# The Connecticut Agricultural Experiment Station

The Connecticut Agricultural Experiment Station
*Putting Science to Work for Society since 1875*

## *At a Glance*

**THEODORE G. ANDREADIS, Ph.D.,** ***Director***
**Jason C. White, Ph.D.,** ***Vice Director***
***Established*** **– 1875**
***Statutory authority*** **– CGS 22-79 – 22-118**
***Central office*** **– 123 Huntington Street, New Haven, CT 06511**
***Number of employees*** **– 96**
***Recurring operating expenses*****:**

| | |
|---|---|
| **General Fund –** | **$ 7,107,797** |
| **Federal Funds –** | **$ 3,222,854** |
| **Other/Pass Thru –** | **$ 2,114,575** |
| **Total –** | **$12,445,226** |

***Organizational structure*** **– Administration, Analytical Chemistry, Entomology, Environmental Sciences, Forestry and Horticulture, Plant Pathology and Ecology, Valley Laboratory (Windsor, CT), Griswold Research Center (Griswold, CT).**

## Mission

***The mission of The Connecticut Agricultural Experiment Station is to develop, advance, and disseminate scientific knowledge, improve agricultural productivity and environmental quality, protect plants, and enhance human health and well-being through research for the benefit of Connecticut residents and the nation. Seeking solutions across a variety of disciplines for the benefit of urban, suburban, and rural communities, Station scientists remain committed to "Putting Science to Work for Society, Protecting Agriculture, Public Health and the Environment," a motto as relevant today as it was at our founding in 1875.***

## Statutory Responsibility

Statutory responsibilities for The Connecticut Agricultural Experiment Station (CAES) focus on insects, ticks, plants and related diseases, and the development of methods to reduce pesticide use (i.e., integrated pest management). Within available resources, field and laboratory studies are conducted, as determined by the agency's Board of Control, state residents (e.g., growers), or as requested by the General Assembly, pursuant to Connecticut General Statute (CGS Section 22-81). Scientists and technicians analyze food and other items at the request of any state agency; test ticks for the infectious agents that cause Lyme disease, Babesiosis and

Anaplasmosis upon request of a state or municipal health officer or for scientific research purposes; test mosquitoes for public health threat from encephalitis viruses (CGS Sec 22-81a); oversee official control, suppression or extermination of insects or diseases, which are or threaten to become serious pests of plants; conduct research on integrated pest management (CGS Section 22-84a); inspect for diseases of honey bees and register beekeepers (CGS Sections 22-89, 22-90); and survey towns for gypsy moth, Asian longhorned beetle, Emerald ash borer, and other insect pests of economic or public health importance. In many instances, there are interactions with scientists or other officials in federal agencies. The Director is in charge of all matters pertaining to serious pests of plants and has regulatory authority (CGS Sections 22-84); responsibilities include the inspection and certification of nurseries, the registration of dealers of nursery stock, and enforcement of federal and state quarantines or regulations. Findings are reported to the public and scientific community by correspondence, lectures, media interviews, the agency's website, or published works. Emphasis is placed on submitting scientific manuscripts to peer-reviewed journals.

Station staff members provide prompt answers to routine and difficult but important agricultural, food safety, forestry, environmental, consumer protection, or public health questions by performing analyses; providing services to state residents; assisting small and large businesses, municipalities, state agencies and the scientific community; and by giving oral and written reports of research findings. Transferring new scientific information to the public and businesses is a high priority. The enhanced agency website (https://portal.ct.gov/caes) continues to be an efficient means of communicating research findings and reducing operating costs. Social media is also being used to reach out to our constituents via Facebook www.facebook.com/CT.CAES, Twitter www.twitter.com/CT_CAES, YouTube www.youtube.com/user/CTAGEXPSTATION, Instagram www.instagram.com/ct.caes/, and Pinterest www.pinterest.com/caes123. CAES also maintains a Wikipedia page http://en.wikipedia.org/wiki/Connectcut_Agricultural_ Experiment_Station. Staff members gave 631 talks and interviews to civic groups and the media. One open house event was held at our Lockwood Farm facility during the summer; more than 937 state residents had an opportunity to meet scientists, hear presentations on scientific progress, see experimental plots and laboratories, and to make comments on research and outreach programs. Tapings of the event are available on the CTN, Connecticut Network, http://www.ctn.state.ct.us/.

## Public Service

Public service remains a high priority. The CAES serves a diverse group of state residents, large and small businesses, municipalities, and the scientific community within its areas of expertise. More than 48,000 jobs in agriculture, wood-products industry, and other business sectors are supported by the services provided by CAES staff members. People bring or mail samples or call with questions to the New Haven and Windsor facilities. Extensive contacts with state residents are particularly important for the early detection of emerging insect or plant disease problems. Global marketing of plants and plant products increases the chances for the introduction of invasive pests, such as the Asian longhorned beetle, Emerald ash borer, Southern pine beetle, and boxwood blight. The Emerald ash borer (EAB) was first detected in Connecticut on July 16, 2012, and has subsequently spread through a large portion of the state. The internal state quarantine for EAB was dropped in 2014 and all of Connecticut became part of the larger federal EAB regulated area. State regulations control the movement of wood and other regulated articles into Connecticut. Expanding its range, the Southern pine beetle was detected in

Connecticut on March 17, 2015, and attacks “hard” pines such as red pine, Scotch pine, Austrian pine, and our native pitch pine. More than 40,000 state residents received direct assistance from staff members at the CAES during the past year. Station scientists also visit farms when difficult or unique problems arise and provide information to growers and the media when asked. In addition, scientists served on advisory boards and provided information to more than 150 stakeholder organizations. Employees of other state agencies, such as the Departments of Agriculture, Consumer Protection, Public Health and Energy and Environmental Protection, also requested help from Station staff members when they sent specific samples for chemical, biological or microscopic analyses. All of these activities helped identify emerging problems, facilitated prompt and accurate responses to state residents’ inquiries, and ensured safe foods and other products. CAES Chemists are currently working with the Departments of Agriculture and of Consumer Protection to establish a regulatory testing program for hemp and hemp-related products. Receiving comments from citizens on evaluation or survey forms at public workshops, open house events, and other agency functions helps administrators gauge the effectiveness of research programs and services, and provides opportunities to realign program goals. In addition, there is an annual assessment of whether or not objectives listed in the agency’s 5-year strategic plan are being achieved. This strategic plan and accomplishment reports are requirements for USDA funds. Both documents are reviewed annually by federal officials.

New testing procedures are developed as needed to improve analyses, particularly when samples require more sensitive and specific methods. Scientific research at the CAES involves identifying a problem, investigating existing published knowledge, and designing experiments which will provide new information to help solve the problem, enhance Connecticut’s economy, or improve the well-being of state residents. In many instances, scientific results have impacts nationally.

Specific examples include the following:

- **Food Safety:** Connecticut General Statute [Sec. 22-81(c)] directs the CAES to conduct analyses as requested by other state agencies. In addition, CAES chemists work closely with the US Food and Drug Administration (FDA) in the Food Emergency Response Network (FERN). CAES is now in its 14th year of funding ($3.89 million through 2020) under this program, with the current funding cycle running for one more year. Separately, CAES is completing its second year of a 2-year FDA grant that is enabling the Department of Analytical Chemistry to expand ISO 17025 Accreditation as described in the Food Safety Modernization Act (FSMA). This two-year award is a continuation of a previous 5-year $1.5 million FDA grant that enabled acquisition of accreditation in December 2016. The accredited program involves a surveillance of fresh and manufactured foods for pesticides and arsenic; results are published in Bulletins that are freely available to the public. Separately and in conjunction with the CT Department of Agriculture, CAES is completing a fourth year of a 5-year FDA grant ($750,000) to bring animal feed chemical analysis under accreditation as described in FSMA. This project, which is measuring mycotoxin contamination in feeds, was brought under accreditation in February 2018 and is now being expanded to include label guarantee analysis (fat, protein, fiber). Recent work with the FDA included a surveillance assignment testing rice-based baby foods (100 samples) for heavy metals (including inorganic arsenic), pesticides, poisons and toxins; results were submitted to FDA in December 2018. CAES staff have continued work with the FDA to develop the use of liquid chromatography with high resolution mass spectrometry for the detection of contaminants in food, including ricin and abrin. CAES chemists are also actively using this

new platform in many of our state programs, including the analysis of foods and environmental samples for emerging contaminants such as PFAS. Three CAES staff members are currently participating in the CT Interagency PFAS Task Force. In addition, CAES is currently conducting two FDA surveillance assignments. The first is analyzing juice/juice powders (100 samples) for poisons, toxins, pesticides and heavy metals. The second is analyzing imported mustard seed, mustard products and products (25 samples) with yellow food coloring for lead and chromium. Two CAES staff chemists have continued to serve as primary instructors for FDA training courses that deploy FERN food safety methods to both federal and state laboratories across the country. The Analytical Chemistry Department Head is serving on the FDA Flexible Funding Model Workgroup, which is designing a new strategy for supplying federal funds to the states in support of food safety work. The Manufactured Food Regulatory Program Standards or MFRPS, which CAES conducts with the CT Department of Consumer Protection and the FDA, serves as the sole chemical surveillance and monitoring effort in the state, assuring that the food supply within CT is free from adulteration and contamination. Similarly, the AFRPS or Animal Feed Regulatory Program Standard, conducted with the CT Department of Agriculture and the FDA, serves as the sole surveillance and monitoring effort in the state for pet and livestock feed. Lastly, staff continue to work with the FBI Weapons of Mass Destruction Directorate (FBI WMDD), 14th Connecticut National Guard Civil Support Team (CST), CT State Police Emergency Services Unit, and CT Department of Public Health Bioterrorism Coordinator as a part of statewide counter-terrorism and law enforcement programs. For example, CAES chemists are currently assisting the CT State Police in an ongoing missing person's investigation.

- **Childhood Lead Poisoning:** The Department of Analytical Chemistry provides assistance by request to municipal health departments for investigations of high blood lead levels in children. As part of a lead poisoning investigation in North Haven in November 2018, the Quinnipiack Valley Health District submitted samples of kitty litter from a lead-poisoned child's house. Scientists in the Department utilized FDA methods and detected 19,000 parts per billion (ppb) lead, suggesting that inhalation of kitty litter dust played a role in the child's exposure.
- **Mosquito-Borne Disease Surveillance:** Mosquito surveillance for eastern equine encephalitis (EEE) and West Nile virus (WNV) is integral to the public health response to these mosquito-transmitted diseases in Connecticut and provides an effective early warning system for citizens of the State (CGS Section 22-81a). CAES scientists and technicians monitor mosquito and encephalitis virus activity at 92 trapping sites from June through October. During 2018, WNV emerged as a significant public health threat in Connecticut. A total of 334,369 mosquitoes representing 20,190 pools were trapped and tested for arboviruses. A total of 393 isolations of WNV were made from 13 species: *Culex pipiens* = 242, *Cx. restuans* = 70, *Culiseta melanura* = 34, *Cx. salinarius* = 24, *Aedes cinereus* = 6, *Ochlerotatus canadensis* = 5, *Coquillettidia perturbans* = 4, *Oc. japonicus* = 3, *Ae. albopictus* = 1, *An. punctipennis* = 1, *Oc. taeniorhynchus* = 1, *Oc. triseriatus* = 1, and *Psorophora ferox* = 1, collected from 65 locations in 53 towns in six counties (Fairfield, Hartford, Middlesex, New Haven, New London, Windham). The first WNV-positive mosquitoes were collected on June 18, and the last on October 10. The majority of WNV activity was detected in densely populated urban and suburban regions in Fairfield, Hartford and New Haven counties. Twenty-three human cases of WNV-associated illness

(encephalitis/meningitis n=18, WNV fever = 5) were reported, with one fatality. Dates of onset of symptoms were from July 28 to September 28. Human cases were temporally and spatially consistent with WNV isolations from mosquito pools. Two horse cases of WNV infection were reported in Greenwich (onset August 20) and Glastonbury (onset August 28). There were six isolates of Eastern Equine Encephalitis (EEE) reported, occurring in *Cs. melanura* = 5 and *Ae. cinereus* = 1 between September 19 and October 9 in New London and Windham Counties. There was no EEE activity reported from humans, horses, or exotic birds. Other mosquito-borne viruses isolated included: Jamestown Canyon virus = 48 isolates from 13 species (June 4 – August 22), La Crosse encephalitis virus = 2 isolates from 1 species (August 8, September 13), and Flanders virus = 1 isolate from 1 species (July 18). CAES continues to closely monitor the expansion in Connecticut of two exotic mosquito species from Asia, *Aedes albopictus* (Asian tiger mosquito) and *Aedes japonicus*, which are aggressive human biters and have been implicated in the transmission of several human pathogens, including dengue, chikungunya, EEE, and WNV.

- **Invasive Aquatic Plants:** CGS Section 22-81(c) directs the CAES to perform experiments on plants. Invasive aquatic plants have been introduced in Connecticut from other parts of the world. With no natural enemies, they spread rapidly and threaten the ecological and recreational value of Connecticut's lakes and rivers. Since 2004, the CAES Invasive Aquatic Plant Program (IAPP) has completed 353 aquatic vegetation surveys of 242 Connecticut lakes and has found that 60% contain invasive plants. A total of 61 water bodies have been resurveyed to determine how invasive plants are changing the quality of lakes over time. In fiscal year 2018-19, CAES IAPP surveyed 12 lakes and performed multifaceted research. Lake Candlewood, Connecticut's largest lake, was surveyed for the 10th consecutive year to determine the effects of winter drawdowns and introduced grass carp *(Ctenopharyngodon idella)* on the area and abundance of Eurasian watermilfoil (*Myriophyllum spicatum*), minor naiad (*Najas minor*) and curlyleaf pondweed (*Potamogeton crispus*). Nearby Squantz Pond was also surveyed. Government and local officials request CAES assistance in finding methods to protect their bodies of fresh water. We are in the 17th year of research involving the use of spot applications of herbicides to control variable watermilfoil in Bashan Lake. We had largely restored the lake to pre-infestation conditions prior to lowering the lake for dam repairs in 2014. Surveys of Bashan Lake in 2018 found a regrowth of variable watermilfoil and phragmites (*Phragmites australis*) at some sites. Targeted applications of a new herbicide called ProCellaCOR showed excellent control on variable watermilfoil at most of these sites. *Hydrilla* is a very troublesome invasive aquatic plant in many southern states. Following reports of the plant occurring in the Connecticut River, an investigative task force of over 30 experts from throughout the Northeast led by the CAES IAPP performed preliminary surveillance of the river from central Vermont to southern Connecticut in 2018. *Hydrilla* was found from just north of the Massachusetts/Connecticut border to a point between Hartford and East Haddam, where dense stands were found. The *Hydrilla* found in the river is more robust than seen elsewhere in Connecticut. CAES IAPP in collaboration with the University of Wisconsin-Whitewater, performed genetic tests on the Connecticut River *Hydrilla* and found it to be a different strain than previously found in North America. This could mean the plant has an enhanced ability to spread, harm aquatic ecosystems and resist current control practices. Movement of this strain to lakes and ponds is of utmost concern. CAES IAPP has been commissioned to provide additional surveillance in 2019 to document the full extent of *Hydrilla* infestation in the state. CAES IAPP has extensive public

outreach via workshops, speaking engagements and a comprehensive website available at www.ct.gov/caes/iapp. Results are published in scientific journals, technical reports and in CAES bulletins.

- **Gypsy Moth and Emerald Ash Borer:** With the *Entomophaga maimaiga* fungus finally impacting the gypsy moth late in 2017, resulting in high larval mortality in many localities, we observed defoliation due to gypsy moth on only 278,013 acres in the eastern half of the state in 2018. In December 2018 through March 2019, a gypsy moth egg mass survey was conducted in 80-95% favorable host sites on a 7-mile grid (102 sites) throughout Connecticut. Egg mass counts were low in most locations. The fungus also hit the caterpillars in June 2019, largely bringing the multi-year outbreak of the gypsy moth to an end. Monitoring for the Emerald ash borer through *Cerceris* wasp colonies continued with EAB detected in 42 new towns. Our biocontrol releases for EAB have been successful with all three species of parasitoids recovered one year after release.
- **Honey Bee Health and Pollination:** Colony inspections continue to find *Varroa* mite infestation and the virus complex associated with *Varroa* infestation as the primary reason for colony mortality. Connecticut beekeepers continue to lose colonies over winter in high numbers. The Bee Informed Annual Loss report for CT in 2018 was 64.98%, an 11.09% increase from 2017; the winter loss was 54.29%; the summer loss was 21.9%. An educational program, Biology and Management of the Varroa mite in the honey bee will be presented to CT beekeepers this year in an attempt to increase honey bee survivability. Despite these challenges, beekeeping interest is still strong with over 457 new beekeepers being trained earlier this year. Three *Bombus terricola*, a state listed species last documented in Connecticut in 2009, and under review for Endangered Species Act protection, were found in Litchfield County in 2018 (1 male) and 2019 (1 male, 1 female).
- **Tick-Borne Disease Research:** Human cases of Lyme disease are prevalent, other tick-borne diseases are increasing, and new tick species are becoming more common. An active tick surveillance program was initiated in Connecticut in 2019. Ticks are collected at 40 paired publically-accessible active tick surveillance sampling locations throughout CT's eight counties and tested for multiple tick-borne pathogens funded in part by a grant from the Centers for Disease Control and Prevention (CDC) through the Epidemiology and Laboratory Capacity (ELC) program at the Connecticut Department of Public Health. A joint integrated tick management project in Guilford, CT supported by and in cooperation with the USDA Agricultural Research Service continues to evaluate combinations of deer-targeted 4-poster treatment stations, rodent-targeted bait boxes, and acaricide applications to reduce tick abundance and the risk of Lyme disease. A program using the deer-targeted 4-poster to control a heavy, established population of lone star ticks, *Amblyomma americanum*, on Manresa Island in Norwalk, CT was continued in 2019. Lone star tick numbers at the site are approximately 80% lower in 2019 than the previous year. In the third and final year of a winter survival study, up to 78% of lone star tick adults successfully overwintered in Connecticut, which suggests further establishment of this tick in New England coastal areas is likely.
- **Tick Testing Program:** Tick testing for infectious agents that cause human disease is freely available to State residents. The objectives are to: 1) examine ticks for evidence of infection in order to better understand the epidemiology of tick-associated diseases in Connecticut, 2) inform residents of any potential health risk, 3) assist physicians and residents concerning treatment, and 4) identify and report new and invasive tick species that are unintentionally

introduced into the State. In 2015, the Tick Testing Laboratory was expanded to test blacklegged ticks, *Ixodes scapularis*, for two additional pathogens. In the past, testing was limited to *Borrelia burgdorferi*, the Lyme disease agent, but in view of increasing human cases of tick-related illnesses in the state, testing has been expanded to include *Anaplasma phagocytophilum*, the causative agent of Human Granulocytic Anaplasmosis, and *Babesia microti*, the causative agent of Babesiosis. Of the 4,251 ticks submitted by Connecticut residents, health departments and/or physicians' offices during fiscal year 2018-2019, 3,159 were examined, of which 1,171 (37.1%) tested positive for Lyme disease, 358 (11.3%) for babesiosis, and 350 (11.1%) for anaplasmosis. New molecular-based testing methods have additionally been implemented to reduce the average turnaround time to three days or less representing a significant enhancement of the tick testing services. The number of lone star tick encounters by residents has been steadily increasing in Connecticut in recent years; locally-acquired lone star ticks submitted by the residents and health departments to the CAES Tick Testing Laboratory have increased significantly by 58% from the period of 1996-2006 to 2007-2017. During the past fiscal year, established populations of the lone star tick were discovered in New Haven County in addition to existing populations in Fairfield County. Previously considered an aggressive nuisance pest, the lone star tick is now associated with several human diseases and medical conditions including tularemia, rickettsiosis, ehrlichiosis, Hartland virus disease, likely Bourbon virus disease, southern tick-associated rash illness, and red meat allergy. Even in the absence of disease transmission, lone star tick numbers can be extremely abundant, multiple bites are not uncommon, and bites can be highly irritating.

## Improvements/Achievements 2018-2019

Statutory authority (CGS 22-82a) permits the CAES to seek patents, trademarks, and licensing agreements. License agreements have been established for a new cultivar of strawberry and four disease-resistant tobacco cultivars. Portions of the royalties are being used for operating costs and reinvesting into the crop research programs.

Efforts continue to reduce energy and other operating costs to become more efficient in performing research and delivering services to our residents. The agency has actively participated in the Governor's Lead by Example Energy Efficiency Program over the years. The agency has converted all interior and exterior lighting to LED technology, changed over from heating oil to natural gas to heat our buildings and is in the process of replacing old drafty windows with energy efficient windows to lower heating and other operating costs. Our Jenkins-Waggoner Laboratory building which opened in January 2015 received a federal LEAD gold energy efficiency certification. Plans to renovate outdated CAES greenhouses with state-of-the-art technology have been initiated.

The Experiment Station is utilizing the state's e-licensing software program for the online registration of nursery growers, nursery dealers and beekeepers. The program also allows inspectors to enter and store regulatory inspection data in the online program. The statutorily required registration and inspection process is much more efficient for both the agency and registrant and provides the agency and state with significant cost savings.

Plant pathologists at the CAES continued to monitor and research boxwood blight, a disease caused by the fungus *Calonectria pseudonaviculata*. New to North America, the disease was first detected on boxwoods in nurseries in Connecticut in 2011 and on pachysandra in

landscapes in 2012. This disease has continued to spread and is now found in 26 other states in addition to three provinces in Canada. Boxwood blight was confirmed on 467 of 1254 boxwood samples that were examined during the year. Boxwood is an economically important crop for the Connecticut nursery industry and is a popular ornamental plant in landscapes. With input from the nursery industry, personnel at the CAES responded to industry concerns by researching and developing best management practices (BMPs) in the mitigation of boxwood blight; these BMPs are suitable for use by landscapers, commercial plant producers, as well as homeowners. Research programs at CAES have made advances in developing molecular tools for early detection in plants, soil, and water, understanding survival and longevity of the fungus on hard surfaces in nursery production, identifying effective sanitizers for disinfecting tools and equipment, identifying effective fungicides and spray programs to prevent new infections, fungicides capable of curative activity for up to 48 hours after infection, boxwood accessions with resistance to infection, susceptibility of pachysandra varieties, and understanding the genetic mechanisms underlying the potential for fungicide resistance. BMPs have been updated recently with new science-based information from our ongoing research programs. BMPs and basic information on the fungus (including an identification guide with pictures of infected plants) are posted on the CAES website (https://portal.ct.gov/CAES/PDIO/Boxwood-Blight/Boxwood-Blight).

Several new programs in Plant Pathology have been initiated and a new Fruit Virologist who plans to work closely with the wine industry in the State has been hired. Efforts are underway to advance our understanding of the molecular genetics of plant pathogenic bacteria. By deciphering the pathogen distribution and evolution of virulence factors in plant pathogenic bacteria, CAES scientists are identifying possible areas for disease management. In addition, a new program has been initiated in FY19 that is designed to investigate the role of protists in microbiome or agronomic plants and their contribution to plant health. Our forest pathologists are developing new areas of study that employ electrical-resistance tomography to nondestructively detect internal decay and cavities in trees. This technology determines if there is a higher frequency of internal decay in American elms that receive trunk injections for the treatment of Dutch Elm Disease. It also measures the amount of C in forest trees, thus refining current models of the role that forests play in sequestration of atmospheric carbon. CAES plant pathologists have made significant inroads into demonstrating a role for nanoparticles of copper and silicon in suppression of plant diseases of asparagus, eggplants, pumpkins, soybeans, strawberries, watermelon, and many ornamental plants along with urban tree species. This novel strategy utilizes host nutrition of young plants and results in minimal amounts of nano-products being applied, which in turn, may increase yields for a negligible cost. Our disease modeling and forecasting efforts continue to advise wine grape growers about disease outbreaks throughout the state. These CAES-web based postings are saving growers unnecessary fungicide applications, thus reducing costs and chemical inputs into our environment.

CAES scientists are increasing our knowledge and understanding of the appropriate selection, location, and maintenance of trees in urban and suburban spaces to increase utility reliability, public safety, public health, environmental benefits, and reduce costs and risks for municipalities. Roadside trees and branches that fall during severe weather often cause extended power outages and extensive road blockages. CAES foresters are collaborating with utilities, environmental groups, land owners, and other state agencies to develop practical, cost-effective protocols to proactively foster healthy, storm-resistant roadside forests by integrating silvicultural and arboricultural practices. Ten demonstration areas including over 4,300 trees

have been established throughout Connecticut. Lessons learned on tree selection and coordination from implementation at nine areas are being incorporated into treatments scheduled at the remaining sites.

Scientists in the Department of Environmental Sciences have made progress in a number of areas in FY19. The Environmental Chemistry program has been conducting research in recent years on interactions of pollutants with environmental particles, the bioavailability of pollutants in environmental particles, pollution prevention and remediation, chemicals in reclaimed wastewater reused for agricultural irrigation, and natural chemical processes in the environment. These studies are funded by the USDA National Institute of Food and Agriculture, the National Science Foundation, and other sources. In one study, they created modified charcoal-like carbons from woody wastes that strongly bind phosphate, inhibiting its movement to water bodies where it can cause eutrophication and groundwater contamination. The carbons can also strongly bind perfluorinated alkyl substances (PFAS), which are water and soil pollutants of growing concern in Connecticut. They have identified the physical and chemical properties of these carbons important for their ability to remove such contaminants from water, permitting the synthesis of more effective materials in the future. In other studies, they have synthesized related carbonaceous materials that can catalyze the degradation of organic contaminants by peroxide reagents; such catalysts can potentially be incorporated in wastewater treatment technologies. Projects have also been initiated in 2019 to investigate phytoremediation of PFAS in soil and to assess the impacts of reclaimed wastewater reuse for agricultural irrigation. Designing methods to detect new and emerging contaminants in reclaimed wastewater will be increasingly important as water recycling continues to expand. Staff scientists are conducting wetland experiments to investigate how plant traits of three common wetland plants (*Typha latifolia, Phragmites australis, Spartina pectinata*) and three water quality impairments (i.e., sea salt, road salt, N-enrichment) interact to alter greenhouse gas (carbon dioxide and methane) fluxes and sediment microbial community composition. Their data show that different perturbations indeed affect the productivity of wetland ecosystems. In a study funded by the Centers for Disease Control and Prevention, CAES scientists evaluated the efficacy of two novel chemical lures to improve collection of mosquitoes that are poorly captured by standard trapping methods. The new trap lures enhanced collection of *Aedes triseriatus* and *Aedes japonicus* mosquitoes, and testing of these collections indicated the entomological risk of La Crosse virus is much higher in Connecticut than previously thought. Historically, La Crosse virus is only rarely detected in this region, but there are suspicions that the main vector species (*Ae. triseriatus*) is systematically under-sampled by conventional trapping methods. In laboratory experiments, scientists have discovered that *Aedes aegypti* mosquitoes having a non-infectious bloodmeal after the initial infectious bloodmeal significantly increased transport of a virus (Zika, dengue, or chikungunya) from the gut to the salivary glands, greatly increasing the insect's ability to transmit that virus to its host, and may help explain the explosive epidemic potential of viruses transmitted by mosquitoes. Scientists in the department have also developed an axenic (bacterial-free) mosquito model, which is a new advance for studying the interaction between mosquitoes, their microbiome, and disease transmission. Scientists in the department have discovered antibiotic-resistant bacteria in the guts of mosquitoes; this suggests that mosquitoes can act as a vector to shuttle antibiotic-resistant bacteria between environments. A study using genomic analysis and computational biochemistry is elucidating the structure of the ribosome of microsporidia, a group of unicellular parasitic fungi that infect all major groups of animals. Future work aims at finding methods to control microsporidial diseases in honey bees and silkmoths.

The CAES reaffirms its continuing policy of commitment to affirmative action and equal opportunity employment as immediate and necessary objectives and relies solely on merit and accomplishment in all aspects of the employment process and research programs. CAES scientists were granted funds from a USDA proposal that funded the CAES/SCSU Summer Undergraduate Fellows in Plant Health and Protection program where undergraduates from Connecticut and elsewhere gained valuable experience working in CAES laboratories. The interns included 2 white males, 2 minority males, 5 white females, and 2 minority females. The goals of mentoring programs are to promote interest in science and provide specialized training. Station scientists also participated as judges in science fairs in New Haven and Hamden. Through these and other direct interactions, staff encouraged high school students to further their science education. The CAES continues to comply with diversity training requirements and is also participating in the University of Connecticut's Employee Assistance Program. The agency's goals in awarding contracts to small businesses and minority business enterprises were exceeded.

## Information Reported as Required by State Statute

Scientists and technicians performed chemical, seed, soil, fertilizer, pesticide, animal feed, mosquito, and tick tests; answered inquiries; conducted plant, nursery, and bee inspections; and surveyed for the gypsy moth and other insect pests as listed below.

| **Service or Test Number** | **2018-2019** |
|---|---|
| Inquiries answered (all departments) | 27,761 |
| Field visits and diagnostic tests | 461 |
| Nematode diagnostics | 159 |
| **Soil Tests Completed** | |
| New Haven and Windsor | 10,220 |
| **Samples Tested** | |
| Department of Agriculture | 75 |
| Department of Consumer Protection (DCP) | 301 |
| Department of Energy & Environmental Protection | 78 |
| CAES Departments | 2,043 |
| FDA, Municipal Health Departments, Cities/Towns, and Misc. Foundations | 221 |
| UConn Cooperative Extension | 35 |
| University Research Collaborations | 600 |
| Seed Samples Tested (vegetable, lawn, field crop) | 563 |
| Consumer Plant Samples Tested | 5,135 |
| Wine Grapes Tested | 27 |
| **Nursery and Seed Inspections** | |
| Greenhouse plants | 1,406 |
| Nursery stock containers and bare root | 27,876 |
| Perennial plants | 1,241 |
| Nursery inspections | 178 |
| Tobacco (bales, boxes, bundles, and cartons) | 153,250 |
| Permits to move homeowner plants out of state | 3 |

| | |
|---|---|
| Seed (cartons and bags) | 569 |
| Acres of nursery stock inspected | 5,000 |
| **Gypsy Moth Survey** | |
| Forest acres surveyed for gypsy moth by air | 1.8 million |
| **Bee Inspection** | |
| Beekeepers registered | 642 |
| Beehives examined for mites and foulbrood | 1,257 |
| **Tick Identification and Testing** | |
| Ticks identified | 31,358 |
| Ticks tested for human pathogens | 3,229 |
| Ticks infected with *Borrelia burgdorferi* (Lyme disease) | 1,200 (37.2%) |
| Ticks infected with *Babesia microti* | 372 (11.5%) |
| Ticks infected with *Anaplasma phagocytophilum* | 359 (11.1%) |
| **Mosquito Testing** | |
| Mosquitoes trapped, identified, and tested for EEE, West Nile, and other encephalitis viruses | 334,369 |
| Number of trapping sites | 92 |