, a new exotic insect pest, the small Japanese cedar longhorned beetle, was discovered in Connecticut in September of 1998. Subsequent surveys during 1999 and 2000, revealed infestations in nurseries and homeowners' properties. Responding to stakeholder requests and input, station scientists promptly performed experiments to find a method of control. A successful procedure was developed with the assistance of an Hispanic arborist, who owns his own company and facilitated testing at a homeowner's property. Successful control was due, in part, to direct input from this arborist. The resulting management practice can now be applied in other infested sites. Information on the biology and control of this pest is available and can be applied if the insect becomes a national problem. During an outbreak of a West Nile encephalitis virus in Connecticut in September of 1999, stakeholders assisted the Director of the Station in locating sites for sampling mosquitoes near the Connecticut/New York State border in Fairfield County, Connecticut. Direct input from stakeholders was considered and greatly facilitated field work. This effort resulted in isolations of the virus from two pools of different mosquito species. Genetic compositions of the isolates were analyzed to determine the identity of the virus and results were of national significance. Moreover, citizens assisted in the program by delivering dead birds for analysis. Isolations of the West Nile Virus were made from brain tissues of 28 crows and a Cooper's hawk. A scientific article was published in the journal Science, which reaches extensive national and international audiences. Hatch funds were used in an emergency situation to collect and analyze the mosquitoes.

During July of 1999, there was an outbreak of *Escherichia coli*: O157:H7 in Lake Hayward (East Haddam, Connecticut). Three children suffered severe kidney disease as a result of the infections. Dozens of other residents had various gastrointestinal problems. A stakeholder requested Station assistance on the problem. A Station scientist responded and collected soil and water samples at the request of the local health director to determine if the *E. coli* O157:H7 pathogen was present. This strain was not found, but other potential *E. coli* virulent strains were cultured. These findings were reported to state and town health officials.

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. Shortly after this insect entered Connecticut in the mid 1980's, citizens reported declining hemlock trees at several locations and asked for the Station's assistance. A Station scientist responded by initiating field studies and identified the pest. Subsequently, he conducted tests to determine which pesticides could be used in control programs. He found that pesticides could 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. In 1992, a Station scientist discovered that populations of *A. tsugae* in Japan, the homeland of this pest, were controlled by several predators, the most effective of which is *Pseudoscymnus tsugae*, a previously unknown coccinellid beetle that feeds voraciously on all adelgid life stages. When foresters and the general public learned about this, they requested that the predatory beetles be reared and released to help control *A. tsugae* in Connecticut. After federal permits were secured, the beetle was imported to Connecticut, reared, and released in sites infested with *A. tsugae*. About 140,000 beetles have been released at 17 sites in Connecticut. Thousands more have been released in New Jersey and Virginia as a part of a 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 will be investigated. Citizens requested a control program that would minimize pesticide use.

The hemlock woolly adelgid is widely distributed in Connecticut and other eastern states and is of great concern to federal, state, and 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. For example, during 1999, a Station scientist answered 2,149 public inquiries and was interviewed about the progress of his biological control research by the media on 69 occasions. In addition, he made 29 field visits and gave 31 talks at the request of stakeholders. 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. A list of 90 federal, state, and private

organizations, which have been assisted by a Station scientist, is available upon request. 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 information on adelgids and the predatory beetle for a web site at Cornell University and advised numerous arborists and extension agents in Connecticut and in Long Island and Westchester County, New York offices so that biological and 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 arborists and USDA Forest Service personnel. A Station scientist donated a colony of the predatory beetles to the Philip Alampi Beneficial Insect Laboratory in Trenton, New Jersey and trained their staff on rearing procedures. Training sessions on releasing the predatory beetle and evaluating the efficacy of such beetle releases have been conducted for cooperators in 10 eastern states.

During the early 1990's there was an outbreak of hemlock loopers (*Lambdina athasaria*) in Connecticut. The infestation was first detected by foresters who alerted Station scientists. At a meeting where state foresters and Station personnel attended, requests were made by stakeholders to determine the extent of hemlock looper infestations and to identify other 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 conducted on hemlock loopers to develop trapping methods for surveillance. Results of these 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. Suggestions were made by stakeholders at these meetings to develop a color atlas of caterpillars that attack jack pine, white pine, pitch pine, balsam fir, cedars, and red and white spruce. Station scientists agreed and are now 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 progress reports.

Gypsy moths have been a problem in Connecticut 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. During 1989, it appeared

that the state would have yet another major outbreak. High densities of egg masses were observed on trees and, subsequently, large populations of caterpillars had begun eating leaves. A major epizootic occurred that year. Mortality of the caterpillars was attributed to a pathogenic fungus, *Entomophaga maimaiga.* Station scientists discovered that this fungus had caused the dramatic decline of gypsy moths. Scientific reports were published and numerous talks and interviews were given to inform the public.

Although *E. maimaiga* had an important impact on gypsy moths in 1989, it was unclear whether or not this fungus would continue to be an important biological control agent, particularly during years of drought. Reporters and other citizens asked questions about the long-term effectiveness of *E. maimaiga* in forests. There was particular concern expressed by forest managers, and requests were made by arborists and homeowners on whether trees should be sprayed for protection. In response, 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. Recent findings indicate that fungal spores are viable for at least 10 years and remain infective to gypsy moth caterpillars.

There have been displays of research results at the Station's annual open houses for the public to see and comment on. Technical presentations also have been given at a national meeting of 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 J. Entomol. Sci. and Environ. Entomol. Comments received by attendees of meetings were useful in modifying experimental design.

During the first half of the last century, 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 has been 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 major 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 is leading the chestnut research program in Connecticut. During the past year, she has interacted with the following stakeholder groups: users of wood products (lumber, fencing, poles, etc.), commercial nut growers, and persons interested in forest health. Major news articles that featured the chestnut research include publications in the New York Times, the Heritage Villager, The Scientist, and the Hartford Courant. 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. At stakeholder requests, oral presentations were given at meetings of the Connecticut Chapter of The American Chestnut Foundation and the Northern Nut Growers Association. 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 learn about chestnut research and to comment on all aspects of the program.

Increasing populations of white-tailed deer have caused damage to tree regeneration in some Connecticut forests. Oak, an economically important tree, 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 along with a Station scientist have aided investigations by providing materials and labor, selecting plots for research, and in designing experiments. There currently is an 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 through journal articles, a lay magazine, and oral presentations.

Changes in forest composition will affect the quality and variety of forest resources available to future generations. Earlier 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. Research is supported by the State Division of Forestry-Connecticut Department of Environmental Protection, which protects the study sites. Additional plots were established with the cooperation of other stakeholders (White Memorial Foundation, Great Mountain Forest, and the Town of Manchester). Publications and oral presentations have been the main means of disseminating research findings to stakeholders throughout southern New England.

Several upland forest oak stands are approaching economic and biological maturity in southern New England. This has led to public concern over species composition following stand regeneration. At the request of state foresters and utility company officials, studies were initiated 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. Reporting of results occurs through scientific publications, articles in a lay magazine, and oral presentations to citizen and professional groups.

Stakeholder input also was obtained when scientists served as members of advisory boards, committees, or officers of organizations. During FY 2000, 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 Phytopathology Society

American Society of Horticultural Science Technical Program Committee

Association of Northeastern Herbaria

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 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

National Christmas Tree Association

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

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
Phyllosphere Microbiology Committee
Plant Biology Working Group, American. Soc. of Horticultural Science
Purple Loosestrife Containment Committee
Quinnipiac University (Adjunct Assistant Professor)
Resource Development & Conservation Committee
Sigma Xi (Quinnipiac University Chapter)
State Survey Committee Cooperative Agricultural Pest Survey, USDA
Society of Invertebrate Pathology
Society of Nermatologists
State Coordinator, North American Blue Mold Warning System
State of Connecticut Eastern Equine Encephalitis Working Group
State of Connecticut Mosquito Management Program
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. 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 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. Book chapters, symposia proceedings, Station bulletins, and state and regional publications are also acceptable means of communication. In addition to written reports, scientists presented their findings to their peers and stakeholders at international, national, and local conferences and meetings. Comments received in writing or orally were important in ensuring accountability, evaluating the usefulness of scientific accomplishments, and in the 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 were tabulated annually and reported in a Station document: Record of the Year. There were 27 publications and 364 talks and interviews recorded for state FY 1999 and 38 publications and 375 talks and interviews documented for state FY 2000 in association with this program goal. The Record also lists the numbers of officerships and memberships held by Station scientists in stakeholder organizations and national or state committees for state FY 1999 (n = 60 ) and state FY 2000 (n = 77). In addition, excerpts of letters from stakeholders regarding services rendered, media reports, and narratives of scientific accomplishments were included in the Record for public referral. This information is available to those who are interested in the Station's research program and results. Samples of stakeholder letters are available upon request.

*Output Indicators. 2.* As described below, research was conducted to produce value-added agricultural products. Progress made on growing flax and sweetcorn, the control of apple scab, and on improved quality of nursery plants and vegetables are examples of accomplishments. Concise annual results summaries are presented under the respective outcome indicators listed below and are an extension of the Plan of Work. The impact statements for projects in advanced phases of research are listed where results statements are presented. In many instances, impact statements in this and other program goal sections are written in non-technical terms ready for release to the public. We anticipate using these statements in the future in the state. In some cases, expected outcomes were realized early in the research effort, 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: Organic agriculture, Sustainable agriculture**

*Results*

This workshop was held during FY 1999 to help meet long-term critical issues. There were 37 participants representing Land Grant Universities (research and extension), Agricultural Experiment Stations, and growers' groups (mainly organic farmers). The idea for a farmer/scientist exchange was an outcome of an earlier successful workshop held in Massachusetts with the Northeast Farming Association. At the request of organic farmers, a scientist at The Connecticut Agricultural Experiment Station wrote a grant proposal for the SARE program to cover the costs for a follow-up multistate workshop and to publish a book of proceedings for the results. Funding was awarded. The following 12 states had persons in attendance: Connecticut, Delaware, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, and West Virginia. The exchange of information was on alternatives to insecticides for managing vegetable insects. Emphasis was placed on organic farming practices.

Although there was a structured program where invited speakers gave formal presentations, sufficient time was allotted for informal discussions. **Impact:** many farmers had years of experience in organic farming techniques and were able to contribute thoughts and to comment on observations made or problems encountered by scientists. Scientists spoke freely about what they did not know and accepted input from the farmers. Discussions were recorded by audio tape and written notes. **Sources of funds**: Hatch, SARE grant, and state. **Scope of impact:** multistate (see above) integrated research and extension.

(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: Organic agriculture, Sustainable agriculture**.

*Results*

A book of proceedings on the workshop was prepared in FY 2000. 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, and the project leader distributed the published proceedings to all participants of the workshop and other interested parties. **Sources of funds:** Hatch, SARE grant, and state. **Scope of impact:** multi-state (see above) integrated research and extension.

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

*Results*

Carbamate pesticides are not easily analyzed by gas chromatography. An analytical method has been developed for the analysis of 14 carbamate pesticides and metabolites to help meet long-term critical issues. The procedure uses liquid chromatography/atmospheric pressure ionization mass spectrometry. Although the methods can be used to detect carbamates in food, the procedure also had application in a survey of residential drinking water wells. Of the 19 pesticides screened in the

survey, which included carbamates and compounds in other pesticide classes, 6 pesticides were detected in 6 of the 53 different wells tested. **Impact:** no residue, however, was above federal tolerance levels. This research accomplishment satisfied objectives in two program goal areas. The impact statement is only listed under the first program goal, however. **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 Pesticide Residues.** Carbamate pesticide residues occur in many environmental compartments. Many pesticides are often not amenable to analysis by standard multi-residue techniques. Scientists at The Connecticut Agricultural Experiment Station have developed liquid chromatography/atmospheric pressure ionization mass spectrometry that can be used in the analysis of many pesticides, allowing for the determination of the environmental fate of these chemicals. This advancement facilitates risk assessment associated with the use of certain pesticides both to the environment and to persons consuming food or water.

(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**

*Results*

Supersweet corn, with sugar content of 30% or greater, was originally developed to maintain its sweetness and flavor so it could be shipped from southern farms in the United States to northern markets. This study meets intermediate critical issues. Six cultivars of yellow supersweet corn were field-tested in Connecticut. **Impact:** supersweet Jubilee had the greatest average yield (1.6 - 2.0 ears/plant) and Northern Extra Sweet had the longest (8.3 in) and heaviest (9.1 ounces) ears. **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).**

**Improved Sweet Corn Cultivars**. High-yielding sweet corn crops with high sugar content and the marketing of fresh produce benefit growers and consumers. During 1996, 4,600 acres of sweet corn were harvested in Connecticut, unchanged from 1995, at a market value of about $8 million. A scientist at The Connecticut Agricultural Experiment Station found that cultivars normally grown in southern states can be grown in Connecticut. Of the six cultivars evaluated, Northern Extra Sweet had the longest and heaviest ears and Supersweet Jubilee had the greatest average yield. Growers in southern New England are including both cultivars in sweet corn production.

(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, Other (Forest health)**

*Results*

A pathogenic fungus, *Entomophaga maimaiga*, has kept gypsy moth populations at low levels 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. Laboratory studies were conducted on resting spore viability (i.e., ability to infect caterpillars) to meet intermediate critical issues. **Impact:** results thus far indicate that resting spores of *E. maimaiga* produced in 1990 can infect early stages of gypsy moth caterpillars after 10 years of dormancy in the soil, albeit less effectively than resting spores which were dormant for 7 years or less. During field experiments in Connecticut, gypsy moth larvae were exposed to *E. maimaiga* at different heights in trees to determine the impact of fungal conidia produced by infected caterpillars on infection of healthy caterpillars. **Impact:** infections by fungal resting spores could explain incidences of disease in gypsy moth caterpillars. **Sources of funds:** Hatch, McIntire Stennis, and state. **Scope of impact:** state-specific.

**Gypsy Moths Under Natural Control In Connecticut.** Major outbreaks of gypsy moths have caused extensive defoliation of oak, maple, other hardwoods, and evergreens in numerous states. Scientists at The Connecticut Agricultural Experiment Station have found that a pathogenic fungus,

*Entomophaga maimaiga,* has kept gypsy moth populations at low levels in southern New England forests. The resting spores of *E. maimaiga* produced by this fungus in 1990 still germinate and can effectively infect early stages of gypsy moth caterpillars after 7 years of dormancy in the soil. The activity of this fungus should prevent further outbreaks of gypsy moths in southern New England.

(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 profitability, Plant health, Integrated pest management**

*Results*

Apple scab is a serious disease of apples and must be controlled to produce marketable fruit. The disease is caused by a fungus that infects the leaves and fruit of apple trees. 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 combined the time courses of changes in ascospore maturation, susceptible leaf area, and leaf litter in a simple model to estimate relative risk of infection. This "risk" curve was compared to data on the time course of ascospore maturation. **Impact:** based on the comparison of results, chemical control measures could be reduced in both the early and late part of the ascospore release season when inoculum levels were below a threshold. This information was given 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.

Perceived and real financial risk due to crop loss can be a serious barrier to the widespread adoption of Integrated Pest Management (IPM) farming practices. Most recommendations about

pesticide applications are based on knowledge of in-field inoculum pressure and ignore the risk of aerial dispersal of pathogens from other locations. An accurate evaluation of fungal inoculum coming into a managed area is critical for the success of IPM. A mathematical model was developed to predict the aerial dispersal of plant pathogenic fungal spores that affect apple quality and the spread of infection between fields, farms, and crop growing regions. The model incorporates the biophysics and biometeorology of fungal spore release, transport, mortality during transport, and deposition by wet and dry processes which have applicability to a wide range of host-pathogen systems. **Impact:** use of the model improved decisions about fungicide application, timing of sprays, sanitation, and usefulness of scouting, quarantine, and eradication strategies and can ultimately reduce the need for fungicides in disease management. **Sources 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).**

**More Efficient Management Of Apple Scab.** A newly developed model has been used by a scientist at The Connecticut Agricultural Experiment Station to quantify the relative risk of apple scab infections due to in-orchard and off-farm sources. Apple scab is a perennial problem in most areas of rain-fed agriculture throughout the world, and it must be controlled to produce marketable fruit, particularly the most susceptible varieties. The model shows that a large off-farm source of the fungus declines as rainfall rate increases and transport windspeed decreases. The use of improved dispersal models in the future should improve the basis for making informed IPM decisions and help reduce the need for fungicides in the control of apple scab and other fungal diseases.

(7) laboratory experiments on enzymes in plants will reveal which enzyme protects plants from photooxidative damage. **Themes: 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. Catalase is one of the crucial enzymes serving this function in both plants and animals. Research focused on genes controlling the three different catalase isoforms of higher plants, using *Arabidopsis* as a model system to meet long-term critical issues of stakeholders. The isoform coded by *Cat1* accounts for 85% of the catalase activity in the leaves, whereas stems contain a mixture of *Cat1* and *Cat3*. **Impact:** enzymatic studies thus far have shown that the *Cat3* isoform has enhanced peroxidatic activity, suggesting that it has a novel role in the plant. Further investigations are underway to determine the cellular locations and physiological roles of the different isoforms. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

**Actions of Detoxifying Enzyme Systems In Plants Described.** New information obtained by scientists at The Connecticut Agricultural Experiment Station on genes controlling different catalase isoforms has aided in the development of molecular tools that will elucidate the basic roles of detoxifying enzyme systems in plants and ultimately provide strategies for scientists to genetically engineer crops adapted to stress environments.

(8) field and laboratory experiments on wood preservatives will determine if surface soil becomes contaminated. **Theme: Hazardous materials**

*Results*

Chromate copper arsenate is a widely used wood preservative, which has potential to contaminate surface soil. Laboratory studies were conducted to determine if there is contamination of soil with copper, chromium, and arsenic under decks built from pressure-treated wood. The study meets intermediate critical issues of stakeholders. **Impact:** analyses of core samples revealed that concentrations of copper and chromium decreased rapidly in the soil with depth, but arsenic

concentrations tended to persist with depth. The average levels of copper and chromium were below statutory limits in state and federal guidelines. However, the average arsenic readings exceeded both regulatory limits. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These results also apply to national USDA goal # 5 by providing information which enhances the quality of life for Americans (**Theme: Children, youth, and families at risk**).

**Pressure-Treated Wood Contaminates Soil.** Pressure-treated wood is used in playgrounds and around homes in construction of decks and other structures. Scientists at The Connecticut Agricultural Experiment Station found that arsenic from pressure-treated wood tended to persist in soil under decks in amounts that exceeded regulatory limits. Concentrations of copper and chromium, however, decreased rapidly in the soil with depth. This information will assist consumers in deciding where to use pressure-treated wood and will encourage producers to find more acceptable methods of wood preservation for domestic and foreign use.

(9) forest health monitoring programs will detect emerging insect and plant diseases that may affect nursery-grown plants. **Themes: Invasive species, Plant health, Ornamental/ green agriculture**

*Results*

A new wood-boring insect pest, the small Japanese cedar longhorned beetle (*Callidiellum rufipenne*), was discovered in Connecticut. 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 in North Carolina. It is unknown how *C. rufipenne* entered Connecticut. Station scientists are working with the USDA Animal and Plant Health Inspection Service to determine if the pest moved from northwestern United States or Canada to Connecticut to meet long-term critical issues of stakeholders.

*Callidiellum rufipenne* invades the branches of arborvitae, junipers, and cedar trees and was previously thought to be a borer of only dead or stressed trees. However, *C. rufipenne* larvae were

detected by Station scientists in living arborvitae branches brought by a citizen to a diagnostic laboratory at the Station during FY 1999. Subsequent annual state surveys of 200 nurseries and examinations of about 27,000 trees on state and private lands in FY 1999 and 2000 revealed infestations in nurseries and on homeowners' properties in at least 28 towns (4 counties) in southern Connecticut and in Massachusetts, New Jersey, New York, and Rhode Island. A statewide quarantine was placed on infested nursery stock, which was destroyed by burning. At the request of stakeholders, a research project was started to determine if insecticides could control the adult beetle. **Impact:** the pest population was reduced by chemical control on a homeowner's property. An arborist (an Hispanic male who owns his own company) worked along with Station scientists to develop a control strategy and to apply a permethrin-formulated insecticide (Astro). Fact sheets and news releases informed other stakeholders within and outside Connecticut and state and federal regulatory officials of potential infestations of *C. rufipenne* and efforts to contain or eradicate this pest. **Sources of funds:** Hatch, McIntire Stennis, and state. **Scope of impact:** multistate (CT, MA, NJ, NY, RI).

**Controlling The Smaller Japanese Cedar Longhorn Beetle.** *Callidiellum rufipenne* is an exotic wood-boring insect that attacks arborvitae, junipers, and cedar trees. Native to Japan, Korea, Taiwan, and eastern China, this insect was found infesting live arborvitae in Connecticut and poses a serious threat to the nursery industry in Connecticut and other states. Scientists at The Connecticut Agricultural Experiment Station have determined the geographic distribution of the insect in Connecticut and other northeastern states and have developed a control method by using a permethrin-formulated insecticide that kills adult beetles.

(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 oriental beetle are major pests in container-grown nursery crops and turf. The presence of larvae in pots can lead to rejection of plant shipments by importing states. Stakeholders requested assistance from Station scientists to meet intermediate critical issues. Of the 22 insecticide treatments tested at a cooperating nursery in a multistate integrated research/extension program, pre-plant potting mix incorporation of bifenthrin at 5 to 25 parts per million gave 100% control of all these target pests. **Impact:** a concentration of bifenthrin at 5 parts per million still remained effective and was most economical. **Impact:** in turf (multistate NE-187 integrated activity), an insect growth regulator (halofenozide) was found to be selectively toxic to Japanese beetle and oriental beetle. Control of European chafer was less effective. Asiatic garden beetle survival improved in the presence of this insecticide, however. **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research (CT, FL, MA, MD, ME, NJ, NY, PA, RI) and extension.

**New Method Of Controlling Japanese Beetles.** A scientist at The Connecticut Agricultural Experiment Station found that pre-plant potting mix incorporation of bifenthrin at 5 to 25 parts per million was an acceptable control method for Japanese beetles. This method was accepted in August, 1998 by the National Plant Board to certify treated plants as being free of Japanese beetle. Many growers are now adopting the use of the 0.2% granular formulation of bifenthrin to protect their container-grown nursery stock from root weevils and white grubs. Homeowners and lawn care companies are being encouraged to identify white grubs in turf to prevent ineffective applications of halofenozide.

(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, Plant health, Integrated pest management**

*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. Because the striped cucumber beetle (*Acalymma vitiate*) does most of its damage to squash early in the season, the ability to trap beetles from before planting to the four-leaf stage could be particularly useful in beetle monitoring and control. As a part of multistate integrated activities, two commercially available types of sticky traps (Pherocon and Multigard) were compared with and without lures (a mixture of attractive plant volatiles: 1,2,4-trimethoxybenzene, indole, and *trans*-cinnamaldehyde) to meet short-term critical issues of stakeholders. Traps were set up around the edge of a field to be planted with squash in March. The first striped cucumber beetles were caught in early May. **Impact:** Multigard traps caught significantly more beetles than the Pherocon traps, while traps with lures caught more beetles than the traps without lures. Experimental results were given to extension personnel at The University of Connecticut and shared with growers. **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research (CT, MD, NJ, ID) and extension.

**A New Method Of Controlling Striped Cucumber Beetles.** 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. Because the striped cucumber beetle does most of its damage to squash early in the season, the ability to trap beetles from before planting to the four-leaf stage could be particularly useful in beetle monitoring and control. A scientist from The Connecticut Agricultural Experiment Station found that large numbers of beetles could be trapped with a combination of a commercial brand of sticky trap, a mixture of plant chemicals, and a flat of young squash seedlings grown in the greenhouse. This finding helps growers reduce amounts of pesticides used.

*Results*

Variations in wax structure and chemistry on the surface of leaves of *Brassica oleracea* (cole crops) have been shown to affect resistance to insects. Variants that appear glossy to the naked eye, have reduced amounts of wax and density of wax crystals, globular or flat crystal structure under electron microscopy, and have been associated with lower abundance and reduced survival of leaf-feeding caterpillars (*Pieris rapae, Plutella xylostella,* and *Trichoplusia ni*) in field studies. This apparent resistance is due, in part, to differences in behavior of the caterpillars and also to increased efficiency of several predators on glossy leaf surfaces. As a part of multistate integrated activities, including NE-9, to meet intermediate critical issues of stakeholders, glossy cauliflower, kale, and broccoli plants collected and bred by a scientist at The Connecticut Agricultural Experiment Station were tested by collaborators at the University of Idaho to determine the relationship between the structure of leaf surface wax and predatory behavior of *Chrysoperla plorabunda* larvae feeding on caterpillars of *Plutella xylostella* (diamondback moth). The glossy kale KCR4 and the glossy broccoli Broc 5 were crossed with the normal broccoli hybrid ‘Packman’ and the progeny of each cross was intercrossed to create a segregating F2 population. A glossy population was selfed from a single mutant plant found in the normal cauliflower hybrid ‘Andes,’ so that these two populations

were closely related and could be appropriately compared. F2 populations from a cross of glossy KCR4 X the normal hybrid 'Packman' segregated as normal-wax, glossy, and intermediate phenotypes in a ratio of 6:1:1. Along with a pair of glossy and normal cabbage phenotypes, this provided nine populations for comparison with three distinct glossy phenotypes among the four glossy populations, one intermediate phenotype, and four appropriate normal wax comparisons. **Impact:** all the glossy types provided an advantage to *C. plorabunda* over normal-wax types by increasing adhesion to the leaf surface, which in turn increased time allocated to walking (as opposed to movements of the legs without locomotion), leading to greater predation of *P. xylostella* larvae. *Chrysoperla plorabunda* larvae were completely unable to walk on the lower leaf surfaces of any normal-wax types, but were able to adhere and thus walk on the lower surfaces of all glossy leaves. Survival of *P. xylostella* first-instar larvae caged on leaves for 48 hours was significantly reduced by *C. plorabunda* on all glossy types, but on none of the normal types. On only two of the glossy types (cabbage NY 1406 and the glossy segregants in the Broc5 X 'Packman' F2) did *C. plorabunda* significantly reduce survival of second-instar *P. xylostella*. Results were reported to extension personnel at the University of Connecticut. **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research (CT, DE, MA, MD, ME, NH, NJ, PA, RI, VT, WV) and extension. Results also apply to goal #3 by maintaining a food source to ensure a healthy, well nourished population (**Theme: Human health**).

**Predators More Effective On Glossy Crop Leaves.** Cabbage, cauliflower, broccoli, and other cole crops with glossy leaves have fewer caterpillars feeding on them in the field than the same crops with normal waxy leaves. This is partly due to differences in the behavior of the caterpillars on glossy leaves and in the behavior of their predators. Scientists at the University of Idaho studied the behavior of one predator, the larva of a green lacewing, on glossy plants collected and bred by a

scientist from The Connecticut Agricultural Experiment Station. The lacewing larvae could walk more easily on the glossy leaves, and could even walk on the underside of the leaves, which they could not do at all on the leaves with normal wax. As a result, they killed more caterpillar larvae on the glossy plants than on normal plants.

*Results*

A wasp parasitoid, *Pediobius foveolatus*, was released by a Station scientist in three vegetable farms and several community gardens where snap beans were grown to control the Mexican bean beetle and meet intermediate critical issues. The wasp attacked beetle larvae and was most effective for control during mid-August through hard frost in mid to late October. **Impact:** some organic growers were able to produce snap beans late in the season for the first time in many years. At one small farm, bean production increased from 58 to 72 bushels and resulted in increased sales of $4,000. **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**).

**Parasitic Wasp Helps Increase Bean Production.** The Mexican bean beetle limits the growing season for bean plants in New England. A wasp, *Pediobius foveolatus*, was released in farm plots to help control the bean beetle. Successful parasitization of beetles enabled a longer growing season for bean crops in Connecticut; harvest was extended to late October, as opposed to early September, with the effect of the wasp. At one small farm, bean production increased from 58 to 72 bushels and resulted in $4,000 in increased sales.

*Results*

Two exotic insect pests, apple tortrix and the green pug, have been detected in fruit orchards. Caterpillars of both species eat buds, young leaves, and blossoms. Surveys were conducted to determine the geographic distributions of the pests and to meet intermediate critical issues of stakeholders. **Impact:** as a part of integrated activities, the apple tortrix, a leafroller pest from eastern Asia, was found infesting 73 different woody plants in Connecticut, Massachusetts, Rhode Island, New Jersey, and New York State. The green pug, a geometrid moth from Eurasia, damaged apple trees in southern New England and was observed feeding on 20 species in the apple family (Rosaceae). **Sources of funds:** Hatch and state. **Scope of impact:** multistate integrated research (CT, MA, NJ, NY, RI) and extension.

*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 of strawberry and potato early dying. As a part of integrated multistate research and extension efforts (NE-171), rotation crops were evaluated for effects on nematode and fungal pathogen populations to meet intermediate critical issues of stakeholders. **Impact:** Saia oats and sorgho-sudangrass reduced nematode densities. Runner numbers and yields of strawberry were highest after Saia oats planting. In the laboratory, exposure to sterile plant residues reduced *Rhizoctonia* fungi in media. Rotation and green manure crops reduced early dying of potato caused by *Verticillium dahliae* and *P. penetrans.* Lesion nematode recovery from roots of oat cover crops in 1996 was lowest in Saia oat plots and highest for canola and potato. Signs of verticillium infection on eggplant grown in soil removed from plots were lowest for sorgho-sudangrass and highest for canola and potato.

Potatoes were grown after rotation crops to evaluate early dying symptom development and determine tuber yield. **Impact:** total, marketable and A-sized tuber yields were significantly

increased by Saia oat/Polynema marigold rotation crops. Foliar symptoms were similarly reduced after Saia oat/Polynema marigold rotation. **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**).

**Improved Biological Control Of Nematodes.** Scientists at The Connecticut Agricultural Experiment Station found that potato yields can be reduced by up to 35% by the early dying disease caused by infection with both lesion nematodes and wilt fungi. Perennial strawberry plantings decline more quickly when plants develop black root rot, caused by infection with lesion nematodes and *Rhizoctonia* fungi. Scientists also have identified rotation crops which reduce nematode densities in both strawberry and potato systems without chemical pesticides, significantly reducing fungal diseases, and increasing crop yield.

*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. Fertilization practices affect the severity of root diseases, but for many infections, it is not clear what fertilizers are disease suppressive. Furthermore, it is not known how these minerals would affect beneficial microbes, such as fluorescent pseudomonads, in the rhizosphere. In a multistate research/extension effort, the influence of fertilization on root diseases of asparagus, beets, eggplants, and strawberries was investigated along with the associated effects on microbes in the rhizosphere to meet intermediate critical issues of stakeholders. **Impact:** nitrate-N

and Cl salts suppressed root diseases of asparagus and beets when compared to $NH_4$-N and $SO_4$ salts. On strawberries and eggplants, root diseases were suppressed with $NH_4$-N plus KCl when compared to $NO_3$-N plus $K_2SO_4$. Fluorescent pseudomonads were favored by $NO_3$-N and Cl salts, and were not always associated with disease suppression. **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.

**Fertilizers Suppress Plant Diseases.** Soil-borne diseases cause significant damage to agronomic crops. A scientist at The Connecticut Agricultural Experiment Station identified disease suppressive fertilizers for specific root diseases of asparagus, beets, eggplants, and strawberries. Nitrate-N fertilizers that included NaCl suppressed root diseases on asparagus and beets, while fertilizers containing $NH_4$-N and KCl suppressed the severity of root diseases on eggplant and strawberries. Inasmuch as fertilization practices are already in place for these crops, only minor changes in source of N-form and salt amendment are necessary to implement this management strategy.

*Results*

Making decisions, which minimize pesticide use without suffering a loss in yield, requires accurate assessment and prediction of crop damage. The spatial aggregation of both host plants and their pathogens and/or pests play a major role in determining the overall impact of plant damage on yield. In addition, the spatial distribution of host tissue and infection or infestation will affect the eventual spread of the pathogen or pest over time. These factors were considered when developing a computer model program to meet the long-term critical issues of stakeholders. **Impact:** easily implemented sampling schemes have been developed along with statistical computer programs to

enable epidemiologists and farmers to incorporate spatial aggregation into their research or agricultural programs. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific but potentially multistate with further development.

**New Statistical Computer Program For Plant Diseases.** A computer program (2DCORR) has been developed by a scientist at The Connecticut Agricultural Experiment Station and made available to scientists throughout the world. This program outputs a two-dimensional map of disease incidence, reports on the overall spatial aggregation of the data, and estimates the distance range and direction of spatial correlation. This approach has been applied to the spread of viruses in hops and lupine in Australia, virus in orange trees in Brazil, and "black measles," a disease of grapes in Italy. In conjunction with a scientist in the USDA, the above algorithm (2DCORR) is being incorporated into a Windows-based computer program called EPISTATS, which outputs directly in spreadsheet format and will increase the availability of this method of spatial analysis.

(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, Plant health**

*Results*

As a part of the integrated multistate research and extension project NE-183 involving multi-disciplinary evaluation of new apple cultivars, the focus of the Connecticut planting is an evaluation of cultivars for disease resistance. Fruitgrowers eagerly await research results and have requested assistance on meeting their long-term critical issues. Data from cultivar field-tests have been combined with information from similar participating sites in Michigan, Virginia, New York, West

Virginia, and Georgia for the rapid indexing of new cultivars that have resistance to foliar pathogens. The following new apple cultivars: Braeburn, Yataka, Arlet, Creston, Carousel, Enterprise, Fortune, Fuji Red Sport 2, Gala Supreme, Ginger Gold, Golden Supreme, Goldrush, Honeycrisp, Cameo, NY 75414-1, Orin, Pristine, Sansa, Senshu, Shizuka, Suncrisp, and Sunrise were evaluated for disease resistance. **Impact:** four cultivars (NY 75414-1, Enterprise, Gala Supreme, and Sansa) were identified as having disease resistance to multiple pathogens. Gala Supreme is popular in new grower plantings, while the other cultivars have only recently become commercially available or are still in the experimental stage. **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**).

**New Apple Cultivars Resistant To Foliar Pathogens.** A scientist at The Connecticut Agricultural Experiment Station, participating in a multistate integrated research and extension project, found that among several new apple cultivars evaluated for resistance to foliar pathogens, four were consistently ranked low in susceptibility to scab, cedar apple rust, and powdery mildew. These cultivars were NY 75414-1, Enterprise, Gala Supreme, and Sansa. NY 75414-1 is an experimental apple. Field trials are now required to show that it is worthy of being introduced as a named cultivar for commercial use. Enterprise and Sansa have only recently become commercially available from U.S. nurseries. The cultivar Gala supreme is popular among growers in new plantings.

(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**

*Results*

Sixty five lines representing 55 fiber flax cultivars were grown at 10-cm drill spacings in 1 x 5 meter plots with 2 replications to meet intermediate critical issues of stakeholders. Yields were calculated on an inner 0.6 x 4 m plot. Yields of clean seed ranged from 219 to 1050 kg/ha, while de-seeded straw ranged from 2250 to 6450 kg/ha. Total fiber ranged from 356 to 1513 kg/ha. Twelve lines yielded at least 30% total fiber. Four of these cultivars originated in France, two in Russia, one in the Netherlands, and three in the Czech Republic. During another year of study, there were additional trials with 18 lines representing 13 cultivars and selections with high yield and high fiber content. Thirty-eight lines were dropped and one new one, Evelin, was added. Only two lines, Merker and Diane exceeded 5000 kg/ha because of low stand densities. Total fiber yield was lower than in the first year of study and varied from 333 (Niva) to 1350 (Merkur) kg/ha. **Impact:** the cultivars Argos, Ariane, Diane, Hermes, and Viking from France along with Natasja from the Netherlands and Merkur from the Czech Republic consistently had higher fiber yields and percent total fiber than other cultivars. As an alternative to the production of long fiber flax, a harvest trial was conducted with a drum mower on flax destined for the production of cottonized flax, which is blended with other types of fibers. Flax cut and windrowed well without wrapping or twisting on the mower. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These results also apply to national goal #5 by providing an alternative crop that can enhance economic opportunity for American farmers (**Theme: Promoting business programs**).

**Flax Production Possible In The Northeast.** A scientist at The Connecticut Agricultural Experiment Station determined that cultivars originating from Western Europe performed best in trials. About 972 hectares (ha) with yield of 4490 kilograms (kg)/ha de-seeded straw would be required to operate a scutching-cottonizing plant full time. Purchase of flax straw at $0.132/kg and sale of cottonized flax to southern textile mills at $2.20/kg would yield a modest profit, although

payback on an initial $2 million investment would be slow. While long fiber flax requires special harvesting equipment, processing results showed that a drum mower could be used on flax destined for cottonizing. Cottonized flax is blended with cotton or synthetic fibers and spun dry on spinning machines which are available in the United States.

(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. 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:** a microwave assisted extraction of yew needles with different organic solvents was successful in reducing solvent consumption, solvent costs, and extraction time in the production of a partially purified mixed taxane fraction. This extract is qualitatively and quantitatively equivalent to that obtained by a conventional method. **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**).

**Improved Extraction Of Taxanes From *Taxus* (Yew) Plants.** Taxanes are used to produce taxol, a drug used in cancer treatment. A scientist at The Connecticut Agricultural Experiment Station used a

microwave assisted solvent extraction procedure to obtain purified mixed taxane fraction from yew needles. The new procedure reduced solvent consumption, solvent costs, and extraction time in the production of an extract that was qualitatively and quantitatively equivalent to that obtained by a conventional method.

*Results*

The needles from ornamental yew shrubs, members of the genus *Taxus,* represent a renewable resource for the anti-cancer compound, paclitaxel (Taxol®). A survey of yew shrubs, cultivated for their commercial value as ornamentals at four major nurseries where *Taxus* is grown in the Northeast, was conducted to ascertain if cultivars differed substantially in their contents of natural product. **Impact:** of the 14 cultivars studied, concentrations of paclitaxel in the needles ranged from a low of 118 ppm in *T. cuspidata* "Sieboldii" to a high of 882 ppm in *T. media* "Nigra". **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These findings also apply to national goal #3 by utilizing medicinal plants to ensure a healthy population (**Theme: Medicinal plants)**.

**Yew Plants Yield Medicinal Chemicals.** Farm products have traditionally been considered sources of food, fiber, and landscape material. Economic pressures now demand high value-added products to sustain agricultural operations. "Farmaceuticals", medicinal chemicals produced from biomass cultivated exclusively for this end use, can have economic value far in excess of traditional farm products. A scientist at The Connecticut Agricultural Experiment Station showed that paclitaxel, an anti-cancer compound, is produced from rapidly growing *Taxus* cultivars. With adequate concentration of the compound in the needles under suitable field conditions, paclitaxel has a potential market value substantially above the ornamental value of the plant biomass.

(15) laboratory tests will identify key genes involved with photoprotective response and photosynthesis. **Theme: 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, and plants have developed protective mechanisms to alleviate the problem. Cloning genes involved in photoprotection will lead to enhancement of primary productivity, and allow engineering of crop plants adapted to marginal environments. Gene analyses were conducted to meet the long-term critical issues of stakeholders. **Impact:** using a mutational approach, scientists at The Connecticut Agricultural Experiment Station have identified three new genes involved in photoprotection and mapped their chromosomal locations in the genetic model plant *Arabidopsis.* Analysis of protein components in the light-harvesting apparatus of these mutant plants is underway. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

**New Tools For Crop Improvement.** New information obtained by scientists at the Connecticut Agricultural Experiment Station on genes involved in phytoprotection further clarifies the mechanisms governing photoprotection, and provide tools for genetically engineering crop plants adapted to stress environments.

*Allocated Resources.* Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 1999 and 2000.

| | 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 | | 2,417,000 | | 17.8 | |
| 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 reported in a Station document: Record of the Year. During state FY 1999, there were 3 publications and 16 talks and interviews recorded in association with this program goal. In state FY 2000 there were 3 publications and 23 talks and interviews. As stated in the Plan of Work, excerpts of letters from stakeholders regarding services rendered, media reports, and narratives of scientific accomplishments were included in the Record. This document is available to citizens who are interested in Station research.

*Output Indicators (2).* The Department of Analytical Chemistry is responsible for testing agricultural products for pesticide residues. During FY 1999 and 2000, 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 safety**

*Results*

As a part of general market-basket surveys, inspectors of the food division of the Connecticut Department of Consumer Protection submitted 203 samples to Station scientists in the Department of Analytical Chemistry for pesticide residue analyses in 1999. The detection of a violative residue of vinclozolin in imported canned peas led to a voluntary recall of the product by the distributor. In other analyses of produce offered for sale in Connecticut, pesticide residues (if present) were well below tolerance levels set by the United States Environmental Protection Agencies (EPA). Research studies revealed that residues of captan, a fungicide used on a wide variety of fruits and vegetables, can be nearly eliminated by water rinsing produce. During FY 2000, 160 samples of produce and processed foods, such as canned and frozen vegetables, fruits, and juices were submitted for analyses. **Impact:** results indicated that when produce offered for sale in Connecticut contained pesticide residues, amounts were generally well below tolerance levels set by the U.S. EPA. These studies were conducted to meet short-term critical issues of stakeholders. **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 safety**

*Results*

Maple syrup producers in Connecticut requested Station assistance on sources of lead contamination in maple syrup and on corrective measures to produce a safer food product. To meet the short-term critical needs of stakeholders, amounts of lead in maple syrup were quantified. Field

sampling determined the source of lead contaminants. Relatively low amounts of lead were found in sap samples collected from trees and from plastic containers placed in maple groves. Increased lead content was linked to the use of galvanized buckets, bronze gear pumps, and lead-soldered buckets. Studies also revealed that a major portion of lead can precipitate out of solution during initial processing stages. When changes in procedures were implemented, the final product contained significantly less lead. **Impact:** knowledge of how lead contamination occurs has made it possible to correct problems and to market a safer food product. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

**Reduced Levels Of Lead In Finished Maple Syrup.** Maple syrup producers operate predominately small businesses in rural environments where sources of income are scarce. Maple syrup is a premium value-added product, but lead in the product will negatively impact the industry as a whole. In collaboration with the producers, scientists at The Connecticut Agricultural Experiment Station have identified the sources of lead contamination in maple syrup. Guidelines have been established to enable producers to lower or eliminate lead content of the finished maple syrup. This improved the producers competitiveness in domestic and foreign marketing.

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

Please note: research results reported above in Outcome Indicator #2 satisfied this indicator as well.

(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*

Carbamate pesticides are not easily analyzed by gas chromatography. An analytical method has been developed for the analysis of 14 carbamate pesticides and metabolites to meet long-term critical needs of stakeholders. The procedure uses liquid chromatography/atmospheric pressure ionization mass spectrometry. Although the methods can be used to detect carbamates in food, the procedure also had application in a survey of residential drinking water wells. Of the 19 pesticides screened in the survey, which included carbamates and compounds in other pesticide classes, six pesticides were detected in water from 6 of the 53 different wells tested. **Impact:** no residue, however, was above federal tolerance levels. This research accomplishment satisfied objectives in two program goal areas listed in the Plan of Work and has application to national goal #3. The impact statement is only listed under the first program goal. Please note: this paragraph was also included in the first program goal section under a different outcome indicator and is listed here to show how this research impacts different national goals.

(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: Food safety**

*Results*

Field and laboratory studies were conducted to determine if white-tailed deer (*Odocoileus virginianus*), an animal that enters orchards is a possible source of *Escherichia coli* O157:H7. This pathogenic bacterium contaminates beef, lettuce, and apple cider and can cause severe illnesses in humans. *E. coli* O157:H7 was not detected in 200 samples of deer feces collected from 5 sites in Connecticut, 4 of which were in close proximity to apple orchards. Other *E. coli* isolates (strains different from O157:H7) containing the genes for verotoxin production were identified, however.

Moreover, deer meat linked to a possible human infection of *E. coli* O157:H7 was analyzed, and this strain of bacteria was isolated in culture. Following DNA analyses, it was concluded that the deer meat did indeed contain the pathogenic strain. These studies were conducted to meet the intermediate critical needs of stakeholders. **Impact:** deer, therefore, are likely incidental hosts in the transfer of this bacterium to humans. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

***E. Coli* O157:H7 Contaminates Deer Meat**. Scientists at The Connecticut Agricultural Experiment Station and Yale University have found that a pathogenic strain of *Escherichia coli* O157:H7 infected deer meat. Partially cooked deer meat was consumed by a person who became ill and had *E. coli* infection. Analyses of 200 deer feces from 5 sites, 4 of which were near apple orchards, however, did not reveal the presence of this bacterial strain. Deer are likely incidental hosts in the transfer of *E. coli* O157:H7 to humans.

*Allocated Resources.* Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 1999 and 2000.

| | 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 | | $341,700 | | 3.0 | |
| 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 and reported in a Station document: Record of the Year. During state FY 1999, there were 26 publications and 334 talks and interviews recorded in association with this program goal. Totals recorded in state FY 2000 (33 publications and 604 talks and interviews) were higher. Numbers of officerships and memberships in stakeholder organizations and national or state committees were 29 and 44, respectively, for state FY 1999 and FY 2000. The Record also contains excerpts of letters from stakeholders regarding Station programs and assistance, comments from the media, and narratives of scientific accomplishments. This information is available to all interested persons. Sample letters from stakeholders are available upon request.

(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*

Nitrate in lettuce tissue grown in hydroponics can approach an unacceptable 6,000 parts per million (ppm) in northern Europe during winter. Studies were conducted in Connecticut to determine if similar high concentrations of nitrate could be curtailed when lettuce is grown under low sunlight by modifying the nutrient solution. In the northeastern USA, lowering nitrate supply by one third relative to other elements in the nutrient solution lowered tissue nitrate concentrations by one-third in winter. Similar changes were noted in other seasons. In summer, plants supplied with one third less nitrate grew more slowly, however, than those with the standard nutrient solution. In winter, growth was similar with both solutions. Leaves of other salad greens grown in unheated high tunnels had higher nitrate concentrations in winter than in summer, but they had less nitrate amounts than hydroponic lettuce grown in heated greenhouses. These studies were conducted to meet the intermediate critical needs of stakeholders. **Impact:** New information gained on applying nutrients enable growers to minimize amounts of nutrients used. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

**High Nitrate Content In Salad Greens Is Unfavorable.** Nitrate accumulates in leaves during growth under low sunlight. There are several hundred acres of salad greens grown in New England. Only a small fraction of this area uses hydroponics, high tunnels, or greenhouses to extend the growing season. A scientist at The Connecticut Agricultural Experiment Station measured nitrate content in hydroponic lettuce and in other salad greens grown in all seasons of the year. The nitrate approached a concentration considered hazardous by European Economic Community standards only in hydroponic lettuce grown in heated greenhouses in mid-winter and given a high concentration of nitrate.

(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**

*Results*

Sorption (adsorption or absorption) of chemicals to soil organic matter (SOM) has been the subject of scientific interest for decades. The traditional paradigm of SOM is a three-dimensional macromolecular phase that sorbs organic compounds passively by a solid-phase dissolution (partition) mechanism. A new dual-mode sorption model based on a ‘rubbery’ and ‘glassy’ polymer conceptualization of SOM has been developed. The rubbery phase tends to be flexible, expanded, and soft and acts as a partition medium for chemicals. This results in fast, linear, and noncompetitive sorption. The glassy phase tends to be rigid/condensed/hard and contains internal nanoporosity that provides adsorption sites for molecules. This results in slow nonlinear, and competitive sorption. This model has been validated by analysis of single-solute and bisolute isotherms of many polar and nonpolar compounds (pesticides and other compounds) in a variety of soils and SOM fractions. These studies were conducted to meet the long-term critical needs of stakeholders. **Impact:** consistent with

the model, it has been shown thus far that the rates of sorption and desorption and bioavailability to bacteria are increased in the presence of a competing solute. Recent high-intensity (72 point) sorption isotherms covering 4-5 orders of magnitude in concentration capture the predicted dual-mode shape. Solid-state analysis and carbon dioxide absorption experiments verified the partial glassy character of SOM. **Sources of funds:** Hatch and state. **Scope of impact:** multistate (AR, AZ, CA, CT, FL, HI, IA, IN, KS, MN, MT, NV, NY, WA).

**A Clearer Understanding Of Organic Chemical Sorption.** Scientists at The Connecticut Agricultural Experiment Station have found that sorption (adsorption or absorption) of soil organic matter is fundamental to the fate and transport of agricultural and other chemicals in the environment. Mathematical models used to predict rates of transport, biodegradation, and toxic effects of chemicals in contaminated soil, sediment, or groundwater all require a factor that takes into account sorption to this material. The dual-mode model provides insight into the nature of the sorption process and a potential explanation for long-term sorption and de-sorption rates.

(3) results of field experiments will lead to more efficient production and use of compost in agroecosystems, including stakeholder gardens. **Theme: 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. Field studies of 7 types of vegetables were conducted at two sites to determine if inorganic fertilizer rates can be reduced by one-half when the soil is amended annually with 1-inch of leaf compost. **Impact:** yields from these plots equaled or exceeded the un-amended control plots

fertilized at the full agronomic rate of 1300 lbs of 10-10-10/acre. In addition, there was less leaching of nitrate to the groundwater from the compost amended plots. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

**Expanded Uses For Compost.** Elevated levels of nitrate in groundwater are of concern to agricultural, state regulatory agency, and municipal health officials. A scientist at The Connecticut Agricultural Experiment Station has determined that using compost as a soil amendment reduces the fertilizer requirement for vegetable production, leading to less nitrate leaching to groundwater. Several growers in New England are now using less inorganic fertilizer in fields amended with compost. In addition, results from this research were incorporated into compost specifications written for the Connecticut Department of Transportation for those situations where compost is used to help establish vegetation after the completion of construction projects.

(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*

Eastern Equine Encephalitis (EEE) is a rare but deadly zoonotic disease of humans, horses and domestic fowl (emu birds). The latter are being raised on farms for meat and other commercial products. Eastern Equine Encephalitis is caused by a virus that is found in wild songbird populations that inhabit freshwater swamps along the eastern United States from New England to Florida. The

virus is transmitted by mosquitoes. The principal vector, *Culiseta melanura*, is a bird-feeding species that develops almost exclusively in white cedar/red maple swamps. Other mosquitoes, *Aedes* species, acquire the virus from birds and transmit the pathogen to mammals.

At the request of citizens and health department officials to meet intermediate critical issues, mosquitoes were collected at several sites in Connecticut in miniature light traps baited with dry ice, a source of carbon dioxide which attracts blood-sucking female mosquitoes. A total of 66,383 mosquitoes representing 25 species were obtained in Connecticut and tested for EEE virus, Highlands J virus, and Jamestown Canyon virus. **Impact:** isolations of EEE virus were made from *Culiseta melanura* and *Culiseta morsitans* and 22 isolations of Highlands J virus from five mosquito species (*Aedes triseriatus, Aedes vexans, Culiseta melanura, Culex pipiens,* and *Coquillettidia perturbans*) were made from five locations. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These findings also apply to national 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**).

**Infected Mosquitoes Found.** A scientist at The Connecticut Agricultural Experiment Station found that several mosquitoes of different species were carrying viruses that could cause severe human illness in Connecticut. Of particular concern was the Eastern Equine Encephalitis virus, which can be fatal to humans, horses, and domestic fowl (emu birds). Surveillance programs identified areas where infected mosquitoes lived. Health officials and the public were notified, and mosquito control measures were implemented to reduce risk of human infection. Well-defined mosquito management

efforts reduced broad scale pesticide applications by targeting those specific mosquito populations that posed the greatest public health threat.

During 1999, a new pathogen (the West Nile encephalitis virus) was isolated from *Culex pipiens* and *Aedes vexans* mosquitoes in southwestern Connecticut and from the brains of crows and a Cooper's hawk, which had died at numerous locations in southern Connecticut. This virus, new to North America, is known to occur in Africa and Europe. **Impact:** in collaboration with the Connecticut Department of Environmental Protection, mosquito control programs were conducted in 1999 and 2000 to reduce risk of human infection in the areas where infected *Culiseta, Culex pipiens,* or *Aedes* mosquitoes were found. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific. These results also apply to national 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**).

As a part of multistate project S-265 (now S-301), studies were performed to determine the impact of a microsporidian parasite *(Hyalinocysta chapmani*) for natural control of *Culiseta melanura.* Field studies thus far have revealed that this parasite overwinters as an active infection in the last larval stage of the mosquito, but prevalence of infection was low (3%). **Sources of funds:** Hatch and state. **Scope of impact:** multistate (AL, AR, CA, CT, FL, GA, ID, IL).

(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

and to control ticks. **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. At the request of state health officials and veterinarians to meet intermediate critical issues, antibody tests were developed to improve laboratory diagnosis. Sixty eight dog serum samples and 104 horse sera from ill animals were analyzed in newly developed enzyme-linked immunosorbent assays (ELISAs). These tests contained a purified antigen made from an immunodominant outer surface protein of the disease agent having a molecular mass of about 44 kilodaltons. **Impact:** results thus far indicate that the assays for dogs and horses are highly sensitive and specific and are suitable for screening large numbers of samples. As a part of research / extension activities, cow sera are being tested for antibodies to granulocytic ehrlichiae by newly developed immunofluorescence staining or immunoblotting methods. Prevalence of exposure to this pathogen in cattle appears to be lower than in horses. Analyses of human sera are in progress. **Sources of funds:** Centers for Disease Control and Prevention, Hatch, National Institutes of Health, and state. **Scope of impact:** multistate (CT, GA, MD). These results also apply to national goals #3 and #5 by providing important information on a new 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**).

**New Veterinary Diagnostic Tests For Ehrlichiosis**. Granulocytic ehrlichiosis is a newly recognized tick-associated illness in North America. The causative agent is a bacterium that is

transmitted by the same tick that passes the infectious agents of Lyme disease and human babesiosis in widely separated regions of the United States. Highly sensitive and specific tests are needed for laboratory diagnosis and epidemiological studies. Scientists at The Connecticut Agricultural Experiment Station and Yale University have developed new antibody-detecting tests called enzyme-linked immunosorbent assays for dogs and horses and are evaluating similar methods for humans and cows. The new technology is being used to diagnose ehrlichiosis and to determine the geographic distribution of this disease in the United States.

*Results*

Serum samples collected from white-footed mice (*Peromyscus leucopus*) or cotton mice (*Peromyscus gossypinus*) in Florida, Georgia, Maryland, Mississippi, North Carolina, and southern Connecticut were analyzed by indirect fluorescent antibody (IFA) staining methods and Western blot procedures for antibodies to granulocytic ehrlichiae in the *Ehrlichia phagocytophila* genogroup. Positive rodent sera were from numerous locations in southern Connecticut, Assateague Island (Maryland), Sapelo Island (Georgia), and Amelia Island (Florida). Antibody concentrations ranged from 1:80 to 1:2,560. Immunoblotting methods confirmed IFA staining results and revealed frequent antibody reactivity to a specific surface protein (p44) of the infectious agent, a similar observation made in the analyses of positive human, dog, cattle, and horse sera. **Impact:** granulocytic ehrlichiosis infections occur in mice at widely separated, tick-infested areas of eastern United States. **Sources of funds:** Centers for Disease Control and Prevention, Hatch, National Institutes of Health, and state. **Scope of impact:** multistate (CT, FL, GA, MD, MS, NC). These findings also apply to national goals #3 and #5 by providing geographic distributional information on a new 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**).

**New Evidence Of Granulocytic Ehrlichiosis.** Granulocytic ehrlichiosis, caused by a bacterium transmitted by ticks, is a disease of humans, dogs, horses and cattle. Scientists at The Connecticut Agricultural Experiment Station, Yale University, and in Georgia tested mouse sera from *Peromyscus leucopus* and *Peromyscus gossypinus* and found evidence of past or current granulocytic ehrlichial infections in southern Connecticut, Florida, Georgia, and Maryland, areas where Lyme disease is also known to occur. Like Lyme disease, granulocytic ehrlichiosis has widespread distribution in eastern United States. Physicians, veterinarians, and health officials were notified by media releases.

(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*). The abundance of nymphal ticks infected with the Lyme disease bacterium was highly correlated (R = 0.916) with the incidence of human cases of Lyme disease in Connecticut during a two-year study. By contrast, reductions in the local density of white-tailed deer at two sites in Connecticut are impacting both tick abundance and the prevalence of a parasitic wasp (*Ixodiphagus hookeri*) in those ticks. This wasp parasitizes the tick in localized areas, primarily on islands off the northeast coast, where there is

superabundant tick populations. These studies were conducted to meet long-term critical issues of stakeholders. **Impact:** field studies indicate thus far that the abundance of nymphal ticks has declined nearly two- to five- fold during the mid and late 1990's, while the wasp parasitism rates have declined from around 17% to less that 3% in response to reductions in the deer population from over 200 per square mile to around 40-50 deer per square mile. Monitoring of tick and wasp populations continue. **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 #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**).

**Deer Management And Parasitic Wasps Impact Ticks.** Lyme disease is the leading arthropod-associated disease in the United States. The continuing rise in the incidence of tick-associated diseases in different regions of the United States is related to increasing abundance of blacklegged ticks (*Ixodes scapularis*) and the abundance of one of its principal hosts, white-tailed deer. A scientist at The Connecticut Agricultural Experiment Station has found that a decline in the local density of deer at two sites in Connecticut is reducing tick abundance and the prevalence of a parasitic wasp (*Ixodiphagus hookeri*) that attacks the tick. Determination of the deer density required for maintaining tick abundance has helped develop better tick control strategies.

(7) laboratory analyses will determine concentrations of pesticide residues in air, water, or soil samples submitted by state regulatory agencies. **Themes: Hazardous materials, Pesticide application**

*Results*

Personnel in the Connecticut Department of Environmental Protection submitted 26 samples, including foliage, water, and air samples, to Station scientists in the Department of Analytical Chemistry for pesticide residue analyses to meet short-term critical needs of stakeholders. Quinomethionate and oxadiazon were detected in one or more of the 57 water samples tested. **Impact:** all other samples were negative or pesticide residue concentrations were below federal tolerance levels. During FY 2000, 72 samples were submitted for analyses, and all were found to be negative or below federal standards for pesticide residues. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

(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**

*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-265) project, scientists at The Connecticut Agricultural Experiment Station investigated the life cycles and natural epizootiology of several species of microsporidia that parasitize northern *Aedes, Culex* and *Culiseta* mosquitoes for the purpose of assessing their regulatory impact and biocontrol potential. **Impact:** 1.) the entire life cycles and developmental pathways of several species of *Amblyospora* and *Hyalinocysta* have been described; 2.) the mechanisms of horizontal and transovarial transmission of microsporidia have been elucidated; 3.) intermediate copepod (crustacean) hosts via nucleotide sequencing of microsporidian ribosomal DNA have been identified; 4.) infectivity, pathogenicity and transmission efficiency have been quantitatively assessed and; 5.) host(s)-pathogen population dynamics in the field have been identified along with abiotic and biotic factors that regulate pathogen infectivity, prevalence, survivorship and transmission. **Sources of funds:** Hatch and state. **Scope of impact:** multistate ( AR, CA, CT, FL, GA, ID, IL).

**Biological Control Of Mosquitoes.** Scientists at The Connecticut Agricultural Experiment Station have provided basic knowledge on the life cycles, transmission mechanisms and natural epizootiology of microsporidian (protozoan) parasites of mosquitoes. This information can now be used to assess the impact of these parasites on mosquito populations and help to formulate strategies for their sustainable use as biological controls in integrated pest management systems. The development of new molecular techniques for direct sequencing of ribosomal DNA of microsporidia has become an invaluable tool for screening potential intermediate hosts and elucidating the most difficult component of the life cycle. These techniques also are being used to generate a new database of ribosomal DNA sequences and to help clarify the identity and phylogeny of the entire group of microsporidia.

(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: Ornamental /green agriculture, Biobased products, 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 to meet long-term critical issues of stakeholders. To familiarize growers with how biosolids compost can replace expensive amendments to potting media, 11 species of woody ornamentals, 10 species of perennial flowers and 8 species of annual flowers were grown in media containing 0, 25, 50, and 100 percent (by volume) of Hartford biosolids compost. The remainder of the potting mix was bark, peat and sand. **Impact:** after one growing season, optimal plant growth occurred in media containing 50 and 100 percent compost. Many of the woody ornamentals will be grown for a second year. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific.

**Expanded Uses For Compost.** A scientist at The Connecticut Agricultural Experiment Station has found that large amounts of biosolids compost can be used in potting media to grow ornamental plants. Growers can realize substantial reductions in the cost of producing plant compost while providing a means for recycling a difficult to dispose of waste product. A large nursery used substantial amounts of the compost, and owners of other nurseries are considering implementing this practice.

(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**

*Results*

Studies were conducted by a research scientist at the Station with an extension specialist at the University of Connecticut to assess economic analysis of integrated pest management (IPM) practices and effectiveness and cost/benefit analysis of non-chemical weed control. This work was needed to meet intermediate critical issues. The economic analysis of IPM adoption is in the preliminary stages, but a literature review and contact with a cooperating agricultural economist has been completed. The test-case nursery has reported information on labor and other costs associated with their pest management program.

Field studies were conducted in a large Connecticut nursery to evaluate IPM programs to control rhododendron leafminer, an insect pest. In a 70 acre container production operation, the cost per plant unit (pre-IPM) was $0.51 in the first year of study, whereas a cost of $0.44 per plant unit was recorded after IPM practices were implemented in the second year. **Impact:** there was a total savings of $77,000 in production costs by reducing amounts of pesticides used. **Sources of funds:** Hatch and state. **Scope of impact:** state-specific, integrated research and extension.

**Economic Analysis of IPM Programs.** In efforts to reduce amounts of pesticides used in nurseries and to decrease costs of operations, field studies were conducted to determine the positive impact of IPM programs designed to control rhododendron leafminer, an insect pest. In a large nursery in Connecticut, 70 acres are devoted to container production of rhododendrons. The total cost per plant unit (2 gallon equivalent rhododendron) in the first year of study (pre-IPM) was $0.51. In the second

year, the total cost per plant unit ($0.44) decreased after IPM practice were implemented. There was a total savings of $77,000 in production costs by reducing amounts of insecticides at this nursery.

A weed control experiment was completed during the first field season and has entered the second season. The purpose of this study was to determine if non-chemical weed control methods are as effective as and similar in price to standard chemical herbicide applications in container nursery production. The following treatments were used: untreated check; sprayable herbicide [isoxaben (0.75 lb/A + oryzalin (2 lb/A]; granular herbicide [Ornamental Herbicide 2 (2 lb/A oxyfluorfen + 1 lb/A pendimethalin)]; fabric disc with copper-coated underside (Geodisc); pine bark mulch (3/4″ layer); cocoa hull mulch (3/4″ layer); and corn gluten meal (650 lb/A, 3.0g per container). The test plants were an evergreen azalea (*Rhododendron* 'Girard's Pleasant White') and the deciduous plant winter berry holly (*Ilex verticillata* 'Winter Red').

Weed control evaluations were conducted at 6 and 13 weeks after treatment. **Impact:** at 6 weeks after treatment, there was control of common groundsel (*Senecio vulgaris* L.) by sprayable herbicide (>99%), granular herbicide (85%), fabric disc (96%), cocoa hull (57%), and pine bark (35%). There was no control with corn gluten meal (0%). At 13 weeks after treatment, the following weed control ratings were recorded: sprayable herbicide (70%), granular herbicide (38%), fabric disk (67%), cocoa hull (51%), pine bark (57%), and corn gluten meal (32%). Future work will evaluate costs over a 3-year period based on the manufacturer's claim on the length of effective control provided by the fabric discs. **Sources of funds:** Hatch and state. **Scope of impact:** multistate (CT, MA) integrated research and extension.

**New Method Of Weed Control.** A scientist at The Connecticut Agricultural Experiment Station found that fabric discs were an effective alternative control method, compared to the use of chemical herbicides in weed management.

*Allocated Resources.* Fiscal and human (expressed as Scientist Years) resources are listed for federal FY 1999 and 2000.

| | 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 | $222,192 | $1,410,000 | $1,510,458 | 16.0 | 17.1 |
| 2001 | 205,373 | | $1,410,000 | | 16.0 | |
| 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 1999 and FY 2000. The CRIS code for The Connecticut Agricultural Experiment Station is CONH.

Table 1. Multi-Institutional (FY 1999 and FY 2000)

| Hatch Project | CRIS Access.# | Collaborating institutions and businesses |
|---|---|---|
| CONH 130[c] | 0172279 | CT Dept. of Agriculture, N. Amer. Maple Syrup Council |
| 131[c] | 0173195 | None |
| 132 | 0177218 | CT Dept. of Consumer Protection |
| 133[b] | 0183165 | CT Dept. of Consumer Protection |
| 134[b] | 0183796 | U.S. Environmental Protection Agency |
| 237[c] | 0174732 | Yale University (New Haven, CT) |
| 238[c] | 0174788 | Rutgers Univ., Univ. of Gent (Belgium) |
| 239 | 0177684 | 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), Johns Hopkins Univ. (MD), $L^2$ Diagnostics (New Haven), Bronx Lebanon Hospital Center (NJ). |
| 358[c] | 0133614 | Yale Univ. |
| 359[c] | 0133609 | CT. Dept. of Environ. Protection, Centers for Disease Control (Fort Collins, CO). |
| 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[b] | 0185235 | Yale Univ., CT. Dept. of Health |
| 375[a,d] | 0183834 | Univ. of CT (Storrs), Univ. of Mass., Univ. of Rhode Island, etc. |
| 546[c] | 0157556 | Hopkins and Stonington (Connecticut Vineyards) |
| 548[c] | 0163925 | Univ. of Georgia, Clemson Univ. Center Amer. Fiber Flax |
| 551[a,d] | 0167653 | Cornell Univ., W. Virginia (Univ.), Univ. of Georgia, Univ. of Arkansas, Virginia Tech. Univ., Michigan State Univ. |
| 555 | 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[b] | 0186018 | CT. Dept. of Environmental Protection, CT. Nursery & Landscape Assoc. |
| 622[c,d] | 0168962 | Univ. of Connecticut (Storrs), Michigan State Univ., Washington State Univ. |
| 623[c] | 0170500 | CT. Dept. of Envir. Protection, USDA Forest Service |
| 624[b,c] | 0171998 | Univ. of CT (Storrs) |
| 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) |
| 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 |
| 763[a] | 0170382 | USDA/ARS Center for Med. Agric. & Vet. Entomology |
| 764[c] | 0173196 | State of CT. Dept. of Transportation |
| 765[c] | 0173197 | Univ. of CT (Storrs) |
| 766[b] | 0181763 | Biolog. Bundesanstalt fuer land-und Forstwirtschaft (Germany) |
| 767[a] | 0184011 | USDA/ARS, Cornell Univ., Washington State Univ. |
| 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

| Hatch | Project | Scientific Disciplines |
|---|---|---|
| CONH | 130 | analytical chemistry, food production systems |
| | 131 | analytical chemistry, horticulture |
| | 132 | analytical chemistry, food production systems |
| | 133 | analytical chemistry, toxicology |
| | 134 | analytical chemistry, food production systems |
| | 237 | plant biochemistry, molecular genetics |
| | 238 | plant biochemistry, molecular genetics, plant physiology |
| | 239 | plant biochemistry, molecular genetics, plant physiology, immunology |
| | 344 | acarology, microbiology, immunology, molecular biology, epidemiology, human and veterinary medicine |
| | 358 | insect pathology, molecular biology |
| | 359 | acarology, ecology, insect pathology |
| | 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 |
| | 546 | horticulture, food production systems |
| | 548 | horticulture, fiber production systems |
| | 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 |
| 622 | plant pathology, mycology, horticulture, soil bacteriology, agronomy |
| 623 | virology, plant pathology, mycology, nematology |
| 624 | plant pathology, biological control |
| 625 | meteorology, plant pathology, epidemiology, biophysics, biological control |
| 626 | mycology, plant pathology, horticulture, molecular biology |
| 627 | plant pathology, biological control |
| 695[a] | nematology, plant pathology, entomology |
| 762 | organic chemistry, environmental toxicology, environmental engineering, soil chemistry |
| 763 | protozoology, invertebrate pathology, entomology |
| 764 | soil microbiology, horticulture, soil and water chemistry |
| 765 | soil chemistry, environmental toxicology |
| 766 | environmental toxicology, soil chemistry |
| 767[a] | organic chemistry, environmental toxicology |
| 804 | analytical chemistry, horticulture, weed management |

[a]USDA approved multistate research project.

Table 3. Multistate Collaborations

| Hatch Project | CSREES Multi-state Project Number | Participating states |
|---|---|---|
| CONH 130 | | |
| 131 | | |
| 132 | | |
| 133 | | |
| 134 | | |
| 237 | | |
| 238 | | CT*, NJ |
| 239 | | |
| 344 | | CT*, MD, GA |
| 358 | | |
| 359 | | CO, CT* |
| 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 |
| 546 | | |
| 548 | | CT*, GA, SC |
| 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 | | |
| 622 | | CT*, MI, NJ, WA |
| 623 | | |
| 624 | | |
| 625 | | CT*, NY |
| 626 | | CT*, FL, MI, PA, WA |
| 695 | NE-171[a] | CT*, FL, MA, MD, MI, NY, PA, WV |
| 762 | | CT*, MA, NY |
| 763 | S-265[a] | AL, AR, CA, FL, GA, ID, IL, KY, LA, ME, MN, MS, NJ, NY, NC, SC, TN |
| 764 | | |
| 765 | | |
| 766 | | |
| 767 | W-082[a] | AZ, AR, CA, FL, HI, IA, IN, KS, MN, MT, NV, NY, WA |
| 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 and 2000 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 $392,863 | $1,579,780 | $1,972,643 | 15.9 | 37.3 |

| | |
|---|---|
| Total funds available for entire Hatch program (FY 1999) at C.A.E.S. | $768,626 |
| % Hatch funds dedicated to multi-institutional, multi-disciplinary, and multistate programs | 48.9% |
| Total funds available for entire Hatch program (FY 2000) at C.A.E.S. | $768,385 |
| % Hatch funds dedicated to multi-institutional, multi-disciplinary, and multistate programs | 51.1% |

Table 5. Integrated research activities between The Connecticut Agricultural Experiment Station (C.A.E.S.) and extension programs in Land Grant Universities during federal FY 1999 and FY 2000.

| | | | | SY units | |
|---|---|---|---|---|---|
| | Fed. Hatch Funds | Connecticut State Funds | Total | Integrated only | Total Hatch Program |
| FY 99 | $288,340 | $977,827 | $1,266,167 | 8.5 | 37.3 |
| FY 00 | $298,777 | $1,022,467 | $1,321,244 | 8.1 | 37.3 |

| | |
|---|---|
| Total funds allocated to entire Hatch program at C.A.E.S. in FY 1999 | $768,626 |
| % dedicated to all multi-categories and integrated activities | 37.5% |
| Total funds allocated to entire Hatch program at C.A.E.S. in FY 2000 | $768,385 |
| % dedicated to all multi-categories and integrated activities with CT and other states | 38.9% |

**The Connecticut Agricultural Experiment Station receives no Smith-Lever Funds but dedicated Hatch funds to integrated activities with extension systems in Land Grant Universities in different states. In Connecticut, $272,652 and $297,078 were dedicated to integrated activities in FY 1999 and FY 2000, respectively, 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 and FY 2000.

| | 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 |

*Funds distributed to all "multi" categories and integrated activities. Note: Total Hatch allotment for FY1999 ($768,626) and FY 2000 ($768,385) were similar.

Table 7. Distributions of projected and actual fiscal and human resources (SY units) dedicated to the entire Hatch and associated state research program (excluding federal and non-federal grants) for federal FY1999 and FY2000.

| | 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) | $768,385 | $4,188,037 | 37.3 |

Progress Reports: Integrated Activities

(Hatch Act Funds)

Federal FY 2000

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 follows brief summary statements for these specific programs. If applicable, page members are provided in the summaries for referral to the expanded reports presented earlier in this document.

1. Tick-borne infections: Indirect fluorescent antibody staining methods were used to detect antibodies to ehrlichiae, a tick-transmitted bacterium, in dairy and beef cattle exposed to ticks in Connecticut. Preliminary serologic tests revealed that these animals were exposed to granulocytic ehrlichiae in the *Ehrlichia phagocytophila* genogroup, but the animals showed no overt signs of disease. Application of immunoblotting procedures (Western blot analysis) verified the presence of antibodies to granulocytic ehrlichiae and showed specific reactivity to an outer surface protein having a molecular mass of about 44 kilodaltons. The reactivity of cow sera to this protein is important evidence of past or current infection of a granulocytic *Ehrlichia* that causes disease in humans and horses.

2. Managing insects on vegetable crops: Two commercially available and visually attractive sticky traps with plant-derived chemical lures were evaluated as an alternative method of controlling striped cucumber beetles on squash in organic farm plots. The Multigard traps caught significantly more beetles than the Pherocon traps and showed promise in integrated pest management programs. (Annual Report, page 44).

3. Plant genetic resources (NE-9): Glossy cauliflower, kale, and broccoli plants were collected and bred to determine if certain cultivars were resistant to caterpillar infestations. Lower infestations of caterpillars were noted for certain genetic varieties of crops. (Annual Report, pages 45-46).

4. Managing insects in apple orchards: Two exotic insect pests, apple tortrix and the green pug, have been detected in stakeholders' apple orchards in northeastern United States. Both insects caused damage to apple trees and were capable of infesting dozens of other plant species in the apple family (Rosaceae). (Annual Report, pages 47-48).

5. Integrated pest management (IPM) for Connecticut nurseries: In experiments conducted in stakeholders' greenhouses, two-spotted spider mites were controlled by using horticultural oil. This was more effective than using chemical pesticides.

6. Management of insects in soil and other pests (NE-187): At the request of the nursery and turf industries, experiments were conducted to control black vine weevil, Japanese beetle, and oriental larvae in root systems of plants. A pre-pot potting mix incorporation of bifenthrin at 5 to 25 parts per

million gave 100% control in nursery containers. The insect growth regulator, halofenozide, was effective in controlling Japanese beetle and oriental beetle larvae (Annual Report, pages 42-43).

7. Evaluation of new apple cultivars (NE-183): Twenty-one new apple cultivars were evaluated for disease resistance. Of these, NY 75414-1, Enterprise, Gala Supreme, and Sansa were identified as having disease resistance to different pathogens that cause apple scab, cedar apple rust, and powdery mildew. (Annual Report, pages 51-52)

8. Suppression of soil-borne diseases: To control *Fusarium* (fungal) infections of asparagus, beets, eggplants, and strawberries, tests were conducted on the use of fertilizers. Nitrate-N and chloride salts suppressed root diseases of asparagus and beets. Other compounds (salts) were effective in strawberry and eggplant plots. (Annual Report, pages 49-50).

9. Analysis of risk for plant diseases: Studies were conducted to control apple scab, a serious fungal disease. Field data on temporal changes in ascospore maturation, susceptible leaf area, and leaf litter were analyzed to develop a predictive model to estimate relative risk of infections. The new information is useful in determining more precise times to use chemical control treatments. In addition, a mathematical model was developed to predict aerial dispersal of plant pathogenic fungal spores that affect apple quality and the spread of infection between fields, farms, and crop growing regions. (Annual Report, pages 38-39).

10. Integrated pest management of plant parasitic nematodes (NE-171): Rotation crops were evaluated for effects on reducing nematode and fungal pathogens of nursery plants, strawberries, and

potatoes. Saia oats and sorgho-sudangrass reduced nematode densities. Rotation and green manure crops reduced early dying of potato caused by two fungal pathogens. (Annual Report, page 48-49).

11. Herbicides/weed control: Non-chemical weed control methods, such as fabric discs and mulches, were acceptable alternatives to the use of herbicides in container nursery production operations. (Annual Report, page 78).

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 | FY 2000 | Actual Expenditures FY 2001 | FY 2002 | FY 2003 | FY 2004 |
|---|---|---|---|---|---|
| k-borne infections | $ 61,204 | _____ | _____ | _____ | _____ |
| naging insects on vegetable crops | 6,367 | _____ | _____ | _____ | _____ |
| nt genetic resources (NE-9) | 9,117 | _____ | _____ | _____ | _____ |
| naging insects in apple orchards | 68,890 | _____ | _____ | _____ | _____ |
| M for Connecticut nurseries | 4,649 | _____ | _____ | _____ | _____ |
| nagement of insects in soil (NE-187) | 1,722 | _____ | _____ | _____ | _____ |
| luation of new apple cultivars (NE-183) | 1,699 | _____ | _____ | _____ | _____ |
| pression of soil-borne diseases | 44,279 | _____ | _____ | _____ | _____ |
| alysis of risk for plant fungal disease | 17,989 | _____ | _____ | _____ | _____ |
| M for management of plant nematodes (NE-171) | 69,690 | _____ | _____ | _____ | _____ |
| bicides/weed control | 13,171 | _____ | _____ | _____ | _____ |
| al | $298,777 | _____ | _____ | _____ | _____ |

_____ _____
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 (469-68-31, 46a-68-74). The Policy Statement was 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. 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 1999 and 2000 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 state 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 letter and survey form were sent to members of 39 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 the past two state fiscal years. Plant Science Days were held in the spring (April 7, 1999, May 10, 2000) and summer (August 4, 1999, August 2, 2000) and Agricultural Chemistry Night was presented on October 26, 1999 and October 24, 2000. Notifications of these events were made in the Experiment Station Associates Bulletin, on radio shows, and in major newspapers in the state.

About 1,200 persons attended each of the Plant Science Day events held in August during the past two fiscal years 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. A wheelchair accessible path was constructed in the bird/butterfly demonstration garden plot to allow better access for all persons. About 65-100 citizens attended each of the Plant Science Days in the spring and in each of the Agricultural Chemistry Nights, all held in the Station's main auditorium at the New Haven facilities. Selected laboratories were opened for public inspection. Citizens who live in urban, suburban, and rural areas of Connecticut attended these events, listened to presentations on research, saw experimental plots or toured laboratories, and were given opportunities to comment on research programs. Oral inquiries were answered by Station scientists during these sessions. In addition, the Station participated in Farm/City Week during May of 1999 and 2000 in New Milford, CT and in the Connecticut Flower Show in Hartford on February 17-20, 2000 by showing a popular exhibit on honey bees. Hundreds of students, including minorities, from area high schools attended Plant Science Days in August and the other events. Station displays on research projects or agricultural topics of interest also were presented at a fair in Orange, Connecticut on September 18, 1999, at a Conservation Fair in Lockwood Farm on October 2, 1999; and at the State Department of Agriculture Expos held on October 23 & 24, 1999 and on October 21 & 22, 2000 in Hartford; and at an agricultural fair in Southington in June of 2000. The agricultural expos were attended by more than 8,000 persons each year, including minority students and their

parents. In all instances, 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, the Station farm manager and his assistants plowed inner city garden plots in New Haven for no fees. Seeds for vegetables were donated by Station scientists. This enabled the poor, who live in different neighborhoods, to have gardens as a source of fresh vegetables. 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 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 worked 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*: 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. About 14 tons of produce were donated. Contacts with charities were maintained.

*Results*: Public Notifications

The Station has a continuing policy of commitment to affirmative action and equal employment. A Policy Statement, signed by the Director, is posted in public areas and was given annually to all employees and their labor unions. As a result of a CSREES Civil Rights Compliance review held in March of 1999, this document was revised to include research programs along with other items on the employment process. There was 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 annually to each Station employee. One of the objectives (a new entry resulting from the CSREES Civil Rights Compliance review) ensures equal access and nondiscrimination in all terms and conditions of research programs. Employees and their unions were invited annually to review and comment on the Station's Policy Statement and state-approved Affirmative Action Plans. All job notices included statements that the Station is an Affirmative Action/Equal Employment Opportunity Employer. Job notices were posted on the Station's Home Page (Web site), published in newspapers, sent to colleges and universities, and mailed to members of organizations representing minorities 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. As a result of the CSREES Civil Rights Compliance Review, a new, expanded anti-discrimination statement appears on Station publications for all to see. Station policies on equal employment and against discrimination were reviewed annually 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.

Procedures: Job notices will be posted on the Station's web site (http://www.caes.state.ct.us), published in newspapers, and distributed to colleges, universities, and members of protected organizations to announce vacancies. All notices will have statements on equal employment opportunity and affirmative action. The Station's Policy Statement on employment processes will be given annually to all employees and their labor unions and will be posted along with USDA notices against discrimination to reaffirm nondiscrimination policies based on race, color, national origin, sex, sexual orientation, disability, genetic information, and other categories covered by state and federal laws.

*Results*: Job notices were posted on the Station's web site, published in newspapers, and distributed to college and university placement offices and members of organizations for protected groups to announce vacancies and provide opportunities for all qualified applicants to apply for employment. Advertised notices had statements on equal employment and affirmative

action. A Policy Statement was reviewed annually, revised as needed to comply with all state and federal laws, and posted in public areas on Station property. All Station employees received copies of the CSREES Civil Rights Compliance review, revised Policy Statement, and the Station Director's responses to the Civil Rights review. Employees were invited to review and comment on the Station's approved Affirmative Action Plans and objectives for affirmative action and equal employment. In addition, all bidding forms included non-discrimination clauses.

## 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 was hired as an Agricultural Scientist II during FY 2000. Civil rights training for current and newly hired staff members is included with programs to improve employee job skills. All Station employees received a minimum of 3 hours of diversity training and education during December, 2000 or thereafter as needed. New employees were trained within 6 months after being hired. Educational sessions on sexual harassment laws were offered to all staff members. 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 schools and with other community leaders to reach minorities in urban settings. The Private Industry Council of New Haven provided funds for two Black females to work in the Station's business office and libraries to learn computer skills in FY 1999. 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 1999 and 6 students during FY 2000 to improve plantings on Station grounds. Outside funding was provided for two Black females, two White females, one Hispanic male, and one Hispanic female. These students learned about agricultural research at the Station and participated in Plant Science Days held at the Station's farm in Hamden, Connecticut during August.

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 1999, one Black male, one Black female, one Hispanic male, one Hispanic female, one Other male, and one Other female were hired along with White males and females to learn new skills. During FY 2000, one Black female and one Black male were included in the workforce.

A volunteer program is available for students to work part-time during the school year. One Other male worked with a scientist on pathogenic *Escherichia coli* O157:H7 in FY 1999 and learned techniques in DNA detection of the bacterium. Results gained by this person strengthened his educational background by providing "hands-on" experience. One Hispanic male worked as a volunteer before being hired as a Postdoctoral Research Scientist.

To assist the under-served and under-represented in more advanced research, persons were hired 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 one Hispanic male, two Other males, and one White female to work as Postdoctoral Research Scientists in FY 1999. One Other male, hired prior to 1999 as a Postdoctoral Research Scientist, accepted a permanent job with an American company and is now working in Asia. During FY 2000, one Other female one Hispanic male, and two Other males worked as Postdoctoral Research Scientists.

## Results of Special Crop Program

Stakeholders of different ethnic groups requested the Station's assistance on growing specialized crops, such as okra, jilo, artichokes, sweet potatoes, and Chinese cabbage. A Station scientist field-tested these crops to determine if they would grow in Connecticut and if they were of economic value. Certain cultivars grew well and yields were high enough to be of interest to vegetable farmers. These crops are now being grown by vegetable growers and represent an emerging "niche market". There is current interest in growing arugula. In response, a Station scientist has written a grant proposal to augment funding for field studies to find ways of reducing insect damage through organic farming practices.

## Assistance to Mohegan and Pequot Tribes

Members of the Mohegan and Pequot tribes in Connecticut have asked for Station assistance on composting, forest/wetlands management, and control of hemlock woolly adelgids. Three scientists responded and 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. The Pequot tribe has provided grant funding to a Station forester to help support his research effort.

## 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 who have state contracts through the Department of Administrative Services, a portion of the budget is available for outside bidders. The total state FY1999 outside purchasing/contracting expenditures for the Station totaled $1,454,845. Of this amount, $261,398 (18%), which included 113 (12.6%) of 897 total contracts, was awarded to small contractors. This amount greatly exceeded the state-approved goal established ($64,805) for the Station. There were a total of 19 Minority Business Enterprise set-aside purchases and contracts worth $14,770. Contracts were awarded to businesses owned by Hispanics, Asian Americans, African Americans, and women. During state FY 2000, $1,746,787 was expended for outside purchases. Of this amount, $225,047 (12.9%) was awarded to small contractors. This total greatly exceeded the state-approved goal ($65,577). There were 22 Minority Business Enterprise set-aside purchases and contracts worth $80,842, which greatly exceeded the state-approved goal of $16,394. Contracts were awarded to businesses owned by African Americans, Asian Americans, and women.

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

As presented in Tables 1 and 2 of this Annual Accomplishment Report, 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. Some statutory requirements, however, 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 extensive (Table 3). Of the 37 Hatch projects listed, 18 (48.7%) have multistate collaborations. Scientists at The Connecticut Agricultural Experiment Station interact with colleagues in 41 other states. The 6 USDA-approved multistate projects (NE-009, NE-171, NE-183, NE-187, S-265, 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, an institution that is unaffiliated with The Connecticut Agricultural Experiment Station.

In this evaluation of the multi-programs and joint activities, there are four key questions that need to be 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 has been made regarding all of these key questions, and 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. General comments in our evaluation of the multi-programs and joint activities as they relate to the key questions listed above follow. We emphasize, however, that scientific work is a continuum and that some projects progress more rapidly than others.

In each of the program goal sections of the Plan of Work, the critical issues of strategic importance are stated, as identified by stakeholders. The expected outcomes and impacts were

listed accordingly. In earlier sections of this Annual Accomplishment Report, specific results were listed for each item demonstrating the progress being made in research. Impact statements were identified in each progress report. Brief impact statement summaries, ready for release to the public, were provided in those instances when significant scientific advances occurred. As indicated in the Executive Summary and in the text of the Planned Program section of this Annual Accomplishment Report, the research goals were met early in some instances. However, research continues on these topics and issues to further broaden our knowledge, to replicate experimental trials to check reproducibility of results, or to refine techniques developed. The critical issues of producing new and value-added agricultural products and commodities; protecting crops and forests from insect pests and plant diseases; 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.

The multi-programs addressed the needs of the under-served and under-represented. A section of the Annual Accomplishment Report gives examples of how this was done. Briefly, members of 39 organizations serving protected groups of minorities were invited to attend open houses, see experimental plots, and to comment on research findings. Minorities benefited from research dedicated to growing specialized ethnic crops. Knowledge gained from Hatch-funded multi-program research on crop diseases and insect infestations specifically benefited the under-served and under-represented who participated in inner city garden community projects. Produce from Hatch-supported research projects were donated to charitable organizations and food-sharing programs. 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 outreach

program to the under-served and under-represented is successful. Program expansion to address more problems and to inter-connect minority groups with more multi-program projects is being planned.

The multistate, multi-institutional, and multi-disciplinary programs have increased program effectiveness and efficiency by reducing unnecessary duplication of research experiments and by better utilizing resources of participating institutions within and outside Connecticut. Examples of improved efficiency include determining the specific periods of risk for apple scab fungus, the discovery of a pre-plant potting mix to treat Japanese beetle larvae in container-grown nursery stock, the identification of cole crops and apple cultivars that are resistant to insect problems and diseases, improved nutrient management in hydroponic lettuce production, the efficient use of biosolids compost in nurseries, and the use of integrated pest management practices to reduce costs in nurseries. In general, the ease of accessing research from USDA-approved multistate projects has resulted in more efficient experimental design and better utilization of equipment and facilities located in cooperating institutions.

In conjunction with the multi-programs, integrated activity (research/extension) is particularly successful. For example, a current research effort on ehrlichiosis has collaborators from Connecticut and Iowa. In Connecticut, a scientist at The Connecticut Agricultural Experiment Station has some reagents and expertise needed to develop antibody tests in cattle. A collaborator at the University of Connecticut, trained in pathobiology and who also has an extension appointment, has the other key reagents and skills necessary to facilitate the development of new diagnostic tests. When the project is completed, findings will be disseminated to stakeholders via scientific publications, media releases, and other means. The inclusion of research/extension specialists in USDA-approved projects (NE-009, NE-171, 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 have functional extension components where research results are reported to stakeholders in extension publications or at meetings. Internet program development at the national level and in states would improve program effectiveness and efficiency by allowing all interested clientele and stakeholders easy access to all scientific results. For example, a homepage has been established for NE-171 "Biologically Based IPM Systems for Management of Plant-Parasitic Nematodes" at a website (http://www.caes.state.ct.us/coopregionalresearchproject/multistatenematode.htm) supported and maintained by The Connecticut Agricultural Experiment Station. The Administrative Advisor for this group is the Vice Director of The Connecticut Agricultural Experiment Station.

In conclusion, the overall evaluation of the multi-programs with joint research/extension activities is very good. This approach best serves the interests and needs of citizens. Efforts to expand this approach are being encouraged within the institution.

## Certification

This 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 _____