CAES

The Connecticut Agricultural Experiment Station

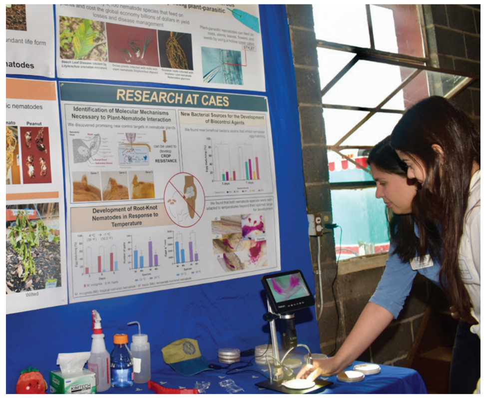
Putting Science to Work for Society since 1875

DIRECTOR'S REPORT

Public Health

Public Service

Agriculture



Food Safety

Vector Biology

Enviroment

CAES

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Putting Science to Work for Society since 1875

The Connecticut Agricultural Experiment Station

First in the Nation, Founded 1875
Putting Science to Work for Society
Protecting Agriculture, Public Health, and the Environment

Welcome to The Connecticut Agricultural Experiment Station (CAES), the first and oldest AES in the country, dedicated to serving the needs of state residents and the nation since its founding in 1875. Now at our 150th anniversary, our core values remain the foundation of our work through dedicated scientific exploration, groundbreaking discoveries, and disseminating our findings in an effort to solve the region's, countries, and globe's most challenging problems in the areas of agriculture, the environment, food safety, and public health.

True to our beginnings, our commitment to public service remains the foundation of everything that we do. Our exemplifying mission to "Put Science to Work for Society" is evident through our innovative and multidisciplinary research projects, as well as the wide range of civic engagement efforts to educate and assist the public. Every day our scientists come to work with the sole goal of improving the lives of not only CT residents but citizens around the world, and we do this through science and through communication.

I hope you enjoy reading through this report, learn more about this esteemed institution's work, and are inspired. It highlights the many notable accomplishments of Station scientists over the last 150 years and provides a brief sampling of research projects we are conducting today. Enjoy.

Sincerely,
Dr. Jason White, Director

CAES BY THE NUMBERS (FY2024)

RESEARCH

97 federally funded research projects
$6.59 million in federal and external funds
92 peer-reviewed manuscripts
112 formal research presentations

PUBLIC SERVICE

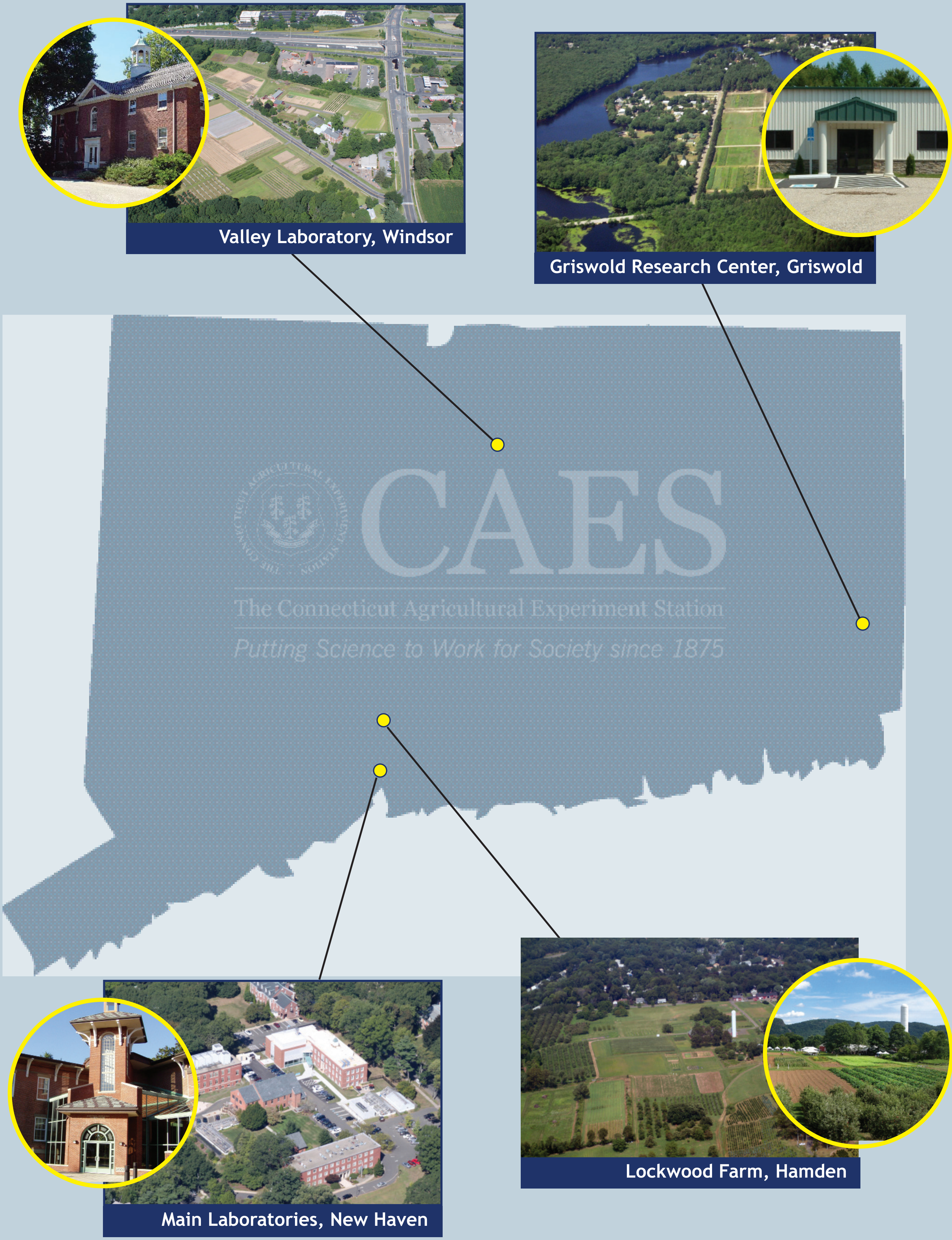
261 lakes and rivers surveyed for invasive plants
15,567 citizen plant and insect inquiries answered
11,561 soil samples tested
154 nurseries inspected
6,244 ticks tested for pathogens
1,020 beehives inspected for disease
357,448 mosquitoes tested for pathogens
3,987 food and other samples tested for contaminants
1.8 million acres of forest aerially surveyed

OUTREACH

415 stakeholder presentations and workshops reaching **4,275** adults
1,156 attendees at Plant Science Day
65 media interviews
18 farm visits

EDUCATIONAL IMPACT

111 students performed mentored research projects
42 graduate students trained
61 undergraduate students trained
11 Connecticut colleges and universities supported by research internships
8 high school students trained
15 postdoctoral researchers trained
28 K-12 outreach events reaching 1,050 children
61 international trainees from 14 countries supported by J-1 visa program since 2017


Valley Laboratory, Windsor
Griswold Research Center, Griswold
CAES
The Connecticut Agricultural Experiment Station
Putting Science to Work for Society since 1875
Main Laboratories, New Haven
Lockwood Farm, Hamden


scientist
looks
DAWN

TABLE OF CONTENTS

BOARD OF CONTROL

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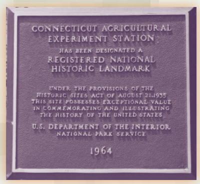
The Connecticut Agricultural Experiment Station

Putting Science to Work for Society

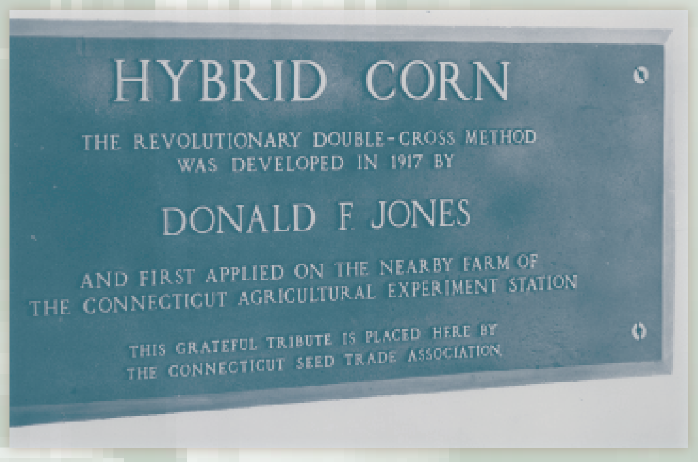
150th ANNIVERSARY 1875 – 2025

Historical



OPEN

Perspective



OPEN

HISTORICAL PERSPECTIVE
KEY EVENTS AND SCIENTIFIC ACCOMPLISHMENTS

1875 Samuel Johnson's proposal to support agricultural research comes to fruition with establishment of the Nation's first agricultural experiment station, "for the purpose of promoting agriculture by scientific investigation and experiments".

1875 The Station begins work in the area of consumer protection with the analysis of agricultural feeds and fertilizers.

1877 The Station moves from Wesleyan University to the Sheffield Scientific School at Yale University.

1882 The Station buys five acres of land from the estate of Eli Whitney, Jr. and moves to its current location on Huntington Street (formally Suburban Street) in New Haven.

1888 The Mycology Department is established to provide diagnosis and information for control of plant diseases and the fungal pathogen causing potato scab is identified.

1888 Biochemistry research on plant proteins begins leading to the discovery of vitamin A in 1913 by Thomas Osborne.

1900 The tobacco shade tent is introduced for the first time in Connecticut, revolutionizing the tobacco industry.

1901 Office of the State Entomologist is formed leading to state regulation of plant pests and diseases. Wilton Britton appointed.

1901 Forestry research begins, Walter Mumford becomes the first Station and "State Forester".

1903 The first "spray calendar" guide is published to help Connecticut farmers minimize pesticide use.

1903 The Station initiates investigations on mosquitoes and mosquito control in the State.

1903 The Station purchases the first parcel of land that will become the 170,000 acre state forest system.

1910 Lockwood Farm in Mt. Carmel is purchased with income from the Lockwood Fund, the first "Field Day" is held.

1915 The Experiment Station is authorized by law to make rules and orders regarding the elimination of mosquitoes and to survey and eliminate mosquito breeding areas.

1919 Geneticist Donald Jones invents a double cross pollination method leading to commercial production of hybrid corn revolutionizing global agriculture.

1921 The Tobacco Substation is established in Windsor and research on tobacco diseases begins.

1926 The oldest research plots in the United States to monitor unmanaged forest change and succession over time are established.

1927 Research on the use of "insect parasitoids" for biological control of insect pests is initiated as an alternative to chemical pesticides.

1933 X-disease of peaches is discovered.

1934 M. Francis Morgan develops the world's first test for rapid analysis of soil fertility.

1940 The first organic fungicides to protect crops are discovered.

1940 A new laboratory is constructed in Windsor and renamed the Valley Laboratory (1964) to reflect more diversified agriculture in the Connecticut Valley.

1945 The Horsfall/Barratt scale for assessing plant disease severity is published.

1946 The usefulness of composted sewage sludge for soil improvement is demonstrated for the first time.

1948 Activated charcoal is used for the first time to adsorb a toxic organic pesticide from contaminated potato fields.

1948 Phosphorus generated from upstream factories is shown to enhance growth of algae in Connecticut lakes.

1949 The technique for "chemotherapy-by-injection" is developed for control of Dutch Elm Disease.

1951 The tobacco cyst nematode is discovered.

1955 The use of Ion exchange chromatography is developed for analysis of organic acids.

1957 State Entomologist, Neely Turner prevents the USDA's proposal to spray the entire state of Connecticut with DDT from the air to "eradicate" the gypsy moth. Rachel Carson publishes Silent Spring" four years later.

1963 CAES scientists develop a gas chromatography technique to detect pesticide residues on agricultural produce.

1964 The Connecticut Agricultural Experiment Station is designated as a National Historical Landmark by the US Department of the Interior.

1966 A new system is invented to describe the biochemistry of enzymatic reactions that is widely used in biochemistry research today.

1967 Nutrient budgets and phosphorous recycling from sediment that affect lake eutrophication are described helping to establish priorities in providing clean water.

1967 Pioneering methods of pest control based on insect behavior are developed.

1968-69 Computer models are developed showing the impact of leaf area on temperature and evaporation in the forest canopy. The first computer model of a plant disease epidemic is published.

1970 A rapid method for detecting lead in urine of children suspected of eating lead paint is developed.

1970 An extensive survey of Connecticut coastal wetlands is published.

1972 A parasitic wasp credited with helping to control an outbreak of the elm span worm is discovered.

1973 A European "hypovirulence" technique is developed and implemented to control chestnut blight and increase survival of American chestnut trees.

1973 An artificial soil composed of sand, peat, and vermiculite is developed for the nursery industry.

1974 Tree mortality in Connecticut forests is shown to be significantly increased by insect defoliation.

1975 Research on ticks and tick-borne diseases in Connecticut is initiated. A serology laboratory is established and an isolation facility is built on the New Haven campus.

1980 In a statewide survey, 15 different species of ticks are discovered in the State.

1982 Conducted the first aerial spray trial with the biological insecticide, *Bacillus thuringiensis* for control of gypsy moth infestations in Connecticut forests.

1982 A computer model for long-distance, aerial transport of spores causing plant disease is published.

1983 The first isolations of the Lyme disease agent, *Borrelia burgdorferi* are made from ticks, mice and raccoons.

1984 Antibody tests for laboratory diagnosis of Lyme disease are developed.

1987 Studies on the ecology and control of the black-legged tick, *Ixodes scapularis* are initiated leading to the development of novel integrated pest management techniques to reduce risk of exposure to ticks and tick-borne diseases in and around the home.

1987 Studies reveal that some pollutant molecules in soil become trapped in micropores of soil particles and therefore are highly immobile and biologically inaccessible.

1989 A fungal pathogen, *Entomophaga maimaiga*, that causes the collapse of the gypsy moth is discovered.

1990 A Tick Testing Program for the Lyme disease agent, *Borrelia burgdorferi*, that is free to Connecticut residents is established.

1991 The first of several new cultivars of broadleaf cigar wrapper tobacco that are resistant to wilt and tobacco mosaic virus are developed and licensed saving millions of dollars for local growers.

1991 Broadleaf tobacco variety C9 was released. This was an open pollinated inbred that was the first broadleaf type with resistance to Fusarium wilt and tobacco mosaic virus (TMV). Fusarium wilt had caused up to 20% loss of the entire crop and increasingly threatened the production of broadleaf wrapper in Connecticut. C9 became the most widely grown broadleaf variety worldwide.

1992 Novel methods for decontaminating organic pollutants from water and soil using chemical reagents are developed.

1993 Station scientists introduce the concept of "dispersive epidemic waves" which accelerate as they move away from a focus of disease, a major advance in understanding the ecology of plant disease.

1997 A comprehensive statewide Mosquito/Arbovirus Surveillance Program is launched following an outbreak of eastern equine encephalitis activity in southeastern Connecticut.

1997 Scientists initiate a series of reports identifying several novel chemical bonding mechanisms of pollutants to carbonaceous particles found in soil.

1999 Station scientists make the first isolations of West Nile virus in North America from mosquitoes and crows. Findings are published in *Science*.

2000 Station scientists discover that specific plants accumulate persistent organic pollutants from soils.

2001 The principal mosquito species that transmit West Nile virus to birds and humans are identified.

2001 A new exotic, invasive, mosquito native to Japan, *Aedes japonicus* is discovered in Connecticut.

2002 Systematic studies on invasive aquatic plants in Connecticut lakes and ponds are initiated that find 60 percent of the water bodies contain one or more invasive species, and that identify two new invasive species originating from southern states.

2004 A new Biosafety Level 3 Containment Facility begins operation in the newly renovated and constructed Johnson-Horsfall Laboratory.

2005 The Analytical Chemistry Laboratory is selected by the US FDA's Food Emergency Response Network (FERN) to help protect the nation's food.

2005 Two mosquito-borne viruses, Lacrosse and Potosi are isolated and described from mosquitoes in New England and the northeastern US for the first time.

2006 Station scientists discover that the American Robin is the chief reservoir and amplification host for West Nile virus in the region.

2009 The Griswold Research Center is established and a new laboratory is constructed (2012).

2009 The Center for Vector Biology & Zoonotic Diseases is established to advance knowledge of the epidemiology and ecology of vector-borne disease organisms and to develop novel methods and more effective strategies for their surveillance and control.

2009 Invasive shrubs are shown to create habitats that increase the density of blacklegged ticks carrying Lyme disease.

2010 The Analytical Chemistry Department becomes one of three laboratories in the country to test seafood from waters of states impacted by the Deepwater Horizon oil spill.

2011 The spotted wing Drosophila is discovered in Connecticut, the first record for New England, by a Station scientist.

2011 A pathogenic fungus called *Fusarium palustre* is described and found to be associated with massive diebacks of salt marsh grasses along Connecticut's coastlines.

2011 Broadleaf tobacco variety B2 was released. This was the first of a series of male-sterile hybrid broadleaf varieties developed with genetic resistance to a number of plant pathogens including Fusarium wilt, TMV, tobacco cyst nematodes, black root rot, blue mold and black shank. Licensing and royalty fees supported the breeding program.

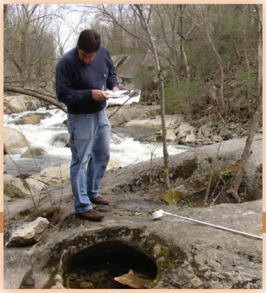
2012-15 The Department of Analytical Chemistry is awarded grants from US FDA to accredit methods testing the safety of the state's food supply (2012) and pet and livestock foods (2015).

2012 The exotic and destructive emerald ash borer is discovered in Connecticut for the first time by Station scientists.

2012 A new cyst nematode-resistant broadleaf tobacco cultivar is registered and licensed that results in more effective nematode control than soil fumigation.

2013 A new strawberry cultivar is developed and licensed that is more resistant to insect damage and fungal infection.

2015 New "Plant and Insect Information Offices" are opened in the newly renovated and constructed Jenkins-Waggoner Laboratory.



2015 Scientists in the Departments of Analytical Chemistry and Plant Pathology & Ecology are awarded USDA funding to investigate how nanotechnology can be used to suppress crop disease and increase food production levels.

2015-25 CAES scientists described 6 new fungal genera and 47 new fungal species. Among these new species, some are pathogens responsible for newly emerged plant diseases.

2016 The CAES Board of Control introduces the Magnarelli Postdoctoral Award, annually supporting one scientist to hire a postdoctoral trainee. The program has currently supported nine trainees and helped initiate research leading to over $3 million in federal awards to Connecticut.

2016 CAES Valley Lab scientist published a book titled 'Biology of Microfungi'.

2016-23 The Department of Analytical Chemistry earned several international accreditations from the American Association for Laboratory Accreditation. These demonstrated that the lab meets international (ISO) standards for reliable, precise measurement of environmental substances including pesticides and arsenic contaminants in food (2016), aflatoxin in animal feed (2019), and THC and CBD in hemp and other products (2021, 2023).

2018 The CAES Invasive Aquatic Plant Program documents a new, genetically distinct genotype of hydrilla growing throughout the Connecticut River in CT. The invasive plant's propensity to overwhelm native ecosystems and impair navigation is unparalleled.

2019 A new fungal-like species of root rot organism principally causing disease to Christmas trees was discovered and named Phytophthora abietivora. CAES scientists discovered and described a new fungal species, Diaporthe humulicola, which causes leaf spots to common hops, a newly emerged disease in the world.

2019 CAES launches the Active Tick Surveillance Program, a service that monitors tick activity, pathogen prevalence, new and emerging tick species, and phenology trends across 40 sites throughout all of Connecticut.

2021 Insecticide trials found three active ingredients to be effective for managing armored scale insect pests in Christmas tree plantations.

2022 The Office of Aquatic Invasive Species was established under Connecticut General Statutes Section 22-79 to coordinate research and management efforts for controlling aquatic invasive species statewide.

2023 CAES scientist published a book 'Color Atlas of Fungal Spores: A laboratory identification guide'. Mycological Society of America book review stated that "This book is a masterwork. Published by ACGIH Press, the atlas offers descriptions and photographs of around 610 species. .... [T]he book will also be useful to scientists and companies tracking the presence and composition of spores in air, for example, as a tool to understand asthma and allergies".

2023 CAES scientists discovered the disease suppression mechanism of a biological control product and found that it is very effective in apple orchards. The biocontrol and best practices for use have been adopted by many apple growers in the Northeastern U.S. and are used on over 11,000 acres of apple orchards in the Pacific Northwest.

2023 CAES funding from federal and private industry grants surpasses $6 million for the first time; CAES scientists manage 121 externally funded research projects.

2024 International publication of "The Physician's Guide to Delusional Infestation," a pioneering book for the treatment of Delusional Infestation.

2024 Two novel sprayable deer repellents conceived of by a station scientist, emulsified lanolin and milkfat, were demonstrated to be extraordinarily effective and long lasting. These are environmentally benign and inexpensive treatment options for edible crops and ornamental plants, respectively.

2024 CAES scientist published a mycological monograph 'Asexual Fungi I: A compilation of tretic hyphomycetes published after Ellis 1976'.

2024-25 CAES scientists discover attractants and deterrents that are detected by the devastating insect pests Spotted Lanternfly and Spotted Wing Drosophila (SWD), providing hope for future control of these pests through new traps and sprays.

2025 The CAES greenhouses undergo their first renovation since the 1940s, enabling new levels of scale and precision in CAES agricultural and entomological research.

2025 The CAES Plant Disease Information Office becomes only the fifth plant diagnostic laboratory in the United States to earn the status of "Core Accredited Lab" from the National Plant Diagnostic Network, having demonstrated outstanding quality assurance in its services.

Agriculture

INTRODUCTION

Agriculture, important in Connecticut since colonial times, is still a significant part of the state's economy. Eleven percent of Connecticut is farmland, and the state ranks first in New England in the value of sales per farm. Nearly half of all sales are from the nursery and turf industries, but a wide variety of other crops and commodities are grown here, including tobacco, fruit, vegetables, and Christmas trees. The number of farms has increased over the last decade, and Connecticut agriculture now produces up to $4.6 billion in economic output annually, and supports 31,000 jobs.

The Connecticut Agricultural Experiment Station is dedicated to supporting agriculture in the state. Research is dedicated to finding new methods of pest management to sustainably control insects, weeds, and insects, supporting the health of native and honeybee pollinators, developing ways to improve soil health, and monitoring and controlling the organisms that threaten crops. CAES scientists work together to prevent the import and spread of potentially devastating disease and pests in the state, using a combination of research, diagnostics, plant health certification services, and grower outreach to protect the health of Connecticut's plants.

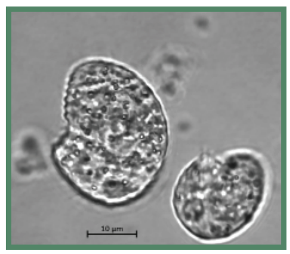
URBAN AGRICULTURE

CAES is one of few agricultural research stations located in a major US metropolitan statistical area, also called an urban environment. To address the special challenges faced by urban farmers and gardeners in Connecticut, Dr. Leigh Whittinghill established the CAES research program in Urban Agriculture in 2021. The program seeks to minimize the cost and pollution impact of crop production in urban soils, containers, and green roof systems. Cut-and-come-again, or repeat harvesting, is one common urban agricultural practice in which the outer leaves of greens such as kale, spinach, or lettuce are harvested multiple times over the course of a growing season in order to reduce labor and cost. Dr. Whittinghill's research is developing recommendations on the best fertilizer regime to get high yields over multiple harvests. She has found that continued fertilizer applications can prevent low yields of kale and collards (pictured, left) from later harvests. Other research is evaluating the best practices to ensure the yield and safety of low-cost container gardening systems, including cucumber production in baby pools (pictured, right).

Dr. Leigh Whittinghill

PLANT MICROBIOMES FOR SUSTAINABLE AGRICULTURE

Just as the gut microbiome supports human health, plants recruit a root microbiome to help them develop correctly and to resist disease and climate stress. Application of beneficial bacteria and fungi has become an important part of sustainable agriculture, and $9 billion in microbial products are applied to crops globally. CAES scientists are making important contributions to the development of healthy plant microbiomes, with projects that are finding promising new biological controls, revealing the effects of nanotechnology and chemical inputs, and helping understand how plants interact with microbes to promote healthy soils. In 2018, Drs. Lindsay Triplett and Blaire Steven established a research program focused on the role of microscopic predators called protists in establishing the plant microbiome. Protists can consume thousands of bacteria per hour, and are important for recycling soil nutrients, but little is known about their effect on plants. By sequencing the microbiomes of plants in the field and in a library of protist isolates, this work discovered that certain protist predators partner with plant growth promoting bacteria and enhance bacterial benefits. This project has led to $2.1 million in federal funds awarded to the State of Connecticut, supported many educational opportunities, and is uncovering new sustainable strategies to enhance the benefits of the plant microbiome



Dr. Blaire Steven teaches a student to sample corn root tissue for microbiome sequencing (L), The glowing of root protist cysts demonstrates internalization of fluorescent bacteria (R).

Lindsay Triplett
Blaire Steven

WEED SCIENCE RESEARCH

Herbicide resistant weeds can substantially reduce crop productivity and increase production costs. Palmer amaranth (*Amaranthus palmeri*), common waterhemp (*Amaranthus tuberculatus*), horseweed (*Conyza canadennsis*), common lambsquarters (*Chenopodium album*), common ragweed (*Ambrosia artemisiifolia*), and redroot pigweed (*Amaranthus*

retroflexus) are highly troublesome annual broadleaf weeds in corn and soybean fields in northeastern U.S. Triazine-resistant redroot pigweed and common lambsquarters were first confirmed in Connecticut in 1984 and 1992, respectively.Recently, glyphosate-resistant Palmer amaranth and waterhemp biotypes have been identified in multiple corn, soybean and pumpkin fields in CT. Greenhouse dose-response research conducted at the valley laboratory in Windsor revealed 54- to 69-fold resistance to glyphosate in a glyphosate-resistant Palmer amaranth biotype from Connecticut as compared to a susceptible biotype from Kansas. Similarly, a common waterhemp biotype from a Connecticut corn field had 5.8-fold resistance to glyphosate compared to susceptible biotype from Nebraska. It was discovered that Connecticut glyphosate-resistant Palmer amaranth and waterhemp biotypes had an amplified copy number of EPSPS-gene compared to their relative sensitive biotypes. The quantitative polymerase chain reaction assays indicated that Connecticut Palmer amaranth had 33 to 111 relative copies of the *EPSPS* gene compared to a susceptible biotype. Whereas glyphosate-resistant waterhemp biotype from Connecticut had 3.5 relative copies of the *EPSPS* gene compared to the sensitive biotype. Glyphosate-resistant Palmer amaranth biotype from Connecticut was also found to be resistant to ALS-inhibitor herbicides and showed low levels of resistance to triazine herbicides. Furthermore, preliminary dose-response bioassays conducted at Windsor Valley laboratory have shown ALS-inhibitor herbicide resistance in horseweed, kochia, and waterhemp biotypes from Connecticut. Suspected herbicide resistant waterhemp and horseweed biotypes were collected from corn fields and kochia (*Bassia scoparia*) biotype was collected from non-crop area(roadside) in Connecticut. Weed scientists at the Valley laboratory in Windsor, Connecticut and Cornell University, New York have collaborated to quantify the level of ALS-inhibitor herbicide resistance and determine the underlying molecular and physiological resistance mechanisms in ALS-inhibitor herbicide resistant weeds.

Dr. Jatinder S Aulakh

PROTECTING CONNECTICUT STRAWBERRIES FROM INVASIVE FUNGAL DISEASES

Strawberry cultivation is a critical component of Connecticut's agricultural heritage and has historically been protected from many fungal pathogens by our cold winters that limit fungal establishment in the Northeast. Unfortunately, with warming climates leading to increasingly mild winters, multiple pathogens believed to be restricted to the Southern US have been detected in our state. In 2023, both Anthracnose Crown Rot (caused by *Colletotrichum siamense*) and Neopestalotiopsis Petiole Blight (caused by *Neopestalotiopsis rosae*) were identified in the state by CAES scientists. Current research efforts are focused on identifying functional resistance to these diseases in common northern varieties and identifying effective integrated pest management strategies to better manage these diseases in the northeast. These investigations have already yielded varietal recommendations for growers, environmentally sustainable strategies to limit the introduction of the pathogens to farms, and novel insights into the biology of these pathogens.

Dr. Nathaniel Westrick

TRACKING INSECT PEST RESISTANCE

The European corn borer (*Ostrinia nubilalis*; ECB) is a serious pest of corn (*Zea mays*) in North America that was first introduced in the early 1900s. Historically, ECB was one of the most economically impactful pests and damage exceeded $1 billion USD annually. Many management strategies were attempted, but few were fully successful until 1996 with the commercialization of genetically modified corn (Bt-corn) in North America. For over 20 years, no cases of ECB resistance to Bt-corn were identified; however, in 2018, field-evolved evidence of ECB resistance to Bt reported in Nova Scotia, Canada. In 2023, as the result of a Bt-resistance monitoring effort conducted by Dr. Kelsey E. Fisher, the first occurrences Bt-resistant ECB were observed in the US; evidence of Bt-resistance persisted in Connecticut in 2024. With Bt-resistant ECB in the US, farmers will need to rely on additional management strategies. Dr. Kelsey E. Fisher is working to monitor the extent and prevalence of Bt-resistance in Connecticut with sentinel plots at CAES farm properties, spot scouting efforts at commercial growing operations, and by organizing an adult trapping network across the state. These and additional efforts studying the origin of Bt resistance in CT, ECB dispersal abilities, and alternative end-of-season field clean-up strategies will help ensure insect resistance management programs targeted at ECB will be proactive rather than reactive to the presence of Bt-resistant ECB in the US.

Dr. Kelsey E. Fisher

ORGANIC MANAGEMENT OF FRUIT DISEASE

Fire blight, caused by a bacterial pathogen Erwinia amylovora, poses a serious threat to apple and pear production in the United States. It primarily spreads through flowers and shoots, and can even be transported throughout the tree through their xylem, which generally results in death of the tree. This can lead to orchard-wide epidemics, already resulting in over $100 million of economic damage annually.

Organic producers face an even greater challenge, as they cannot use antibiotics like streptomycin after they were banned in organic production in 2014 due to concerns of antibiotic resistance and ecological impact. While this shift was necessary to protect the effectiveness of commercially important antibiotics, it created a pressing need for alternative methods of control. Through projects awarded funding through the Organic Research and Extension Initiative (OREI), Dr. Quan Zeng has been collaborating with researchers and growers to develop organic-compliant strategies to manage fire blight. One promising solution involves using a naturally occurring yeast, Aureobasidium pullulans, to protect apple flowers by inducing the plant's natural defenses. This biologically-based control method has shown effectiveness comparable to antibiotics for controlling fire blight, though there are some complications relating to fruit russeting, a purely cosmetic issue, from treated blooms. To refine and improve these control methods, Dr. Zeng is working with eight organic orchards across Connecticut, New Hampshire, New York, and Rhode Island. Together, they are testing new yeast strains and integrated management strategies to maximize disease control while minimizing side effects like russeting. This hands-on collaboration with farmers is a central pillar of OREI and is critical to developing successful, practical, and impactful solutions.

Dr. Quan Zeng

THE CHEMICAL SENSES OF INSECTS

Insects are among the most successful animals on Earth, due in part to their dependence on highly developed chemical senses —primarily olfaction (sense of smell) and gustation (sense of taste) — to navigate their environments, locate resources, and interact with other organisms. These senses are

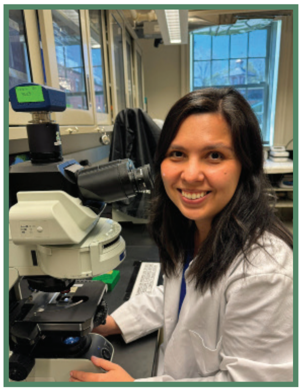
critical for detecting and interpreting chemical cues that enable them to survive, reproduce, and establish populations in new areas. The chemical sensory systems in insects are highly specialized, finely tuned sensory organs with an array of receptors. These receptors can identify specific chemical signals, often at incredibly low concentrations. The olfactory system of insects is located on the antennae and other sensory appendages, such as maxillary palps. These olfactory organs are covered with sensory hairs, or sensilla, which contain olfactory receptor neurons (ORNs). These neurons detect plant-emitted volatiles and pheromones, chemical signals used for communication within a species that trigger mating, aggregation, or alarm responses. In addition to olfactory cues, gustation enables insect pests to evaluate potential food sources and avoid toxic substances. Gustatory receptors are expressed in neurons housed in taste hairs or sensilla, which are located on the mouthparts, tarsi (feet), and other parts of the body, allowing insects to taste substrates upon contact to determine their suitability of plant tissues for feeding or oviposition (egg-laying). By understanding how insect chemosensory systems function and evolve, we can develop innovative tools to combat pest populations while minimizing harm to beneficial insects and ecosystems. The chemical senses of insect pests, while vital to their success, also represent a critical vulnerability that can be leveraged to protect agricultural and natural resources effectively.

Dr. Hany K. M. Dweck

UNDERSTANDING NEMATODE VIRULENCE TO DEVELOP BETTER CONTROL STRATEGIES

Plant-parasitic nematodes are roundworms that infect all economically significant crops. Most nematodes attack plant roots and live in the soil, making their control complex and challenging. Effective management requires a combination of synthetic chemicals, plant resistance, and cultural practices. However, the chemicals commonly used are highly toxic, and nematode resistance is limited to a few plant species. Additionally, this resistance often becomes ineffective over time as nematodes adapt and overcome it. Nematodes inject virulence proteins into plant cells, which alters the plants' metabolism to facilitate nematode feeding and development. Our research employs molecular, biophysical, and biochemical methods to study these proteins and identify the host pathways they target. We also analyze how the expression of these virulence proteins varies among different nematode species and how these proteins respond to temperature variations found in Connecticut and other parts of the United States. Ultimately, by understanding the mechanisms of nematode virulence, we can identify their vulnerabilities and develop new targets for effective control strategies.

Dr. Raquel Rocha
Ms. Regan Huntley



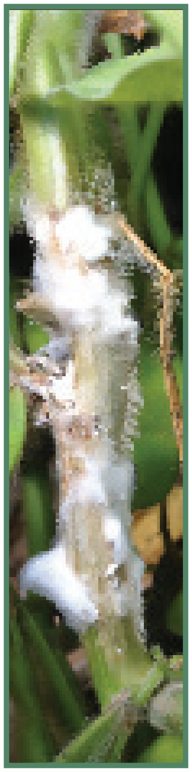
NANOTECHNOLOGY FOR AGRICULTURE

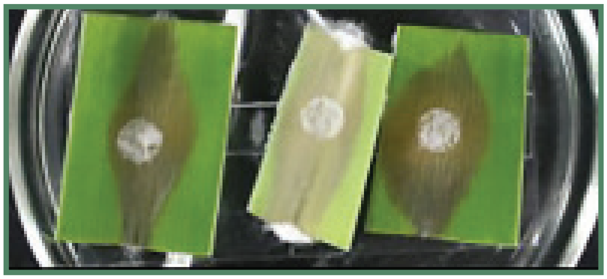
Plant pathogens represent a critical threat to global food security, causing 30% global crop yield losses amounting to $220 billion annually. This issue is further exacerbated by the United Nations' prediction that food production must increase by 60% by 2050 to feed a growing population projected to reach 10 billion. CAES is tackling this multifaceted challenge head-on, recognizing that both increased food production and reduced crop yield loss are essential. Our scientists are developing innovative solutions by focusing on nanoscale interventions. One strategy involves engineering nanoscale nutrients to act as comprehensive crop health boosters, suppressing disease while improving nutritional content and yield. For example, our research data show that watermelon plants sprayed with CuO in a nano form and grown in soil infested with a plant pathogen, Fusarium spp., had less disease, more yield, and more Cu in the roots than plants treated with the same amount of the bulked CuO. A second approach focuses on enhancing RNA interference (RNAi), a natural plant defense mechanism, by developing nanoparticle carriers to protect and deliver RNA molecules that prime plants to fight pathogens. We recently filed a patent for two environmentally friendly nanoformulations that sustainably deliver dsRNA to plants to fight potato virus Y (PVY) infection. Our nanocomplex (nanocarrier-dsRNA) resulted in 100% protection against PVY in potato plants in field trials. This is extremely relevant since there is no viricide available in the market to control plant virus infection. Our research has shown real promise, and we believe that these cutting-edge approaches represent a significant step toward ensuring a sustainable and secure food supply for future generations.

Dr. Washington da Silva
Dr. Raja Muthuramalingam
Dr. Rania El-Tanbouly

COMBATING A FUNGAL PLANT PATHOGEN OF INTERNATIONAL CONCERN

Sclerotinia stem rot (SSR), caused by the fungal pathogen Sclerotinia sclerotiorum, is a globally significant disease that affects a wide variety of economically and nutritionally important plants. Despite decades of research, scientists have found very few sources of SSR resistance within affected crops. To tackle this challenge, researchers at CAES have developed a two-pronged approach: (1) using a technology called RNA interference (RNAi) to control the pathogen without relying on potentially harmful chemical pesticides, and (2) investigating new sources of disease resistance in non-agricultural plant species. Early results demonstrate that the pathogen infects an even broader range of plants than previously thought and have uncovered several new sources of resistance to SSR. By studying these promising discoveries, CAES is helping farmers protect their crops from this destructive disease while reducing dependence on the fungicides currently applied to control SSR in the United States.

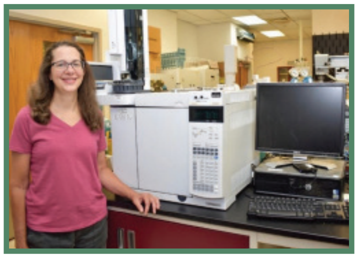




Dr. Nate Westrick

HEMP REGULATORY AND RESEARCH ACTIVITIES

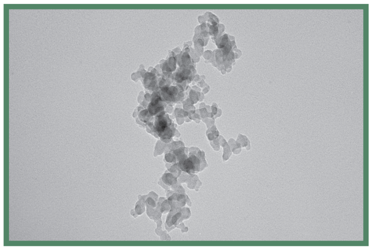
In the 2018 Farm Bill, hemp was defined as Cannabis sativa L with less than or equal to 0.3% total delta-9 tetrahydrocannabinol (THC). Hence, the program's goal was to determine the THC content of hemp grown by state farmers prior to the sale of the product. The state plan requires that each hemp variety is tested within 30 days of harvest. To date, hundreds of preharvest samples have been submitted for analysis. The analysis was brought under the scope of accreditation in January of 2021, and ongoing proficiency is demonstrated by successfully passing the University of Kentucky hemp proficiency testing annually. Test data are reported back to the Department of Agriculture which has regulatory authority over the disposition of the crop. To provide information in support of sampling and cultivar decisions, research is being conducted to assess sampling strategies, and conformance to the THC limit. To this end, 14 hemp cultivars have been grown and tested for THC and cannabidiol (CBD) between 2020-2023. Each year, fresh plant material was collected from each cultivar weekly, beginning in mid-August and ending in late October, to examine the rate of increase in THC and CBD for different cultivars and select individual plants. The sampling demonstrated that both CBD and THC increase rapidly over a 1–2-week time frame with maximum concentrations (about 16% and 0.6%, respectively) around late September to early October. Testing individual plants on the same day showed that while the ratio of CBD to THC remains constant (about 20:1 in compliant hemp) during the growing season, individual plants are highly variable in concentration. This study demonstrated a novel plant-to-plant variability in the levels of THC within the same hemp cultivar. Understanding variability within and between hemp cultivars is useful to determine field sampling strategies and to assess the risk of crop embargoes to growers by compliance regulators. Also, this study indicated that growers should harvest their crops at a specific time window to avoid the potential of being embargoed due to high THC levels. Relatedly, as growers use pesticides to control disease in hemp production, it was envisaged that copper (Cu), being a pesticide and a well-known stimulator of secondary metabolites in plants, could alter the levels and dynamics of THC and CBD production. Our specific objectives were, thus, to determine: (i) whether Cu can modulate the levels of THC and CBD before the onset of THC escalation above 0.3%; (ii) whether there is Cu-type (nano, bulk, or ionic) and dose-dependent effects on THC and CBD levels; and (iii) whether Cu application influences the reported similar temporal trends in THC and CBD production. Hence, two hemp cultivars, Wife and Merlot, were grown in the field and evaluated as a function of harvest time (August–September), Cu type (nano, bulk, or ionic), and dose (50, 100, and 500 ppm). In Wife, Cu treatment temporally increased in THC (33%) and CBD (51%) production during plant growth. Specifically, CuO nanoparticles at 50 and 100 ppm significantly increased THC and CBD levels, compared to the control, which coincided with significantly more Cu in the inflorescences (buds) than in the control and bulk CuO treatments. No such effect of Cu was found for Merlot, suggesting cultivar-specific Cu responses. Collectively, the findings show contrasting implications for the production of these cannabinoids, in which metabolite levels may rise above the 0.3% regulatory threshold for THC but to a more profitable level for CBD (non-regulated), depending on the cultivar.



Ms. Terri Arsenault
Ms. Kitty Prapayotin-Riveros
Mr. Michael Ammirata
Ms. Meghan Cahill
Dr. Nubia Zuverza-Mena
Dr. Christian Dimkpa
Dr. Jason White

GREEN NANOTECHNOLOGY FOR A CIRCULAR AND SUSTAINABLE AGRICULTURE

In a bid to improve nanomaterials by making them more biocompatible, the Department of Analytical Chemistry has engaged in the upcycling of plant biomass in nanomaterial synthesis. This effort has the additional benefit of managing plant waste. To this end, plant biomasses, including of hemp, artemisia, and thymus species, are being used for the synthesis of “green” nano agrochemicals like iron, zinc, copper, manganese and organic nanoherbicides. These plants contain numerous bioactive molecules that facilitate the stability of nanoparticles through surface coating, capping and possibly nucleation, or that in themselves can be converted to nanoscale materials by surface modifications. Given their small size and consequent higher bioactivity, “green” nanoagrochemicals could be used in smaller doses, which reduces the overuse of conventional agrochemicals, thus preserving soil and ground water resources. By synthesizing nanoagrochemicals from plants, two benefits are achieved simultaneously: repurposing of agricultural wastes and stimulation of sustainable agricultural practices. For example, when applied to soybean, iron nanoparticles synthesized from hemp increased the content of chlorophylls by as much as 142% antioxidants by as much as 124%, and polyphenols by as much as 177%, leading to a biomass increase of up to 148%. Similarly, copper and zinc oxide nanoparticles synthesized using Artemisia vulgaris plant extracts exhibited between 2 and 5-fold greater in vitro antifungal activity against fusarium affecting soybean, compared to conventional zinc and copper salts and a commercial fungicide (Medalion Fludioxon), respectively. Using microscopy, it could be demonstrated that the nanoparticles caused severe morpho-anatomical damage to fungal mycelia and conidia. In soybean, 200 mg/L of both NPs enhanced growth by 13%, compared to fusarium infested controls, where microscopic examination showed the deposition of the nanoparticles in the plant and their migration to the interiors to evoke plant defense responses to fusarium attack.



Likewise, while herbicidal bioassays with pristine thyme essential oil (EO) in postemergence treatments on a common weed, Amaranthus retroflexus, reduced shoot biomass by 85%, encapsulation of the EO with silica nanoparticle further enhanced the herbicidal efficacy 96% compared to control plants.

Dr. Milica Pavlicevic
Dr. Nubia Zuverza-Mena
Dr. Christian Dimkpa
Dr. Anuja Bharadwaj
Dr. Yi Wang
Dr. Jason White

Environment

INTRODUCTION

Connecticut, like the rest of the country, faces a number of environmental challenges: contamination of air, water and soil; invasive insect and plant species; climate change impacts; and stresses associated with urban development. Improving the quality of natural and affected environments through research is a primary mission of The Connecticut Agricultural Experiment Station. Improving environmental quality requires a deep understanding of how natural processes work. Economic losses and environmental degradation are an unintended consequence of introduced plants, insects, and pathogens. CAES scientists are developing novel management tools to control exotic terrestrial and aquatic invaders, monitoring the State for new threats and investigating methods of rehabilitating degraded woodlands and returning them to healthy forests. The following pages summarize our research activities in these areas.

SOIL ORGANIC CARBON

Efforts to sequester carbon in soil to improve soil health and reduce atmospheric carbon dioxide increasingly focus on increasing inputs from plant roots, because they have been shown to contribute to soil organic carbon more than above-ground inputs. Root exudates, small organic molecules exuded by roots, are considered especially important below-ground precursors for soil organic matter formation. However, exudates have also been shown to induce microbial decomposition of existing organic matter. We have been using stable carbon isotopes to track root exudates as they are released into the soil and cycled through the soil system. We have recently found that root exudates can simultaneously form new organic matter and break down existing organic matter. These processes depend on the soil mineral type with which the organic matter is associated. Ongoing research is being done to understand which mineral types promote organic matter formation from exudates, and which are susceptible to decomposition.

Dr. Itamar Shabtai

MICRO- AND NANOPLASTICS IN SOIL

Plastic pollution is a critical environmental challenge, prompting the United Nations to propose an international plastics treaty to address the entire lifecycle of plastics, including their production, design, and disposal. The issue is compounded as plastics degrade into micro- and nanoplastics (100 nm–5 mm and <100 nm, respectively), which can cross biological barriers and cause significant ecological harm. This research program aims to enhance understanding of the fate and transport of micro- and nanoplastics in terrestrial environments, focusing on their impact on soil physical properties, their co-transport with other contaminants like heavy metals and PFAS, and their generation from biodegradable plastics and other consumer products.

Dr. Yingxue Yu

MONARCH CONSERVATION

The monarch butterfly (*Danaus plexippus*) is in decline in association with habitat loss including their obligate host plant, milkweed (*Asclepias* sp.). As of December 2024, it is proposed to be listed as a threatened species under the U.S. Endangered Species Act. Restoration efforts are underway to provide milkweed, however, questions arise related to management for these habitats. Current research suggests that monarch larvae grow larger and faster and adults prefer to lay eggs on young, succulent milkweed. As adults arrive in large numbers in July when milkweed is flowering and diverting resources from vegetative to reproductive growth, there seems to be a phenological mismatch. We are currently testing if mowing in June would prolong the milkweeds' vegetative stage and increase monarch success. Future work will explore the impact of clipping milkweed in June, July, and August to identify if this practice will provide younger vegetation that would be available later in the season.

Dr. Kelsey E. Fisher

PROMOTING FOREST ECOSYSTEM HEALTH AND RESILIENCY

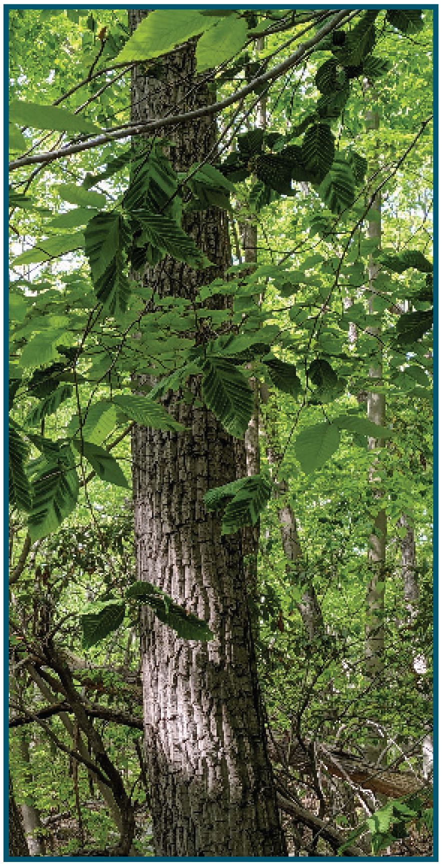
Forests in the northeastern U.S. face multiple, concurrent stressors, which threaten their ability to provide important social and ecological services. These include pest, pathogen, and plant invasions; climate change; forest conversion and fragmentation; and overbrowsing by white-tailed deer. As the lead forest health agency in the state, CAES works in cooperation with the USDA Forest Service and other regional forestry agencies to monitor and manage threats to Connecticut's 1.78 million acres of forested land. These initiatives include an annual aerial survey to detect landscape-level changes in tree health and mortality as well as ground surveys to evaluate the impacts of changing conditions on forest structure, composition, and function. In particular, we are investigating how losses of tree species from pest and pathogen invasions, such as emerald ash borer and beech leaf disease, are affecting understory plant composition and tree regeneration and the extent to which different forest management practices can maintain native diversity at the landscape scale.

Dr. Elisabeth Ward
Joseph P. Barsky

BEECH LEAF DISEASE

Beech leaf disease (BLD) severely negatively impacts the health of native and ornamental beech trees in our forests and residential landscapes. Caused by a newly identified foliar nematode (*Litylenchus crenatae*), BLD was first detected in Fairfield County in 2019 and can kill beech trees through multiple years of defoliation. CAES scientists Drs. Richard Cowles, James LaMondia, and Robert Marra are researching different aspects of BLD including studying the disease in its native Japan to compare its DNA "fingerprints" to those in Connecticut to help determine its origin and spread (Marra) as well as investigating environmentally friendly chemicals that can activate beech tree defenses against the nematode so that we may more broadly protect native and ornamental beech in Connecticut and beyond (Cowles/LaMondia).

Dr. Robert Marra
Dr. Richard Cowles
Dr. James LaMondia



MANAGING HEMLOCK WOOLLY ADELGID

Eastern hemlock, a foundation species, provides critical animal and fish habitat and protection for water resources. Hemlocks in Connecticut have been threatened by non-native hemlock woolly adelgid (HWA) for 40 years. Initial HWA invasions killed thousands of trees in Connecticut. Experiment Station and Japanese scientists discovered, studied, mass reared and released the first HWA biological control agent, the tiny specialist ladybeetle predator, Sasajiscymnus tsugae. Since 1995, *S. tsugae* has been Connecticut's main strategy to manage HWA without chemicals, with over

300,000 released to date. After 30 years of biological control, Connecticut's hemlocks are showing sustained recovery. Over 70% of Connecticut's hemlocks are privately-owned. Recently, beetle releases have been expanded to diverse stakeholders, such as land trusts, towns, private forests, water companies, homeowners etc. using commercially available *S. tsugae*. A major HWA management program, funded by the National Park Service, is implementing beetles to protect important hemlock watershed forest along the Farmington River, the nation's first Partnership Wild and Scenic River.

Dr. Carole Cheah

SALT MARSH SOIL ECOLOGY

Connecticut coastal wetlands face pressure from multiple human activities, including "salt marsh squeeze," which results from the combined effects of sea level rise and coastal

development. As rising sea levels submerge lower marsh areas and development restricts plant migration, critical bird habitats are lost. Sediment addition is being used to raise marsh elevation and create nesting sites for the birds that depend on these systems. However, the impact of this practice on sediment microbial communities, sediment chemistry, and other wetland

ecosystem services are not fully understood. Researchers at the CAES are studying these effects to prevent unintended consequences like altered carbon cycling, pollutant release, or the introduction of pathogens, safeguarding the entire wetland ecosystem from birds to bacteria.

Dr. Blaire Steven
Jacquelyn LaReau

PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

PFAS are an emerging class of highly toxic environmental contaminants. They have been around since the 1940s and are commonly used in many applications including firefighting foams and waterproof and stainproof coatings. Measuring PFAS is challenging, as they can be harmful at extremely low concentrations and the class contains thousands of individual chemicals. CAES work on PFAS began in 2019 as part of Governor Lamont's Interagency PFAS Task Force. Current and past research projects include investigation of soil and water remediation methods (phytoremediation, biochar), improved methods for measuring PFAS (FluoroMatch software), PFAS accumulation in biota (fiddlehead ferns, maple sap, marine food webs), and human exposure studies (dried blood spots, drinking water). Additionally, we have remained involved in PFAS work specifically for the state of Connecticut. We analyzed PFAS in biosolids based fertilizers to aid in regulatory risk assessments and will begin accepting soil samples from CT farms for free PFAS analysis at CAES this year.

Dr. Sara Nason

OFFICE OF AQUATIC INVASIVE SPECIES (OAIS)

Connecticut lakes and rivers are often degraded by non-native invasive weeds. Without natural enemies, these plants disrupt native ecosystems, interfere with recreational uses, and reduce property values. The Connecticut Legislature formed the Office of Aquatic Invasive Species (OAIS) at CAES in 2022. The office is charged with researching aquatic plants, creation of a statewide aquatic plant data repository, public education, aquatic plant management, and serving as a liaison between municipalities, state agencies, and other stakeholders. OAIS is an extension of the Invasive Aquatic Plant Program. Notable accomplishments include nearly 500 aquatic plant surveys, an online aquatic plant herbarium with nearly 6,000 entries, numerous workshops, and an identification guide. Accomplishments include, documenting a distinct hydrilla biotype in the Connecticut River, providing survey data to expedite United States Army Corps of Engineers control projects, linking the presence of invasive aquatic plants to water chemistry, and utilizing integrated management to eliminate invasive plant problems in lakes. OAIS information can be found at https://portal.ct.gov/caes/oais/office-of-aquatic-invasive-species.

Mr. Greg Bugbee
Dr. Jeremiah Foley IV
Summer Weidman
Riley Doherty

AQUATIC INVASIVE PLANT ECOLOGY AND MANAGEMENT

Nonnative aquatic invasive species (AIS) such as *Hydrilla* and water chestnut present significant ecological and economic challenges with their effective management often requiring frequent herbicide application. Their rapid spread leads to dense infestations that disrupt native aquatic habitats, degrade water quality, and increase management costs. Traditional chemical control methods often raise concerns about long-term environmental impacts. To reduce herbicide dependence, Dr. Foley is investigating Integrated Pest Management (IPM) approaches, focusing on biological control with herbivorous insects that specifically target these invasives. His research aims to optimize insect survival, feeding efficiency, and reproduction to enhance control effectiveness. By improving release strategies, assessing environmental influences, and refining insect-host interactions, this work seeks to integrate biological control into a broader IPM framework. Combining biological control with other management strategies, such as mechanical removal, reduced herbicide application rates, and habitat modification will help establish sustainable, long-term approaches to AIS suppression, reducing reliance on chemical treatments while promoting ecological balance.

Dr. Jeremiah Foley IV

SPOTTED LANTERNFLY

Spotted lanternfly (SLF) is a brightly colored, invasive, sap-feeding insect that arrived in Connecticut in 2020. Although SLF feeds on many plants, Connecticut's vineyards are at most risk. SLF feeding increases winter kill of vines and alters grape sugar content. SLF is also a nuisance pest for homeowners due to its large aggregations producing copious honeydew (sugary excrement). This honeydew coats surfaces under their feeding sites with a sticky layer of sugar and attracts wasps. Several aspects of SLF biology and management are being addressed by CAES scientists. Drs. Claire Rutledge and Kelsey Fisher are using stable isotope marking to elucidate movement of SLF adults in the landscape. Drs. Hany Dweck and Rutledge are exploring potential repellents to protect crops. Dr. Rutledge, with Dr. Melody Keena (USDA Forest Service), are studying mating behavior of SLF and how climate impacts the phenology of SLF. CAES hosts the state's portal for citizens reporting SLF sightings.

Dr. Claire Rutledge
Dr. Kelsey E. Fisher
Dr. Hany Dweck

INDICATORS OF URBAN TREE STRESS RESPONSES

Urban trees provide numerous benefits which affect the quality of life for 277 million Americans who live in cities. However, urban site conditions are often suboptimal for tree health and it is estimated that 6-15% of newly planted trees die within five years. Planting practices play a major role in the survival of newly planted trees, but on larger scale, excess heat accelerates tree decline, and globally 56% of urban tree species are estimated to be out of their temperature comfort zone. CAES monitors urban tree health and conducts research on how urban site factors such as urban heat island, compaction, soil properties, fungal pathogens, and mycorrhizae affect urban tree health in streets, parks, and urban forests. Phenotypic, physiological, biochemical, and cellular responses of trees are used to quantify stress. This information is used to determine threshold values that can applied in tree care decisions and species selection for urban tree planting sites.

Dr. Susanna Keriö

CHESTNUT RESEARCH AT CAES

The CAES chestnut orchards at Lockwood Farm, Valley Laboratory, Griswold, and in Sleeping Giant State Park represent a near century-long effort of breeding for chestnut blight resistance. The oldest trees are Chinese chestnuts in the Sleeping Giant orchards planted in 1930. Recently these trees were used for genome annotation and to identify genes and alleles underlying chestnut blight resistance and *Phytophthora* root rot resistance. The CAES chestnut plantings include nearly all pure *Castanea* species, hybrids, orchard type cultivars, and cultivars developed at CAES. These mature trees are a valuable source of germplasm for breeding but also demonstrate chestnut adaptation to Connecticut's environmental conditions. At Lockwood Farm, 50-year-old biocontrol trials with American chestnuts showcase the pioneering work of CAES in chestnut blight biocontrol since 1973. These collections are the result of persistent work by many CAES scientists, collaborators, students, research technicians, and seasonal assistants. CAES carries on the legacy of chestnut research through scientific collaboration and by maintaining this valuable collection of chestnut trees.

Dr. Susanna Keriö

Food Safety

INTRODUCTION

The Department of Analytical Chemistry at The Connecticut Agricultural Experiment Station (CAES) has a 130-year history of work in Food Safety. In 1895, the CT General Assembly passed “An Act Regulating the Manufacture and Sale of Food Products” which mandated that “The Connecticut Agricultural Experiment Station shall make analysis of food products on sale in Connecticut suspected of being adulterated, at such times and places and to such extent…may take from any person…any article suspected of being adulterated.”

Since then, the Department of Analytical Chemistry has become the state’s primary analytical laboratory, testing over 2000 samples each year from a variety of entities. The Department analyzes animal feeds and fertilizers for the CT Department of Agriculture so as to determine label accuracy and purity, as well as cultivated seaweed for human consumption for contaminants such as heavy metals, pesticides, and polychlorinated biphenyls (PCBs). Since 2022, the Department has been the state testing lab for adult use cannabis-based consumable products for THC and CBD label claims, as well as for the presence of potential contaminants such as pesticides, mycotoxins, and toxic elements, and for adulteration with opioids. As part of a Market Basket program with the CT Department of Consumer Protection (DCP) and the US Food and Drug Administration (FDA), we analyze foods for pesticide residues and adulteration. In addition, we conduct analysis on food-related consumer complaints submitted to DCP. We provide analysis for pesticide misapplication investigations on food and non-food crops for the CT Department of Energy and Environmental Protection (DEEP). We provide food-based chemical analysis as needed for the CT Department of Public Health (DPH), as well as for local and municipal health agencies. The Department of Analytical Chemistry is also part of the US FDA Food Emergency Response Network (FERN). The FERN was established to respond to terrorist events involving the food supply and the Department of Analytical Chemistry was one of the eight original laboratories selected to participate. The FERN chemistry network has been activated for national food safety issues such as melamine contamination of pet/human food, seafood contamination as part of the 2010 Deepwater Horizon oil spill, and the analysis of arsenic in juice and rice. Last, scientific staff within the Department conduct federally and state funded research on the analysis and detection of emerging chemical contaminants in food, including engineered nanomaterials, mycotoxins, and antibiotics/ chemotherapeutics.

PESTICIDE RESIDUES IN HUMAN FOOD AND ANIMAL FEEDS

The Department of Analytical Chemistry continues to conduct its annual Market Basket Survey of Connecticut foods for pesticide residues. Conducted in coordination with the CT Department of Consumer Protection (DCP), results are published online annually in a technical bulletin.

For over 50 years, this pesticide residue monitoring program has ensured that pesticides applied to produce sold within the state are applied in accordance with their labels, and that the public is protected from over application or misapplication of pesticides. Samples are collected from local growers, farmstands, and farmer's markets. Over-tolerance or no-tolerance violations are reported back to CT DCP and to FDA who then formulate a response. To date, only approximately 4% of tested samples have resulted in a violation, with "no-tolerance" violations being the more common. Regulatory responses from our findings have included warnings, increased inspections, fines, and product recalls. Additionally, DAC performs pesticide residue analysis on animal feed samples collected by the CT Department of Agriculture (DoAg).

Dr. Carlos Tamez
Mr. Michael Ammirata
Ms. Kitty Prapayotin-Riveros
Dr. Christian Dimkpa
Dr. Brian Eitzer
Dr. Walter Krol

MYCOTOXINS IN HUMAN FOOD AND ANIMAL FEED

Mycotoxins are naturally occurring toxins produced by species of Aspergillus and Fusarium molds that can grow on cereal grains and legumes. The US FDA provides guidance for the concentrations of mycotoxins permissible in animal feeds, based on the feed type and the animal consuming the feed. The Department of Analytical Chemistry analyzes animal feeds submitted by CT Department of Agriculture for aflatoxins B1, B2, G1, and G2; deoxynivalenol; and fumonisin B1. B2, and B3. Submitted feed samples are produced or sold within the state and include single ingredient feeds and mixed feeds intended for livestock animals and retail packaged feeds for domestic animals. Testing for aflatoxins began in 2018, with deoxynivalenol and fumonisins being added in 2023. Monitoring mycotoxin concentrations to ensure they are below FDA guidelines is critical in safeguarding the health and safety of livestock and household pets. Further, safeguarding the feed supply promotes human health, as dairy cattle that consume feed with significant levels of aflatoxins B1 and B2 can produce aflatoxin M1 and M2 and pass this onto their milk. Additionally, DAC tests for aflatoxins in nut based human foods and patulin in apple juice, apple sauce, and apple cider.

Dr. Carlos Tamez
Mr. Micheal Ammirata
Ms. Terri Arsenault
Ms. Kitty Prapayotin-Riveros
Dr. Christian Dimkpa
Dr. Raja Muthuramalingam
Dr. Brian Eitzer
Dr. Walter Krol

ANALYSIS OF MEDICINAL AND ADULT-USE MARIJUANA PRODUCTS

With the legalization of adult-use marijuana in July 2021, a program was launched to analyze cannabis products for cannabinoid content, ensuring compliance with label claims and safeguarding public health. The Connecticut Department of Consumer Protection (DCP) regulates medical and adult-use cannabis establishments, enforcing strict quality and safety standards. CAES supports this initiative by testing cannabis samples submitted by the DCP for regulatory enforcement. Testing results are reported to the DCP to ensure compliance with state regulations, enhancing product safety and consumer confidence in the cannabis market. The program tests cannabinoids like Cannabidiolic Acid (CBDA), Cannabidiol (CBD), Delta-9 Tetrahydrocannabinol (THC), and Tetrahydrocannabinolic Acid (THCA).

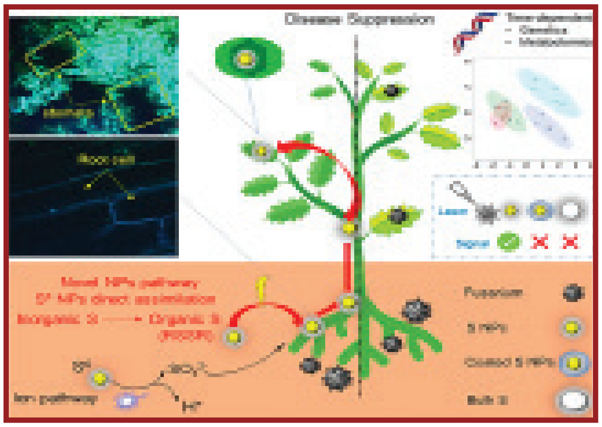
Additionally, products are analyzed for pesticides, mycotoxins, terpenes, and heavy metals, as required by DCP. Two validated methods—HPLC-UV and GC-MS—are used for cannabinoid analysis, accredited under ISO/IEC 17025:2017 by A2LA in March 2023 and 2025, respectively. Since the program's inception, over 265 samples have been tested, including plant materials, gummies, oils, chocolates, tablets, concentrates, vape products, seltzers, curated live resins, and unique and uncommon items like THC-lined straws and pizza dough. Cannabinoid levels, particularly THC, ranged from 0.02% to 94.6%. Accurate testing ensures products meet label claims, with reliable potency critical for medical patients requiring consistent dosing. This program supports a safer and moretrustworthy cannabis marketplace in Connecticut.

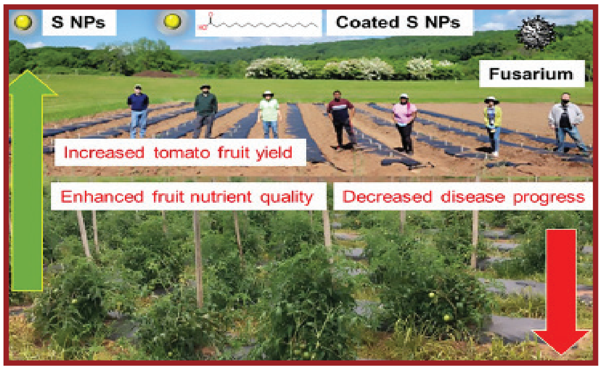
Dr. Anuja Bharadwaj
Ms. Kitty Prapayotin-Riveros
Ms. Terri Arsenault
Dr. Christian Dimkpa
Dr. Jason White

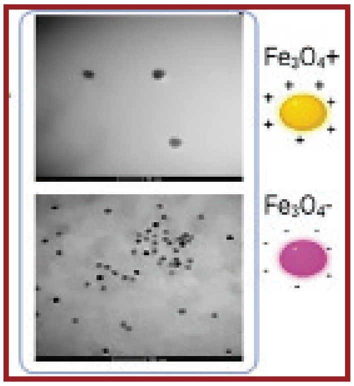
NANOTECHNOLOGY AND PLANT DISEASE MANAGEMENT

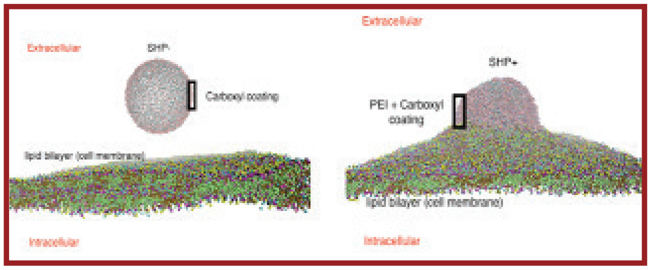
Pathogens, particularly soil-borne fungi like Fusarium, pose a major threat to crop growth, causing significant yield losses and compromising food safety through mycotoxins. Conventional agricultural methods are inefficient, with 90% of applied materials failing to reach their target and pesticide resistance worsening the issue. This leads to overuse of agrochemicals, increasing costs and environmental harm. To address this problem, safer, more effective solutions are needed. Nanotechnology offers promise, with nanomaterials improving crop disease management, boosting plant growth, and enhancing pest control with greater efficiency than traditional methods. For example, we found that nano sulfur (nS) and coated nano sulfur (cS) significantly reduced disease by 54% and 56%, respectively, and a field test showed cS outperformed nS and bulk sulfur in reducing disease severity. The linked gene expression and metabolomics data demonstrated a time-sensitive physiological window where nanoscale stimulation of plant immunity will be effective. Foliar and soil treatments with cS boosted yield by up to 192%, and increased fruit mineral content. A $33/acre investment in cS raised marketable yield from 4920 to 11,980 kg/acre for healthy plants and from 1135 to 2180 kg/acre for infested plants. In another study, Fe3O4 nanoparticles (NPs) reduced Fusarium wilt in tomatoes by 41% to 44% and increased shoot biomass by up to 455%. Positively charged Fe3O4 NPs were more effective than negatively charged ones in mitigating disease and improving nutrient uptake, with computational models confirming the superior attachment of positively charged particles to tomato leaves.

Dr. Yi Wang
Dr. Chaoyi Deng
Dr. Hina Ashraf
Dr. Christian Dimkpa
Dr. Jason White





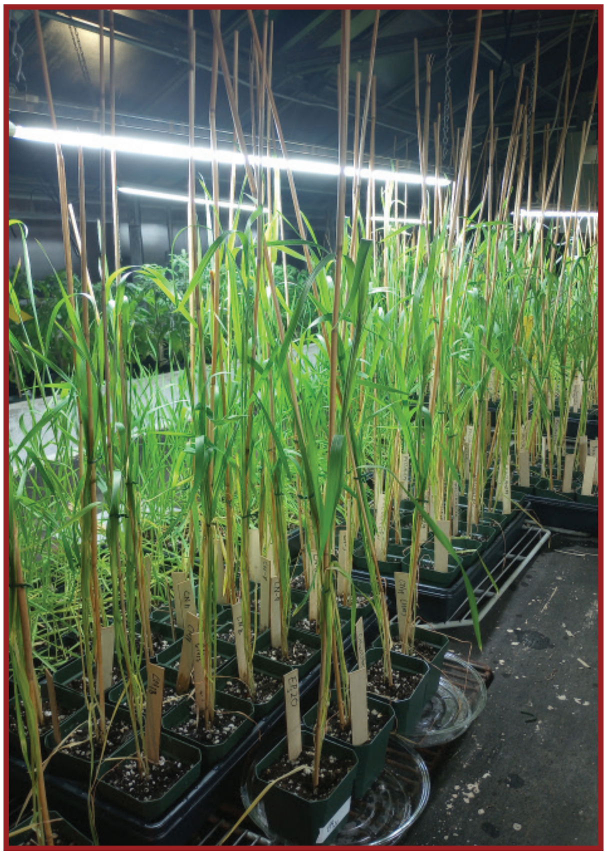




MICRO AND NANOPLASTICS IMPACTS ON CROPS

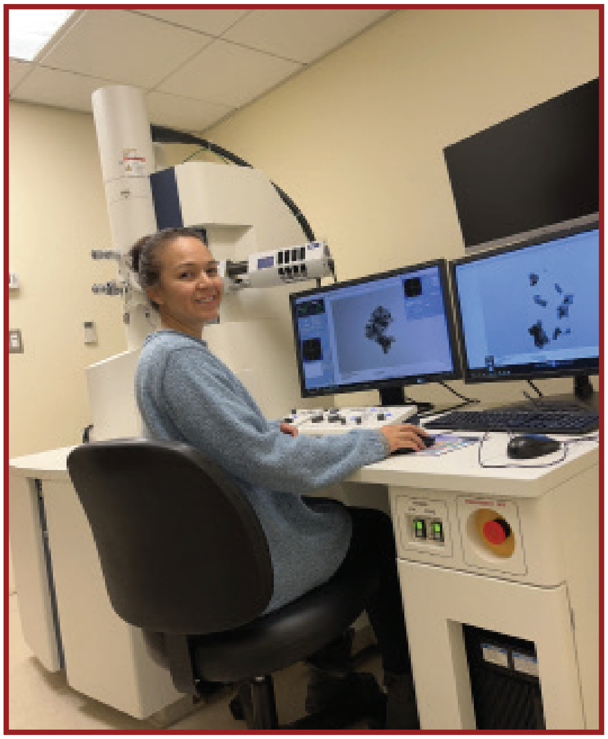
Micro-nano-plastics (MNPs) are emerging contaminants whose exposure can result in different levels of health hazards. In agriculture, widespread use of pesticides and plastic materials has been identified as causing potentially significant MNP contamination of the terrestrial environment. Although the direct toxicity of MNPs in the food chain is a significant concern, less is known about their role in translocating other contaminants in plant tissues. Preliminary studies at CAES demonstrated that MNPs can act as effective vectors for environmental pollutants (EPs) due to significant potential for sorption and surface accumulation. At the Department of Analytical chemistry of CAES investigations take place on the role of micro-nanoplastics like polyvinyl chloride (PVC) and polyethylene terephthalate (PET) in the uptake of EPs such as heavy metals (HMs; arsenic, chromium and lead), boscalid, and PFOS in food crops. In one instance, lettuce was grown hydroponically under the exposure of weathered (cryomilled + UV aged) and unweathered (only cryomilled) PVC 10um (5 ppm) alone and in combination with EPS- HMs and boscalid (0.5 ppm) and PFOs (0.005 ppm). A significant decrease in shoot fresh weight of lettuce of 50 to 78%, and root fresh weight of 25 to 35% was observed under both weathered and unweathered PVCs in combination with EPs. Shoot dry weight was significantly higher (54%) as compared to the control when lettuce was exposed to weathered PVC in combination with the EPs. Similarly, chlorophyll content in lettuce leaves was reduced significantly by 20 to 29% as compared to the control group under both forms of PVCs in combination with EPs. Aging of the MPs significantly influenced the uptake and translocation of HMs in the plant. In wheat, plants grown in soil under greenhouse condition and exposure to weathered (cryomilled + UV aged) and unweathered (only cryomilled) PVC 10um (10 mg/kg) alone and in combination with EPS- HMs and boscalid (1 mg/kg) and PFOs (50 ug/kg) were affected in their growth by 12% under unweathered + EPs treatment, as compared to the weathered PVC treatment group. Taken tother, our findings indicate that co-exposure of PVC with EPs can significantly impact EPs uptake and toxicity in crops, leading to uncharacterized risks to humans and animals. These findings provide important impetus for evaluating the risk of MNPs for compromising food safety.

Dr. Mandeep Kaur
Dr. Nubia Zuverza-Mena
Dr. Jason White

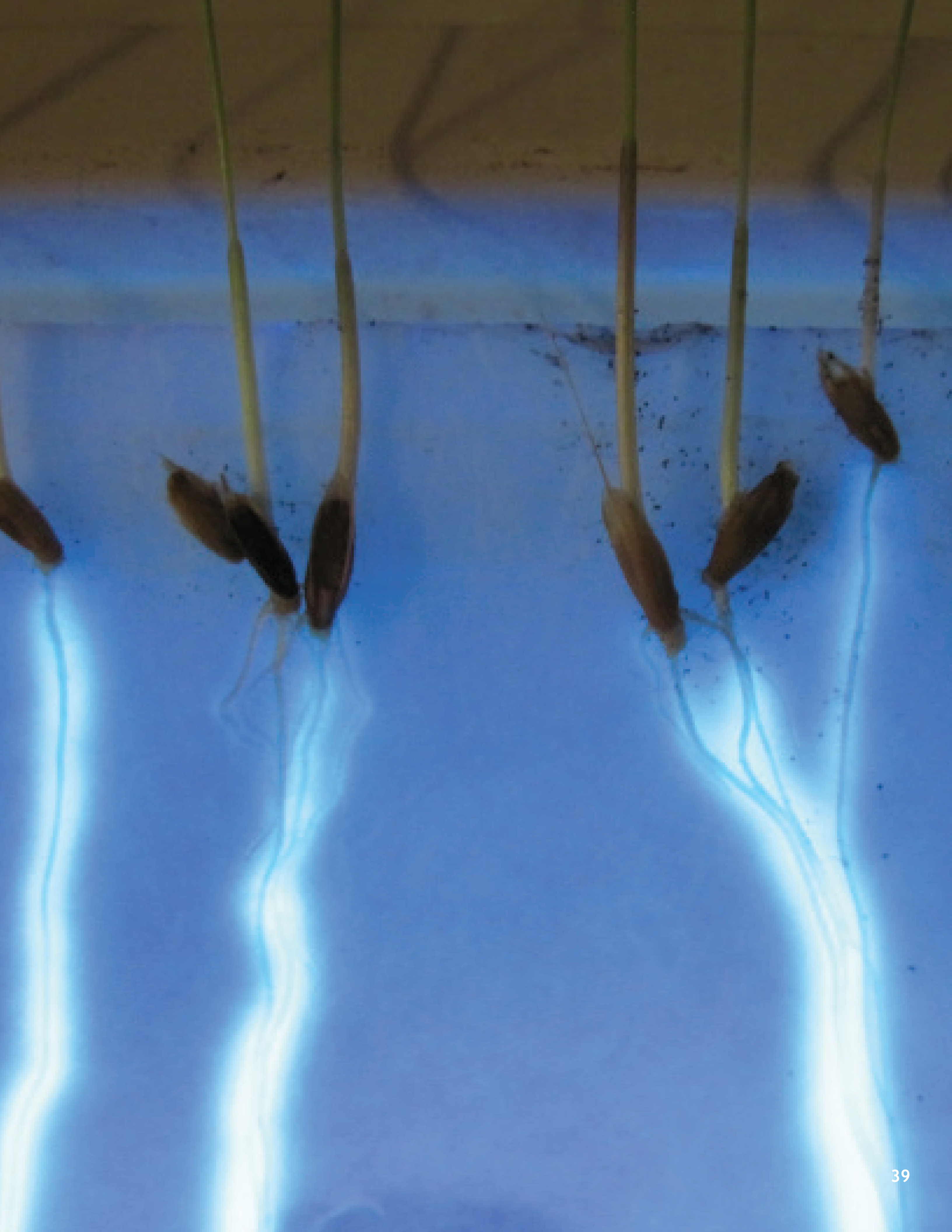


ADVANCING AGRICULTURAL SUSTAINABILITY AND ENVIRONMENTAL REMEDIATION THROUGH NANOTECHNOLOGY AND THE MITIGATION OF EMERGING CONTAMINANTS

This research focuses on applying nanotechnology to enhance agricultural sustainability and address environmental challenges. We investigate the use of nano-agrichemicals to improve crop yield and mitigate biotic or abiotic stress (such as drought, salinity, or light). We also develop sustainable nanoencapsulations to reduce reliance on conventional pesticides, herbicides, and antibiotics, providing eco-friendly alternatives for combating bacterial, viral, and fungal diseases. In addition, we apply nanotechnology to mitigate contaminants of emerging concern, such as per and polyfluoroalkyl substances (PFAS). Our work includes using nanomaterials to enhance PFAS phytoremediation and employing biochar to sequester PFAS in soil, preventing plants for taking up the contaminants. We also explore the role of nanoplastics as carriers of heavy metals and other contaminants, evaluating their potential impact on crop health, and potential human exposure through the consumption of contaminated crops. We are also profiling wastewater under variable weather conditions to understand risks and assess its suitability for the irrigation of crops. We employ advanced techniques like electron microscopy (EM) and inductively coupled plasma (ICP), among others, to study the materials and the effects of these treatments on plant nutrition and health.



Dr. Nubia Zuverza
Dr. Alvaro García
Dr. Anuja Bharadwaj
Dr. Carlos Tamez
Dr. Chris Dimkpa
Mr. Craig Musante
Ms. Jasmine Jones
Dr. Jason White
Dr. Jingyi Zhou
Mr. John Ranciato
Dr. Mandeep Kaur
Ms. Meghan Cahill
Mr. Michael Ammirata
Dr. Milica Pavlicevic
Dr. Raja Muthuramalingam
Dr. Sara Nason
Ms. Terri Arsenault
Dr. Paul Aikpokpodion



Public Health

INTRODUCTION

Mosquito-transmitted diseases, such as West Nile virus (WNV) and eastern equine encephalitis (EEE), and tick-borne diseases, such as Lyme disease, babesiosis, granulocytic anaplasmosis, a new relapsing fever Borrelia, and Powassan virus encephalitis, are significant public health concerns in Connecticut. A resurgence of bed bug activity, although they are not known to transmit any human pathogens, and indoor toxic mold are other public health issues. Public health research on human and animal disease vectors and the pathogens they carry has a long tradition at CAES. Research on mosquitoes and mosquito-borne diseases began back in 1903 and that on ticks in the 1970s. The Station's disease vector research, surveillance, and testing programs within the Departments of Entomology, Forestry and Horticulture, and Environmental Sciences are coordinated through the Center for Vector Biology and Zoonotic Diseases. Past accomplishments include the first isolation of the Lyme disease bacteria from wildlife, development of some of the first Lyme disease laboratory diagnostic tests, the first isolation of West Nile virus from mosquitoes in North America, and the discovery of exotic invasive mosquitoes and new mosquito-borne viruses in the state. Our multifaceted program currently focuses on the biology, behavior, and ecology of mosquito and tick vectors and their hosts; studies on WNV, EEE, Lyme disease, babesiosis, and Powassan virus; the statewide mosquito arbovirus surveillance program; studies on bed bug behavior, monitoring and control; tick pathogen testing; and tick control and management. Public outreach and education is another major component of the public health program. Three major educational publications include (1) Tick Management Handbook: An Integrated Guide for Homeowners, Pest Control Operators, and Public Health Officials for the Prevention of Tick-Associated Disease, (2) Identification Guide to Mosquitoes of Connecticut, and (3) History of Public Health Entomology at The Connecticut Agricultural Experiment Station.

INTEGRATED TICK MANAGEMENT AND TICK CONTROL

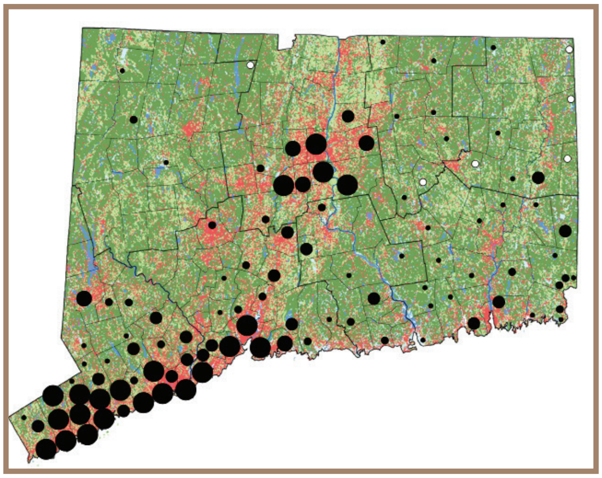
Lyme disease is the major vector-borne disease in Connecticut and the United States. Our research examines the biological, cultural, and integrated control of the blacklegged tick, Ixodes scapularis, to reduce the risk of Lyme disease and other tick-borne illnesses including human granulocytic anaplasmosis, babesiosis, and Powassan virus. Research includes the evaluation of least-toxic pesticides for tick control, biological control, and landscape

modifications. More recent efforts include researching impacts to ticks and beneficial insects of late fall spray application of acaricides (when most insects are dormant) in comparison to the more traditional spring application when multiple species and stages of native insect are active and targeted incidentally. Additionally, host-targeted acaricide treatment of white-footed mice, the main reservoir host for numerous tick-borne pathogens and white-tailed deer, the major blacklegged tick reproductive host, are being investigated. We are currently collaborating with numerous governmental and private partners across the United States, all working toward improving public health through environmentally-friendly tick management strategies.

Dr. Scott Williams
Dr. Megan Linske
Dr. Jessica Brown
Heidi Stuber
Natalie Bailey

MOSQUITO AND ARBOVIRUS SURVEILLANCE

Mosquito-borne viral diseases constitute an annual threat to human health in Connecticut. A comprehensive surveillance program complemented by science-based

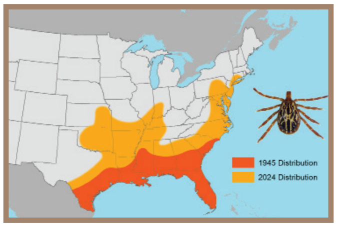


controls and timely public outreach are the most effective ways of protecting the public and reducing the risk of human disease. Our group monitors eastern equine encephalitis (EEE) and West Nile virus activity each year by trapping and testing mosquitoes statewide. Mosquitoes are collected at 108 locations from June-October, sorted into pools by species, and then tested for viral infection by cell culture and molecular assays. This information is used to assess environmental risk of human infection and guide mosquito control and other disease prevention efforts as needed. Although virus activity varies annually, some regional trends have emerged that can help focus the public health response. West Nile virus is most frequently detected in densely-populated areas of Fairfield, Hartford, and New Haven counties. Seasonal transmission of EEE virus occurs sporadically and the focal areas are located primarily in southeastern Connecticut.

Dr. Philip Armstrong
Mr. John Shepard
Ms. Angela Bransfield
Mr. Michael Misencik
Ms. Tanya Petruff

TICK AND TICK-BORNE PATHOGEN SURVEILLANCE

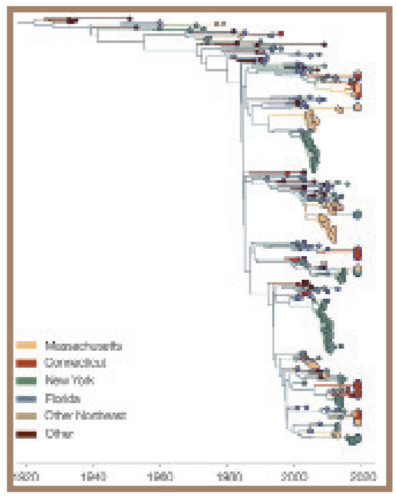
Tick and tick-borne diseases continue to pose a major health concern for Connecticut residents. In recent years, populations of native and invasive ticks have progressively increased. In response, the CAES has established active and passive tick surveillance programs. These programs provide information on the abundance, distribution, and infection of tick vectors to assess the risk of human infection and track the range expansion of exotic and invasive tick species and their associated pathogens in the state. Active surveillance was established in 2019 and monitors tick distribution and abundance and the prevalence of emerging tick-borne pathogens of human concern at 40 sites throughout the state from April through October. Passive surveillance screens ticks submitted by residents for pathogen testing to monitor the distribution and spread of both native and invasive species and develop mathematical and statistical models to better predict the presence, abundance, and range expansion of ticks and their associated pathogens. This program currently tests blacklegged ticks for five prevalent pathogens, including Lyme disease.



Dr. Goudarz Molaei
Dr. Megan Linske
Dr. Douglas Brackney
Ms. Noelle Khalil
Mr. Duncan Cozens
Ms. Jamie Cantoni

MOLECULAR EVOLUTION OF MOSQUITO AND TICK-BORNE VIRUSES

Mosquito and tick-borne viruses, like other RNA viruses, have high mutation rates that allow them to rapidly diversify, acquire new biological properties, and adapt to new environments. Our group is interested in following viral genetic changes in West Nile virus and other viruses over time. We have analyzed numerous viruses in Connecticut and elsewhere to track the origin, spread, and long-term persistence and evolution of strains involved in disease outbreaks. We found that eastern equine encephalitis (EEE) virus strains overwinter in the northeastern US for up to 5 years before disappearing.



Northeastern populations of EEE virus also share recent common ancestry with strains circulating in Florida suggesting long-range viral dispersal among these locations. Our group has also described the patterns of viral lineage turnover and protein evolution for West Nile virus strains circulating in Connecticut since its introduction in 1999. Finally, phylogeographic reconstructions of Powassan virus found that viral sequences strongly clustered by sampling location, suggesting a highly focal geographical distribution of this virus with limited dispersal.

Dr. Philip Armstrong
Dr. Doug Brackney
Ms. Angela Bransfield
Mr. Michael MisencikMs. Angela Bransfield
Mr. Michael Misencik

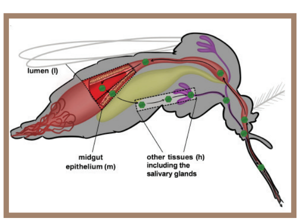
VECTOR-HOST INTERACTIONS AND TRANSMISSION OF MOSQUITO-BORNE PATHOGENS

During the last few decades, we have witnessed the emergence of West Nile virus (WNV), and eastern equine encephalitis virus (EEEV) activity with considerable impact on public health and economy in the U.S. As a main component of our research, we are investigating vector- host interactions and blood-feeding behavior of mosquitoes to assess: 1) the role of mosquitoes in transmission of WNV and EEEV to humans, and 2) the contribution of individual vertebrates as the source of blood meals for mosquitoes and reservoir hosts in maintenance and amplification of these viruses. We are also examining population genetic structure and underlying mechanisms for spatial and temporal variations in blood-feeding behavior of mosquitoes. These studies will identify factors that potentiate the risk of human infections in various localities, prove vital in better understanding of the ecology of virus transmission, and enable mosquito control agencies to more precisely target interventions at the most important mosquito populations.

Dr. Goudarz Molaei
Dr. Andrea Gloria Soria
Ms. Noelle Khalils

VECTOR-VIRUS INTERACTIONS

The emergent epidemics of dengue, chikungunya, Zika, and West Nile virus in the Western Hemisphere highlight the public health burden and continued threat of many arboviruses.

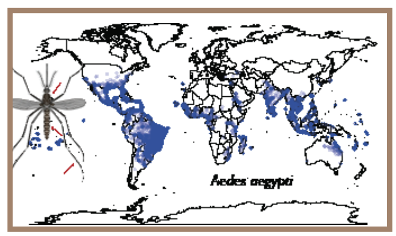


It is therefore critical to develop novel approaches to block arbovirus transmission by elucidating the mechanisms underlying virus-vector interactions. The projects in our laboratory are focused on understanding the cellular and molecular mechanisms mediating virus-vector interactions. The three principal areas of research include 1) elucidating key mosquito and viral factors responsible for mediating the early events of virus infection of mosquitoes, 2) examining how multiple feeding events enhance virus dissemination in mosquitoes, and 3) systematically examine the role of the microbiome in mosquito biology and arbovirus infection.

Dr. Douglas Brackney
Dr. Godfrey Nattoh
Dr. Rebecca Johnson
Mr. Duncan Cozens

POPULATION GENETICS OF MOSQUITO VECTORS OF DISEASE

Mosquitoes transmit numerous viruses that cause human diseases. Historically, most mosquito-borne diseases were tropical and subtropical, but globalization and climate change is driving them northward, putting more people at risk. We study mosquito genomes to understand how populations change in space and time, and identify markers associated with disease risk. This can inform vector control strategies, guiding selection of effective insecticides and evaluating the efficacy of treatments. *Aedes albopictus* and *Ae. aegypti* are invasive mosquitos with high affinity to bite humans. *Ae. albopictus*, first detected in CT in 2003 and spreading, can vector viruses and filariasis, and successfully overwinters here. We are studying the ability of local populations to transmit pathogens and the mechanisms of range expansion. *Ae. aegypti* is a tropical and subtropical species, is the main vector of dengue, chikungunya, and Zika viruses, and is spreading north. Using genetic fingerprints and a global reference panel, we track mosquito introductions to their origin to prevent further spread.

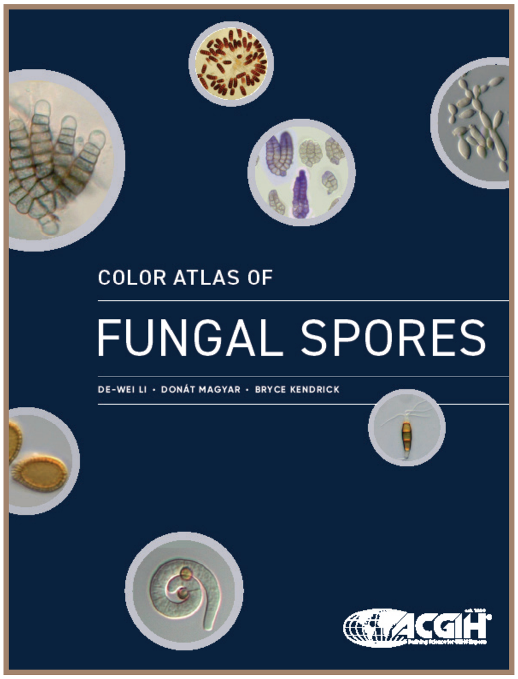


Andrea Gloria-Soria, Ph.D.

CONTROLLING TOXIGENIC INDOOR MOLDS

Molds develop indoors following water damage and dampness. Exposure to certain molds can trigger allergies, cause infection, or aggravate existing medical conditions. Some common molds are allergens, such as species of *Cladosporium*, *Aspergillus*, *Penicillium*, and *Alternaria*. Others such as *Stachybotrys* are mycotoxin producers associated with mycotoxicosis and "sick building syndrome". Research is being conducted to determine the composition and concentrations of airborne molds in CT and to determine the incidence and distribution of *Stachybotrys* species and their phylogenetic relationships. Airborne fungal spores indoors and outdoors are studied. This research will provide a baseline fungal exposure and composition level for public health officials, medical-care providers, and other professionals. The identification of mold species has assisted medical professionals in the diagnosis and evaluation of mold related health risks. Several new fungal species have been described from indoor environments. The study has led to a book "Color Atlas of Fungal Spores: A laboratory identification guide".

Dr. DeWei Li



BED BUGS AND DELUSIONAL INFESTATION

Common bed bug, *Cimex lecturlarius L.* infestations continue to be nationally active. Social and cultural stigma along with poor management have exacerbated this. Integrated pest management (IPM) of the insect has evolved and when performed correctly, is effective. Insecticide resistance remains a problem, so approaches have been developed such as public education, preemptive inspection, silica aerogel treatment, and fungal pathogenesis, to provide more long-term protection. Research continues at the station in fungal pathogenesis, bed bug biology and behavior, and development of bed bug resistant furniture. Delusional Infestation (DI) is a medical condition where a person believes they are infested. Through work at the station, DI has risen from obscurity to medical significance with the understanding it is a common complex underdiagnosed condition that requires both psychiatric and somatic care. Part of this work was the publication of "The Physician's Guide to Delusional Infestation" which defines the condition and guides physicians through differential diagnosis and treatment.

Dr. Gale Ridge

Public Service

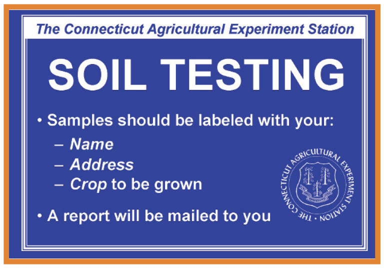
INTRODUCTION

With the mission and motto of The Connecticut Agricultural Experiment Station in mind, staff are continually "Putting Science to Work for Society" with a broad spectrum of service and outreach efforts to educate and assist the public. These activities complement our basic and applied research programs and provide information on topics ranging from plant diseases to ticks to all Connecticut stakeholders. Beginning in 1875, scientists at CAES tested fertilizer for label compliance. This was the cornerstone for many of the service activities that continue to this day. CAES scientists test soil for fertility; ticks for the presence of tick-borne human and animal pathogens; seeds for compliance with federal seed law and truth in labeling; feed and fertilizers for compliance with state and national standards; and pesticides and PCBs in the environment. Other service activities include efforts to safeguard Connecticut's agriculture and forests through nursery, plant and apiary inspections, through assistance with plant health questions by employing traditional and molecular approaches to detect difficult-to-diagnose plant diseases and new or emerging pathogens, and assistance with insect questions.

CAES scientists are on the frontlines providing information to residents, with outreach efforts by educating the public during visits to the Station, by talks at meetings, by hosting workshops, by answering phone calls and emails, and by writing fact sheets, alerts, and bulletins for distribution to the public and for posting on the website.

SOIL TESTING

Plant health is governed to a large extent by soil fertility. Soil tests provide an intelligent guide to the use of fertilizers and other soil amendments. Testing soil for fertility and suggesting methods for growing better plants are a continuing service of CAES for the citizens of Connecticut. Over the last three years, at laboratories in New Haven and Windsor, an average of 11,312 soil samples have been tested from farms, lawns, home gardens, nurseries, golf courses and commercial grounds. The tests determine levels of nitrogen, phosphorus, potassium, calcium, and magnesium. These are the nutrients most likely to be deficient in Connecticut soils.

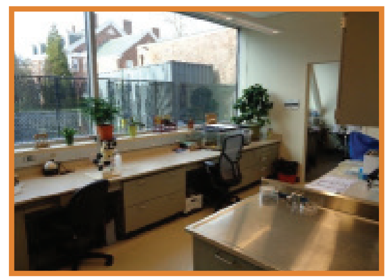


Other tests performed are pH, organic matter, soil texture and soluble salts. In addition to improving plant growth and crop yields, CAES soil tests also help reduce the pollution of groundwater, lakes and Long Island Sound by preventing the overuse of fertilizer. Two thousand seven hundred and twenty-seven soil-related inquiries have also been fielded on average in the last three years by soil testing staff and dozens of onsite visits and talks are given.

Mr. Gregory Bugbee (2000)
Ms. Jennifer Fanzutti
Ms. Diane Riddle (727)
Mr. Thomas Rathier

INSECT INQUIRY OFFICES (IIO)

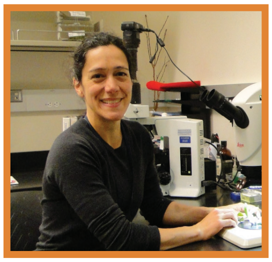
The report of The Connecticut Agricultural Experiment Station published in 1877 announced that it was offering to "identify useful or injurious insects… to give useful information on the various subjects of Agricultural Science for the use and advantage of the citizens of Connecticut". As of publishing, this service is 148 years old and over the years evolved to become an integral part of Connecticut life. The Insect Information Offices (IIOs) are located on the New Haven and Valley Laboratory, Windsor campuses. The New Haven IIO has a reception, climate-controlled collections room with over 300,000 highly valuable specimens, and diagnostic laboratory. Both offices handle thousands of inquiries per year and lead in public outreach with exhibits, numerous talks, and written information for stakeholders and the public. The offices are also integral in protecting Connecticut against exotic pests through swift identification and expertise. Both offices directly serve private citizens, pest management professionals, the real estate industry, the nursery industry, land care businesses, arborists, fruit and vegetable growers, health departments, other medical professionals, charities, manufacturing, the hospitality industry, schools, colleges, and universities, housing authorities, museums, municipalities, libraries, law enforcement, native American tribes, state government, and the media.



Dr. Gale Ridge
Ms. Rose Hiskes
Ms. Katerine Dugas

PLANT DISEASE INFORMATION OFFICES (PDIO)

Plant diseases represent ongoing threats to plants in Connecticut landscapes, farms, nurseries, natural woodlots, and forests. The Plant Disease Information Offices (PDIO) at New Haven and Windsor campuses identify plant health problems using traditional, serological, and molecular techniques for all Connecticut residents and conduct plant disease surveys in the state. Both offices handle thousands of inquiries about plant health problems each year. Accurate disease diagnoses and annual plant disease surveys ensure early detection, prevention, and eradication of potentially high risk pathogens. A timely diagnosis also lead to effective implementation of integrated strategies for disease management, which protect plants from epidemic diseases and reduce the amount of pesticides introduced into the environment and waters of Connecticut. The PDIO is a member of the National Plant Diagnostic Network, which was created to enhance agricultural security through protecting health and productivity of plants in agricultural and natural ecosystems in the United States. The state and national plant disease databases maintained by PDIO help to monitor recurring and emerging problems that threaten plants in Connecticut and increase state and nationwide communications between government agencies, professionals, and growers. The PDIO uses these data along with fact sheets, outreach programs, and disease monitoring to educate and assist growers, plant professionals, and homeowners. Citizens use the disease information to develop integrated pest management programs which reduce costs, prevent unnecessary chemical applications, and avoid potential environmental and public health issues. As the official seed testing laboratory for the state of Connecticut, PDIO works closely with the Connecticut Department of Agriculture on seed germination and purity analyses.



The PDIO tests over 300 seed samples a year using protocols of the Association of Official Seed Analysts to ensure that citizens are being offered viable and uncontaminated seeds.

Dr. Yonghao Li
Ms. Felicia Millett
Ms. Rose Hiskes

TICK TESTING LABORATORY

Ticks and tick-borne diseases continue to pose a major health concern for Connecticut residents. In recent years, populations of native ticks have progressively increased, and established populations of invasive tick species have been discovered in the state. As a result, many communities are at risk of exposure to tick-borne pathogens. Lyme disease is the most prevalent arthropod-associated disease in the United States and Connecticut is among the 14 states from which 95% of all cases are reported. Similarly, a number of other important tick-borne disease cases, including anaplasmosis and babesiosis, has steadily increased. The CAES Tick Testing Laboratory examines ticks submitted by health departments, healthcare providers, and state residents and tests for evidence of infection with five prevalent pathogens using molecular techniques. The tick testing service includes identification of the tick species, life stage, blood engorgement status, DNA extraction, and PCR using diagnostic genes for identification of the pathogens that ticks carry. In 2024, a total of 4,222 ticks were received for identification, and 3,293 were tested for evidence of infection with the five pathogens. Of these, 901 (27.4%), 160 (4.9%), 343 (10.4%), 70 (2.1%), and 13 (0.4%) tested positive for pathogens responsible for Lyme disease, anaplasmosis, babesiosis, hard tick relapsing fever, and Powassan virus, respectively

Dr. Goudarz Molaei
Ms. Noelle Khalil

OUTREACH

Whether the concerns are focused on agriculture, environment, public health, or food safety, CAES scientists are on the frontlines providing information to Connecticut residents. Our goal is to educate and inform individuals, communities, and businesses on topics of interest and concern, utilizing the knowledge obtained through basic and applied research programs at the Station. Our premiere outreach event is Plant Science Day, an annual event held at the Station's Lockwood Farm on the first Wednesday of August every year, beginning in 1910. This one-day event features reports on research, field plots, barn exhibits, tours, and other opportunities for Connecticut residents and attendees to discuss many topics of plant science on an informal basis and interact with CAES scientists and staff. Many other types of outreach activities occur throughout the year, including workshops, lectures, town meetings, displays, and tours of research laboratories and research plots. Scientists also write fact sheets, maintain web-based information and weather records, mentor students, judge science fairs, and participate in numerous agricultural fairs throughout the state.

Selected Awards from Community Partners 2016-2025

Outstanding Contribution Award, National Aquatic Plant Management Society
Greg Bugbee

Award of Merit, CT Pomological Society
Richard Cowles

Bronze Medal, Federated Garden Clubs of Connecticut
Joseph Pignatello

Award of Merit, CT Tree Protective Association
Richard Cowles

John Pearce Memorial Award, The Wildlife Society
Scott Williams

Outstanding Environmental Project Award, CT River Coastal Conservation District
Summer Stebbins

Jeffrey L. Bruce Award of Excellence in Research, Green Roofs for Healthy Cities
Leigh Whittinghill

Special Recognition Award, Northeast Aquatic Plant Management Society
Summer Stebbins

Early Career Achievement Award, The Watershed Fund
Riley Doherty

Partner Award, The American Chestnut Foundation
CAES and Lockwood Farm

Distinguished Service Award, Horticultural Inspection Society
Steven Sandrey (2016)

Fellow, American Phytopathological Society
Wade Elmer (2017)

Stephen D. Ebbs Award for distinguished service,
International Phytotechnologies Conference
Jason White (2017)

Face of the Future in Virology, American Phytopathological Society
Washington da Silva (2020)

Selected Awards from Community Partners 2016-2025 (cont.)

FDA Group Recognition Award, FDA
Jason White (2020)

Lifetime Reviewer Award, Environmental Science and Technology
Jason White (2020)

Member, Connecticut Academy of Science and Engineering
Jason White (2021)

Deputy Administrator's Safeguarding Award, APHIS
Victoria Smith (2021)

New Innovator in Food and Agriculture Research Award,
Foundation for Food and Agriculture Research
Itamar Shabtai (2023)

Best Paper of the year, Environmental Science and Technology
Zhengyang Wang and Joe Pignatello (2023)

Extraordinary Service Award, American Society of Microbiology
Blaire Steven (2023)

New Innovator in Food and Agriculture Research Award,
Foundation for Food and Agriculture Research
Raquel Rocha (2024)

Outstanding National Plant Board Committee Award, National Plant Board
Victoria Smith (2024)

Distinguished Service Award, Horticultural Inspection Society
Victoria Smith (2024)

Distinguished Service Award, Horticultural Inspection Society
Tia Blevins (2025)

Outstanding Forester Award, Society of American Foresters
Jeff Ward David M. Smith (2022-2023)

Award of Merit, American Phytopathological Society Northeastern Division
Sharon Douglas (2017) Wade Elmer (2020) James Lamondia (2022), and Robert Marra (2023)

Fellow, Society of American Foresters
Jeff Ward (2024)

Community Partner Organizations Awards

Outstanding Contribution Award, National Aquatic,
National Aquatic Plant Management Society
Greg Bugbee (2016)

Award of Merit, CT Pomological Society, also CT Tree Protective association (2018)
Richard Cowles (2016)

Bronze Medal, Federated Garden Clubs of Connecticut
Joe Pignatello (2017)

John Pearce Memorial Award, The Wildlife Society
Scott Williams (2018)

Outstanding Environmental Project Award,
Connecticut River Coastal Conservation District
Summer Stebbins (2020)

Jeffrey L. Bruce Award of Excellence in Research, Green Roofs for Healthy Cities
Leigh Whittinghill (2024)

Special Recognition Award, Northeast Aquatic Plant Management Society
Summer Stebbins (2024)

Early Career Achievement Award, The Watershed Fund
Riley Doherty (2024)

Partner Award, American Chestnut Foundation
Lockwood Farm (2024)

Selected Professional Recognition 2016-2025

Distinguished Service Award, Horticultural Inspection Society
Steven Sandrey (2016), Victoria Smith (2023), and Tia Blevins (2024)

Fellow, American Phytopathological Society
Wade Elmer

Steven D. Ebbs Award for Distinguished Service,
International Phytotechnologies Conference
Jason White

Face of the Future in Plant Virology, American Phytopathological Society
Washington Da Silva

New Innovator Award, Foundation for Food and Agricultural Research
Itamar Shabtai (2023), Raquel Rocha (2024)

Extraordinary Service Award, American Society for Microbiology
Blaire Steven

Award of Merit, American Phytopathological Society Northeastern Division
Sharon Douglas (2017), Wade Elmer (2020), James Lamondia (2022), and Robert Marra (2023)

Member, Connecticut Academy of Science and Engineering
Jason White

David M. Smith Outstanding Forester Award (2022); Fellow (2024),
Society of American Foresters
Jeffrey Ward

STATION PERSONNEL

Director's Office

Jason White, Ph.D.
(Cornell University)
Director

Natalie Rivera
Secretary to the Director

Department of Analytical Chemistry

Christian Dimkpa, Ph.D.
(University of Jena and Max Planck Institute for Chemical Ecology, Germany)
Chief Scientist & Department Head

Paul Aikpokpodion, Ph.D.
(Federal University of Technology, Akure, Nigeria)
Post-Doctoral Scientist

Michael Ammirata, B.S.
(Western Connecticut State University)
Technician I

Terri Arsenault, M.S.
(University of Vermont)
Assistant Scientist I

Hina Ashraf, Ph.D.
(University of the Punjab, Pakistan)
Post-Doctoral Scientist

Anuja Bharadwaj, Ph.D.
(Indian Institute of Technology, New Delhi)
Assistant Scientist II

Meghan Cahill, B.S.
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Analytical Chemistry

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MISSION STATEMENT

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,” a motto as relevant today as it was at our founding in 1875.

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