THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

Record of the Year

2021-2022

The Connecticut Agricultural Experiment Station, founded in 1875, was the first state agricultural experiment station in the United States. The Station has laboratories, offices, and greenhouses at 123 Huntington Street, New Haven 06511, Lockwood Farm for experiments on Evergreen Avenue in Hamden 06518, the Valley Laboratory and farm on Cook Hill Road, Windsor 06095, and a research center in Griswold and Voluntown. Station Research is conducted by members of the following departments: Analytical Chemistry, Entomology, Environmental Science and Forestry, Plant Pathology and Ecology, and the Valley Laboratory. The Station is chartered by the Connecticut General Statutes to experiment with plants and their pests, insects, soil and water and to perform analyses.

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BOARD OF CONTROL

The management of The Station is vested in a Board of Control as specified in section 22-79 of the General Statutes of Connecticut.

The members of the Board of Control as of June 30, 2022 were:

Governor Ned Lamont, President
Terry Jones, Vice President
Dr. Michael P. O'Neill, Secretary
Dr. Jason C. White, Director
Commissioner Bryan Hurlburt
Dr. Erol Fikrig
Ms. Joan Nichols
Dr. Frederick Cohan

The Board of Control met on August 4, 2021, October 13, 2021, January 18, 2022, and April 20, 2022.

STATION STAFF

The Experiment Station exists to advance scientific knowledge, and that advance depends completely upon the quality and dedication of its staff. The following was the staff of The Connecticut Agricultural Experiment Station as of June 30, 2022.

ADMINISTRATION
Dr. Jason C. White, Director
Dr. Lindsay R. Triplett, Vice Director
Michael P. Last, Chief Financial Officer
Dianne F. Albertini
Vickie M. Bomba-Lewandoski
Sandra E. Carney
Calanthe J. Cavadini
Lisa L. Kaczenski
Jennifer L. Stevens

ANALYTICAL CHEMISTRY
Dr. Christian O. Dimkpa, Department Head
Michael A. Ammirata
Terri Arsenault
Dr. Anuja Bharadwaj
Meghan S. Cahill
Dr. Chaoyi Deng
Dr. Brian D. Eitzer, Emeritus
Dr. Walter J. Krol, Emeritus
Dr. MaryJane Incorvia Mattina, Emeritus
Craig Musante
Kitty Prapayotin-Riveros
John F. Ranciato
Dr. Christina S. Robb
Dr. Carlos Tamez
Dr. Shital Vaidya
Dr. Yi Wang
Dr. Nubia Zuverza-Mena

ENTOMOLOGY
Dr. Goudarz Molaei, Department Head
Dr. John F. Anderson, Emeritus
Dr. Theodore G. Andreadis, Emeritus
Dr. Philip M. Armstrong
Tia M. Blevins
Dr. Douglas E. Brackney
Angela B. Bransfield
Jamie L. Cantoni
Duncan W. Cozens
Dana E. Crandall
Mark H. Creighton
Katherine D. Dugas
Jeffrey M. Fengler
Dr. Zannatul Ferdous
Dr. Andrea Gloria-Soria
Dr. Rebecca Johnson
Noelle Khalil

Dr. Megan A. Linske
Gerda Magana
Dr. Chris T. Maier, Emeritus
Michael J. Misencik
Dr. Sara L. Nason
Tanya A. Petruff
Dr. Gale E. Ridge
Dr. Claire E. Rutledge
John J. Shepard
Dr. Victoria L. Smith
Dr. Kirby C. Stafford III, Emeritus
Dr. Kimberly A. Stoner, Emeritus
Heidi R. Stuber
Tracy A. Zarrillo

ENVIRONMENTAL SCIENCE AND FORESTRY*
*The Department of Environmental Sciences and the Department of Forestry and Horticulture merged in June 2022.
Dr. Scott C. Williams, Department Head
Dr. Wael Abdelraheem
Joseph P. Barsky
Gregory J. Bugbee
Dr. Zhihao Chen
Dr. Martin P. N. Gent, Emeritus
Dr. Susanna Keriö
Jacquelyn LaReau
Dr. Abigail A. Maynard, Emeritus
Dr. Joseph J. Pignatello, Emeritus
Dr. Brij L. Sawhney, Emeritus
Dr. Itamar Shabtai
Summer Stebbins
Dr. Blaire T. Steven
Dr. Charles R. Vossbrinck, Emeritus
Dr. Paul E. Waggoner, Emeritus
Dr. Zhengyang Wang
Dr. Jeffrey S. Ward, Emeritus
Dr. Leigh J. Whittinghill

GRISWOLD RESEARCH CENTER
Robert J. Durgy, Research Farm Manager

LOCKWOOD FARM
Richard Cecarelli, Research Farm Manager
Rollin J. Hannan

MAINTENANCE
Brian Hart
Ronald A. LaFrazier
Miguel Roman
Michael A. Scott

PLANT PATHOLOGY AND ECOLOGY
Dr. Lindsay R. Triplett, Vice Director, Department Head
Dr. Sandra L. Anagnostakis, Emeritus

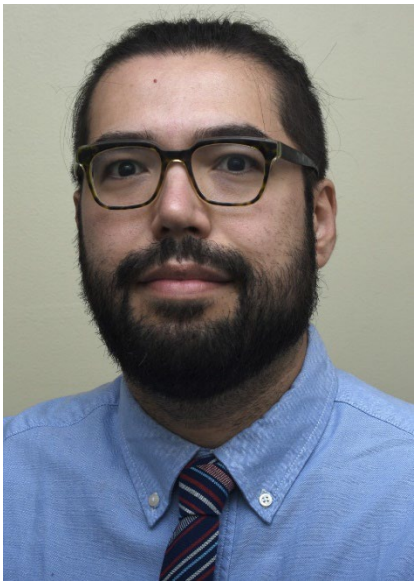
Dr. Donald E. Aylor, Emeritus
Dr. Washington L. da Silva
Dr. Sharon M. Douglas, Emeritus
Dr. Wade H. Elmer, Emeritus
Dr. Francis J. Ferrandino, Emeritus
Dr. Mohamed-Amine Hassani
Rose T. Hiskes
Regan B. Huntley
Dr. Yonghao Li
Dr. Robert E. Marra
Dr. Neil A. McHale, Emeritus
Dr. Salma Mukhtar
Dr. Raja Muthuramalingam
Dr. Ravikumar R. Patel
Dr. Richard B. Peterson, Emeritus
Dr. Neil P. Schultes
Dr. Stephen J. Taerum
Dr. Israel Zelitch, Emeritus
Dr. Quan Zeng

VALLEY LABORATORY
Dr. DeWei Li, Department Head
Dr. Jatinder S. Aulakh
Dr. Carole A. Cheah
Dr. Richard S. Cowles
Jeffrey M. Fengler
Dr. James A. LaMondia, Emeritus
Ethan Paine
James J. Preste, Research Farm Manager
Thomas M. Rathier, Emeritus
Diane C. Riddle
Michelle R. Salvas

Dr. Anuja Bharadwaj

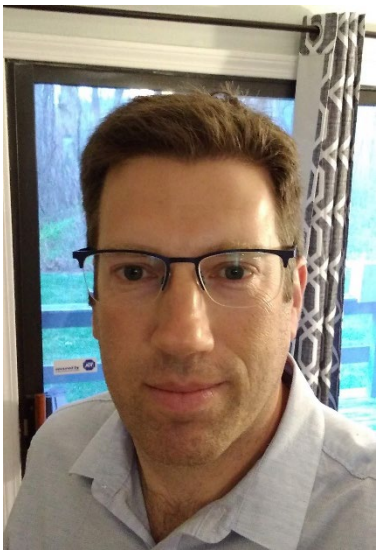
Dr. Anuja Bharadwaj joined The CAES as Assistant Agricultural Scientist II in the Department of Analytical Chemistry on November 19, 2021. Prior to joining The CAES, Anuja served as a Forensic Science Examiner at the State's Forensic Lab in Meiden, where she was responsible for analyzing biological samples submitted by law enforcement and the medical examiner's office, in addition to serving as an expert witness in courts of law. She studied in India and completed her Ph.D. at the Indian Institute of Delhi. At The CAES, her focus is developing and validating methods for analyzing medical and adult-use marijuana products.

Dr. Carlos Tamez



Dr. Carlos Tamez received his doctoral degree in Environmental Science and Engineering from the University of Texas at El Paso in 2019. He joined the Department of Analytical Chemistry at The Connecticut Agricultural Experiment Station on September 14, 2021. Currently, Carlos performs analyses for pesticides in raw agricultural commodities, aflatoxins in animals, and other environmental samples that may contain organic contaminates in his position as Assistant Agricultural Scientist II. Additionally, he assists in the department's research efforts in nano-based agriculture and the detection of PFAS in environmental matrices.

Dr. Itamar Shabtai



Dr. Itamar Shabtai assumed the position of Assistant Agricultural Scientist II on January 28, 2022 in what is now the Department of Environmental Science and Forestry. He came to the Station from Cornell University in Ithaca, New York, where he was a postdoctoral researcher and worked on abiotic mechanisms controlling soil organic matter persistence. Itamar's research interests include examining the role of plant root exudates in biogeochemical cycling in the soil-root interface known as the rhizosphere, and using calcium-based soil amendments to promote soil carbon sequestration. He obtained his Ph.D. in Soil and Water Sciences in 2018 from the Hebrew University of Jerusalem in Israel.

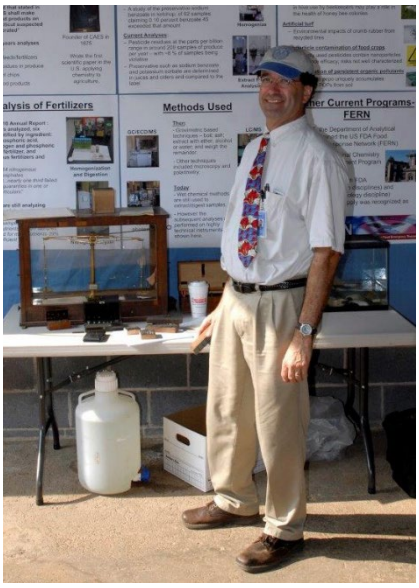
Dr. Leigh Whittinghill

Dr. Leigh Whittinghill started as an Assistant Agricultural Scientist II on October 8, 2021, in what is now the Department of Environmental Science and Forestry. She came to the Station from the School of Agriculture, Communities, and the Environment at Kentucky State University where she was Assistant Professor of Urban Agriculture. Leigh's research has focused on urban vegetable production. One of her areas of focus has been the use of green roof technology to produce vegetables and how that changes the environmental benefits of green roofs, in particular the impacts on runoff water quality. More recently she has also been investigating nutrient leaching in various ground level systems, including small plastic pool containers, raised, beds and on actual urban farms. She has worked on a variety of high value crops including greens and saffron, and is currently examining cut-and-come-again, or repeat harvesting, in greens. Leigh received her Ph.D. in Horticulture at Michigan State University in 2012 and did a Postdoctoral Fellowship at the Earth Institute at Columbia University from 2012-2014.

Dr. Abigail A. Maynard

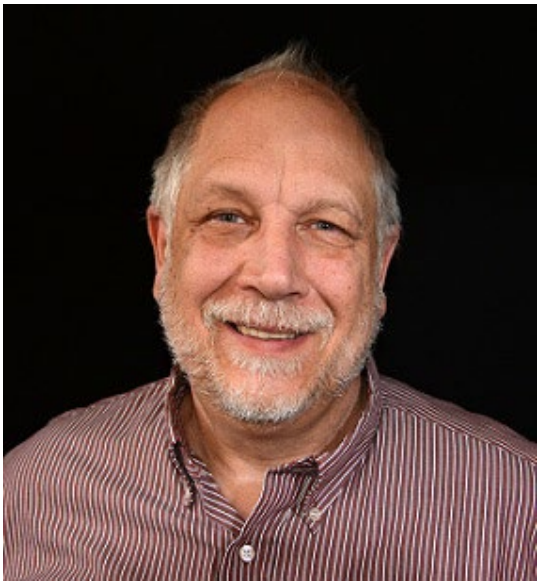
Dr. Abigail Maynard was first hired as a Summer Research Assistant from 1981–1988 in the Department of Forestry and Horticulture, after which time she was hired as a Research Aide I. She was then promoted to Assistant Scientist I, and shortly thereafter, upon the completion of her Ph.D. at Yale University, was promoted to Assistant Scientist II in 1989. In 2001 she was promoted to Associate Scientist and then became an Emeritus Scientist upon her retirement on August 1, 2021. Dr. Maynard is one of the few staff whose roots at the Experiment Station were planted as a seasonal employee and grew her career as a scientist at the Station over the years. During her 40 field seasons, Dr. Maynard logged numerous hours bent over in the summer sun at The CAES's Lockwood Farm in Hamden tending her plots which included the New Crops for Connecticut program as well as the impacts of the utilization of compost in the production of vegetables and nursery stock. Dr. Maynard is a wealth of knowledge for growers and the nursery industry, the Experiment Station and the Connecticut public are fortunate to still have her expertise available to them in her new role as Emeritus Scientist in the Department of Environmental Science and Forestry. Congratulations to Dr. Maynard on her retirement.

Dr. Brian D. Eitzer



Dr. Brian Eitzer retired from the Station after 32 years of service on September 1, 2021. During this time, he rose to the position of full Agricultural Scientist, and assumed the acting Head of the Department of Analytical Chemistry for a period of time in 2020. Over the years, Dr. Eitzer conducted research and public service on the detection and characterization of various types of toxins and other contaminants in food, water, and soil samples. In 2005, Brian became involved with the food emergency response network, where he quickly became a well-respected collaborator, traveling annually to national meetings as well as serving as the top analyst for the different samples involved in the program. While the analytical chemistry tools and methods have changed over the last 32 years, Brian's dedication, commitment to quality work, and willingness to perform all tasks relevant to his research and service remained steadfast. His ability to quickly familiarize himself with the changing landscape of analytical chemistry instrumentation in the last three decades indeed speaks to his great intelligence and adaptability. The department of Analytical Chemistry staff and management will miss Brian's dedication to duty. Thankfully, he was granted Emeritus status and will continue to professionally associate with the department. On the personal side, some of Brian's early colleagues in the department note that he enjoys fine dining, with lots of meat and beer samplers. The department is proud of the work that Brian conducted over the years and wishes him well in his well-deserved retirement.

Dr. Charles Vossbrinck

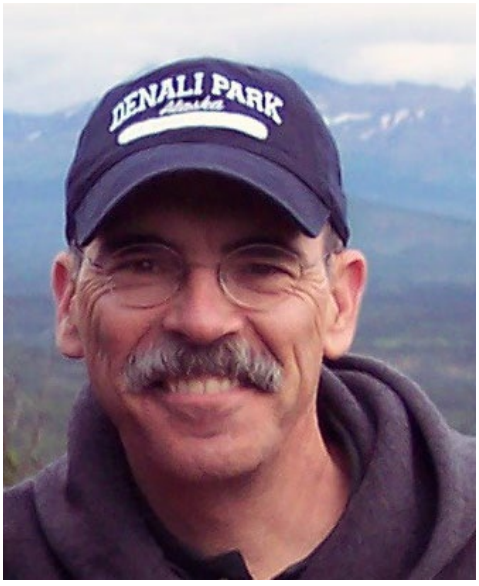


Dr. Charles Vossbrinck received his B.S. and M.S. from Colorado State University and his Ph.D. from the University of Illinois in 1987. He was hired as an Assistant Scientist II at the Experiment Station in 1996 with his research centering around molecular phylogeny of insects and their parasites, ultimately being promoted to Associate Scientist. His more recent research centers around molecular phylogenetic analysis of West Nile virus and microsporidia. Dr. Vossbrinck also has an interest in spiders and other soil dwelling arachnids. Recently Dr. Vossbrinck began a project growing fig trees in self-watering pots. He was growing six cultivars of figs (Neri, Melanzana, Osborne, Battaglia, Conadria, Verte) in 25-gallon self-watering pots both outside and in high tunnels. His research focuses on how best to overwinter potted figs during the inhospitable Connecticut dormant season. He retired on February 1, 2022. The Experiment Station congratulates Dr. Vossbrinck on his retirement from State service, and is pleased he will continue to serve the public of Connecticut as an Emeritus Scientist in the Department of Environmental Science and Forestry. Congratulations Dr. Vossbrinck.

Dr. Wade H. Elmer

Wade H. Elmer joined the Department of Plant Pathology and Ecology at The Connecticut Agricultural Experiment Station (CAES) in 1987 as an Assistant Scientist II. He became an Associate Scientist in 1992, Scientist in 2003, Chief Scientist and Head of PPE in 2015, and Vice Director of CAES in 2020. On March 1, 2022, he retired and was granted Emeritus Scientist status. During his career he researched the ecology and management of soilborne diseases of vegetables, small fruits, and ornamentals. He specialized in diseases caused by species of *Fusarium*. A major focus was using mineral nutrition (nanoparticles) to suppress *Fusarium* diseases. He authored/co-authored over 150 refereed manuscripts, 27 book chapters, and was the editor/co-editor of four textbooks.

Dr. James A. LaMondia



Dr. James LaMondia retired on March 31, 2022, after 36 years of service at CAES as a plant pathologist, nematologist, plant breeder, and Department Head of the Valley Laboratory. He conducted a wide variety of research projects resulting in significant impacts for growers. He bred a Fusarium wilt resistant broadleaf tobacco cultivar that saved Connecticut growers from $5 million in losses annually from 1991 until present, with over $150 million in economic impact. The release of his nematode resistant cultivar saved growers over $500 per acre and reduced environmental impacts of soil fumigation. His research solved economically important disease problems in ornamental, vegetable, small fruit and tobacco systems and resulted in 157 refereed publications, 9 book chapters, 42 Station publications, 31 technical/outreach publications and over 100 abstracts and conference proceedings. During his career he was awarded $2 million in competitive grants, $1 million in industry/commodity grants and $500,000 in tobacco breeding royalties. Service to the State included duties as the CAES ex-officio plant pathologist on the CT Tree Protection Examining Board since 1989, on the Connecticut Agricultural Information Council since 2006, conducting nematode diagnostics and answering an average of 1,000 grower and citizen inquiries per year throughout his career. Jim served the Society of Nematologists as a Senior Editor for 16 years and on the Executive Board for 5 years, becoming President of the Society in 2011. He served on the Executive Board of the Northeastern Division of the American Phytopathological Society, as President in 2009 and Northeastern Division Forum Representative and American Phytopathological Society Forum Chair. Jim was awarded the APS Northeast Division Award of Merit in 2022. Dr. LaMondia continues to serve Connecticut as an Emeritus Scientist.

Dr. Walter Krol

Dr. Walter Krol joined The Connecticut Agricultural Experiment Station (CAES) in the Department of Analytical Chemistry in November of 1998 as an Assistant Agricultural Scientist II. He served in this role until 2015 when he was promoted to Associate Agricultural Scientist. Dr. Krol retired from State service after more than 23 years of service on April 1, 2022. During his career as a research scientist, Dr. Krol provided extensive service to the public health of the citizens of Connecticut, through his work involving the chemical analysis of pesticides, poisons, and toxins in food and the environment. He was a founding participant in the U.S. Food and Drug Administration (FDA) Food Emergency Response Network (FERN), which was formed by Presidential Executive Order after the terrorist attacks of September 11, 2001 – and has the singular goal of protecting the nation's food supply. As part of the FERN, Dr. Krol played an important role during the 2010 Deepwater Horizon Oil Spill and worked to validate a QuEChERS based screening method for PAHs in seafood for which he was recognized by the Commissioner of the FDA. Dr. Krol is considered an expert in mass spectrometry in the field of science, and played a critical role in the Department of Analytical Chemistry being awarded ISO 17025 accreditation for its FDA food safety programs. He was involved in research in hemp cultivation and analysis as well as on the analysis of pesticides and natural products as part of novel nanotechnology-enabled food packaging.

Mr. Michael R. Short

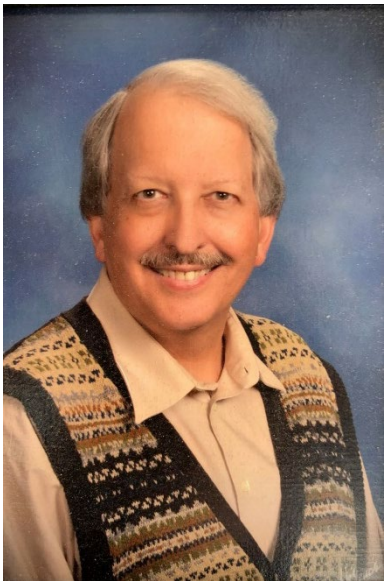
Michael R. Short joined the Department of Forestry and Horticulture at The Connecticut Agricultural Experiment Station in September of 1989 working under Dr. Martin Gent. Michael was charged with the daily operation of heated and unheated high tunnel greenhouses investigating the best practices for growing early season tomatoes and leafy greens. He was responsible for greenhouse maintenance, plant propagation, fruit harvest, measurements, and data collection. Upon Dr. Gent's retirement in 2009, Michael began working with Dr. Scott Williams largely in reducing agricultural wildlife damage and the ecology of ticks and tick-borne diseases. Michael was able to smoothly transition from agricultural greenhouse production to field work in the public health domain without a hitch. With Dr. Williams, as an Agricultural Technician II, Michael was responsible for plant surveys, maintaining field equipment and research plots, and was a valued team member in sampling ticks and small rodents to determine efficacy of integrated tick management practices. Michael's contributions to both the greenhouse industry and improving public health have greatly benefitted the Connecticut public. He retired on April 1, 2022.

Additionally, during his 33 years of service, Michael willingly assisted other scientists at the Station as needed in the fields of Forestry, Entomology, and Aquatic Invasive Plant Management. Michael's practical knowledge, work ethic, and affable cooperation with his supervising scientists throughout his career truly exemplifies the Experiment Station motto: "Putting Science to Work for Society." We honor Mr. Michael Short and his extensive contributions to the Experiment Station and the State of Connecticut on the occasion of his retirement.

Dr. Jeffrey S. Ward

Jeffrey S. Ward received his B.S. in forest biology, and M.S. in silviculture at The Ohio State University, and after service in the Peace Corps in Guatemala, he earned his Ph.D. in forest ecology at Purdue University. He was in the Department of Forestry and Horticulture at The Connecticut Agricultural Experiment Station from 1987 until his retirement as Chief Scientist on June 1, 2022. His research focused on long-term population dynamics in unmanaged forests, alternative forest management practices, control and impact of invasive species, impact of deer damage, and forest health indicators. He currently serves on the CT Forest Practices Advisory Board, CT Forest and Park Association Board of Directors, and as a Trustee of Great Mountain Forest. He has served as Chair and Forest Science Coordinator for New England SAF, Secretary of national SAF Silviculture Working Group, Chair of Yankee and CT SAF, president of the CT Tree Protective Association, and secretary of the CT Tree Protection Examination Board. He has served on the Governor's Council for Agricultural Development, CT Urban Forest Council, CT State Vegetation Management Task Force, CT Invasive Plant Council, CT Endangered Species Committee, and as a science advisor for Audubon CT. His awards include New England Society of American Foresters David M. Smith Silvicultural Award (2023), Connecticut Urban Forest Council Outstanding Urban Forestry Project (2016), Connecticut Urban Forest Council Fred Borman Outstanding Urban Forestry Professional (2015), Yankee Division Outstanding Forester (2009 and 2022), and New England Society of American Foresters Ernest M. Gould Technology Transfer Award (2004). Dr. Ward continues to serve the State as an Emeritus Scientist at the Station in what is now the Department of Environmental Science and Forestry.

Dr. Kirby C. Stafford III



Dr. Kirby C. Stafford III is the former Chief Scientist (Head) of the Department of Entomology and State Entomologist at The Connecticut Agricultural Experiment Station. He retired June 1, 2022, as an Emeritus Chief Scientist after nearly 35 years researching ticks, tick-borne diseases, and tick management strategies. He continues work on several projects and manuscripts part-time. Dr. Stafford has authored or co-authored 87 articles in peer-reviewed scientific journals, review chapters on tick management in two books, produced a Tick Management Handbook (CAES Bulletin 1010), served on regional and national tick-related committees, including the Congressionally chartered Tick-Borne Disease Working Group, and gave over 1,300 media interviews and public talks over his time at The CAES. Dr. Stafford obtained his Ph.D. in medical-veterinary entomology from Texas A&M University in 1985, a Master of Science degree in entomology at Kansas State University, and a Bachelor of Science degree in entomology at Colorado State University.

Dr. Kimberly A. Stoner

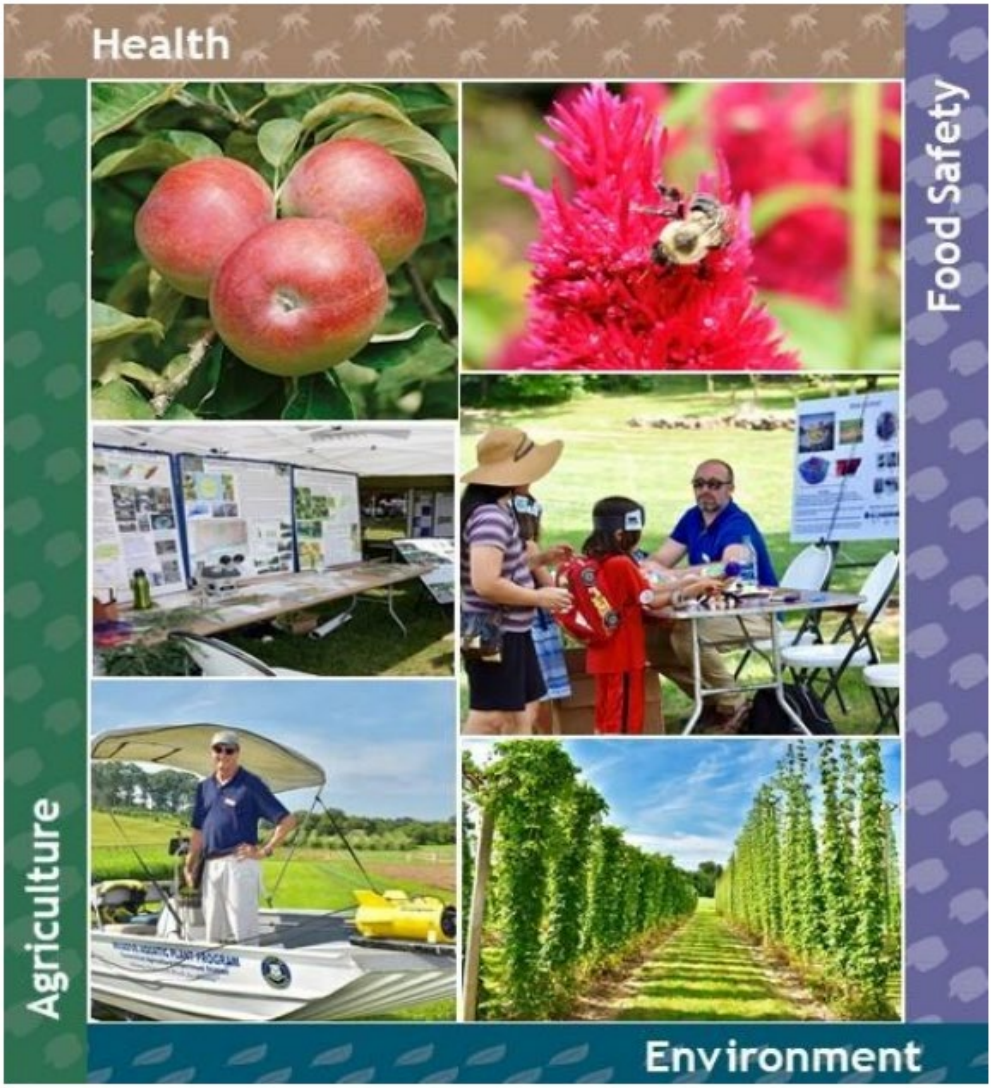
Dr. Kimberly A. Stoner joined The Connecticut Agricultural Experiment Station on October 19, 1987, as an Assistant Agricultural Scientist II to conduct field and laboratory research on insects that attack vegetable crops. Her early research focused on plant resistance to insects, the effects of cover crops and mulching techniques on pest management, and insect trapping devices for IPM programs. She worked closely with organic farmers, drawing from their practical experiences in a conference and book of proceedings, “Alternatives to Insecticides for Managing Vegetable Insects.” She was promoted to Associate Agricultural Scientist in 2001. Recognizing the emerging threats to bees and pollination, in 2007 she began a collaboration with the Department of Analytical Chemistry to study the routes of exposure of honey bees to pesticides, which continued through the rest of her career. Starting in 2012, she joined a regional project on pollination of fruit and vegetable crops, contributing detailed research on pollination and pesticide exposure of pollinators in pumpkin and squash fields across the state. Across her career, Dr. Stoner has worked closely with a diversity of stakeholders in research, education, and public policy. She served on the Board of Directors of the Northeast Organic Farmers Association of Connecticut (CT NOFA) for 20 years, and she initiated and chaired the NOFA Organic Land Care Program and led the effort to write the first organic standards for the landscape industry in the US. She consulted extensively with the Environment Committee of the Connecticut General Assembly on the Pollinator Health Act, which became law in 2016, and worked with the Department of Transportation on creating pollinator habitat along state highways as a result of that law. Dr. Stoner was promoted to Agricultural Scientist in 2019. She gave hundreds of talks on organic management of insect pests, pollinator protection, diversity, and habitat, and other subjects to growers, landscape professionals, garden clubs, land trusts, state and local conservation organizations, government officials, and high school students. One talk to the Fairfield Regional Conservation Partnership inspired the creation of the Pollinator Pathway Network, and she provided technical advice on pollinator habitat as that organization developed. She has been honored with awards from the CT Department of Environmental Protection, the Southwest Conservation District, CT NOFA, and the NOFA Organic Land Care Program. Dr. Stoner continues to serve the Station in her position as an Emeritus Scientist since her retirement on June 1, 2022 from the Department of Entomology. The Station is thankful to have her knowledge and experience.

Ms. Morgan F. Lowry

Morgan Lowry joined The Connecticut Agricultural Experiment Station in September 1988, working under scientists in the Department of Entomology on a diversity of research projects on native and exotic insects and bees. In her early years at the Station, she worked for Dr. Ron Weseloh on the biological control of spongy moth, rearing the caterpillars and their various predators and parasites, and assisting in field research on ant predation. Later in her career, she divided her time between two scientists, Dr. Chris Maier and Dr. Kimberly Stoner. For Dr. Maier, she collected and reared apple pests to measure parasitism and conducted trapping surveys to detect newly arrived exotic insect species and both native and exotic wood boring insects. For Dr. Stoner, she assisted with research on bees and pollination, planting and maintaining field plots, traveling to observe and collect bees in fields of pumpkins and squash and in a diversity of pollinator habitats, and processing, labeling, and databasing thousands of bees. She provided quality control for many of the projects she was involved with and often made helpful suggestions for making tasks more efficient. Morgan was responsible for deploying traps, collecting, processing, and tracking various insect and flower samples, entering data into databases, maintaining sampling equipment, and conducting literature searches that critically supported the research of Station scientists. She retired from her position as an Agricultural Research Assistant III on June 1, 2022. Morgan's contributions to the study of biological control of insect pests, the distribution and spread of exotic insects, and bee diversity and pollination greatly benefited the Connecticut public.

The Connecticut Agricultural Experiment Station
111th Plant Science Day

Lockwood Farm, 890 Evergreen Avenue, Hamden, CT
Wednesday, August 4, 2021



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

PLANT SCIENCE DAY
2021

The weather on Plant Science Day 2021 was in the upper 70s. A total of 973 guests visited Lockwood Farm, making it one of the more heavily attended Open Houses at the Farm in recent years.

Director Jason C. White welcomed attendees in the Pavilion and gave opening remarks. Ms. Vickie Bomba-Lewandoski moderated the short talks and introduced the speakers.

All the short talks were very well attended:

SHORT TALKS:

Dr. Robert E. Marra	**Beech Leaf Disease: Emergence and Spread in Connecticut and New England**
Dr. Walter Krol and Ms. Terri Arsenault	**Industrial Hemp: An Emerging Crop in Connecticut**
Dr. Kirby C. Stafford III	**Plant Science Day Celebration: A History**

The Demonstration Tent was full for all the demonstrations of the day:

DEMONSTRATION TENT:

Mr. Gregory J. Bugbee, assisted by Ms. Summer Stebbins	**Container and Raised Bed Gardening: Big Yields from Small Places**
Dr. Scott C. Williams, assisted by Mr. Michael R. Short	**Deer and Wildlife Control in Your Garden**

Attendees took advantage of several tours around the farm:

BARN EXHIBITS:
A steady flow of visitors went through the barn throughout the day to view the exhibits and listen to scientists explain their research.

- **Food and Feed Safety Investigations and Research at CAES**. Investigators: Dr. Brian Eitzer, Dr. Walter Krol, Mr. Craig Musante, and Ms. Terri Arsenault.
- **Healthy Forests, Healthy People**. Investigators: Dr. Scott C. Williams and Dr. Megan A. Linske.
- **Palmer Amaranth Biotype in Connecticut is Resistant to Multiple Herbicides**. Investigator: Dr. Jatinder S. Aulakh.
- **How Mosquito Feeding Behavior Impacts Disease Transmission**. Investigators: Dr. Douglas Brackney and Dr. Philip Armstrong.
- **Maggots in Murder and Medicine**. Investigators: Dr. Kirby C. Stafford III and Dr. Gale E. Ridge.
- **Soil Protists and Plant Health**. Investigators: Dr. Lindsay R. Triplett, Dr. Stephen Taerum, and Dr. Ravi Patel.

QUESTION AND ANSWER TENT:
Throughout the day, hundreds of questions were answered by the staff under the Question and Answer Tent. The tent was staffed by Ms. Katherine Dugas, Ms. Rose Hiskes, Dr. Yonghao Li, Ms. Diane Riddle, and Dr. Gale Ridge.

FIELD PLOTS:
The plots at Lockwood Farm are planted and maintained by The Connecticut Agricultural Experiment Station's scientists and technical staff, along with the help of Farm Manager Mr. Richard Cecarelli and his Research Technician Mr. Rollin Hannan as well as seasonal resource assistants Ms. Sophia Coppola, Mr. Michael Piercey, and Mr. Harry Tokarz. Visitors were able to visit the following 71 field plots:

POLLINATOR VISITATION AMONG CULTIVATED VARIETIES OF ZINNIAS	Dr. Kimberly Stoner, assisted by Ms. Morgan F. Lowry, Ms. Tracy Zarrillo, Mr. Benjamin Gluck, Mr. James Durrell, and Ms. Annie Bolduc
PROPAGATION OF FIGS	Dr. Charles R. Vossbrinck
COMMERCIAL CHESTNUT CULTIVARS	Dr. Sandra Anagnostakis
COMMERCIAL CHESTNUT SEEDLINGS	Dr. Sandra Anagnostakis
REMOTE ACCESS WEATHER STATION	
TECHNICAL DEMONSTRATION TENT	
CONTROL OF BLIGHT ON AMERICAN CHESTNUTS	Dr. Sandra Anagnostakis
NEW HYBRID CHESTNUT ORCHARD	Dr. Sandra Anagnostakis
SULFUR NANOPARTICLES SUPPRESS FUSARIUM WILT OF TOMATO	Dr. Yi Wang, Dr. Jason C. White, and Dr. Wade Elmer
TABLE GRAPE DEMONSTRATION PLOT	Dr. Washington da Silva and Dr. Gale E. Ridge
CHARDONNAY WINE GRAPE DEMONSTRATION PLOT	Dr. Washington da Silva and Dr. Gale E. Ridge
GROWTH AND CONTROL OF NON-NATIVE BAMBOOS	Dr. Jeffrey S. Ward and Dr. Jatinder Aulakh, assisted by Mr. Joseph P. Barsky and Mr. Nicholas Tait
SEEDLINGS OF OLD SURVIVING AMERICAN CHESTNUTS	Dr. Sandra Anagnostakis
WILD CHESTNUTS FROM TURKEY	Dr. Sandra Anagnostakis
QUESTIONS AND ANSWERS TENT	Ms. Katherine Dugas, Ms. Rose Hiskes, Dr. Yonghao Li, Ms. Diane Riddle, and Dr. Gale E. Ridge
COMPOSTING LEAVES USING THE STATIC PILE METHOD	

HAMDEN POLICE DEPARTMENT	
CROWN CASTLE CELLULAR TOWER THE BIG DIPPER (ICECREAM)	Mr. Harry Rowe
KIDS' KORNER	Dr. Andrea Gloria-Soria
SELF-GUIDED ACTIVITY FOR ALL CHILDREN, INCLUDING GIRL SCOUTS	Ms. Terri Arsenault
FARM EQUIPMENT USED AT LOCKWOOD FARM	Mr. Richard Cecarelli
EXPERIMENT STATION ASSOCIATES	Ms. Cheryl Cappiali
PHOSPHOROUS TRAPPED BY MODIFIED BIOCHAR AND RECYCLED AS FERTILIZER USING ARBUSCULAR MYCORRHIZAL FUNGI	Dr. Tyler Swanson, Dr. Philip Wang, Dr. Wade Elmer, and Dr. Joe Pignatello
THE MINISTRY OF MOLECULAR MAGIC	Dr. Christina Robb and Mr. John Ranciato
MICROBIOME ON PLANTS AND ITS ROLE IN PLANT DISEASE MANAGEMENT	Dr. Zhouqi Cui, Dr. Amine Hassani, Dr. Blaire Steven, and Dr. Quan Zeng
POP-PRODUCE OVERWINTERING PROGRAM	Mr. Robert Durgy
A WORLD OF VIRUSES	Dr. Zannatul Ferdous and Dr. Rebecca Johnson, assisted by Mr. Duncan Cozens
CHESTNUT RESEARCH	Dr. Florian Carle (Yale University), Mr. Jack Swat (The American Chestnut Foundation), Dr. Susanna Keriö (CAES)
POTENTIAL OF NANOMATERIALS AS TREE CARE AGENTS – CHESTNUTS AS A CASE STUDY	Dr. Susanna Keriö, Dr. Washington da Silva, Dr. Blaire Steven, and Dr. Nubia Zuverza-Mena, assisted by Mr. Aiden Florio, Ms. Jacqueline Lemmon, Ms. Jacquelyn LaReau, Mr. Joseph Barsky, Ms. Cora Ottaviani, and Ms. Madeleine Dumas
ROLE OF FOLIAR BIOINTERFACE PROPERTIES AND NANOMATERIAL CHEMISTRY IN CONTROLLING CU TRANSFER INTO WILD TYPE AND MUTANT *ARABIDOPSIS THALIANA* LEAF TISSUE	Dr. Yu Shen, Dr. Jaya Borgatta, Dr. Carlos Tamez, Dr. Wade Elmer, and Dr. Jason C. White
RESPONSE OF BARE-ROOT CHRISTMAS TREE TRANSPLANTS TO FERTILIZER AT PLANTING	Dr. Richard S. Cowles
PHYTOPHTHORA ABIETIVORA, A NEW SPECIES ISOLATED FROM DISEASED CHRISTMAS TREES IN CONNECTICUT	Dr. DeWei Li, Dr. Neil P. Schultes, Dr. James LaMondia, and Dr. Richard Cowles

MEASURING HUMAN EXPOSURE TO PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)	Dr. Sara L. Nason, assisted by Mr. Elizabeth Lin and Dr. Krystal Pollitt (Dept. of Environmental Health Science, Yale School of Public Health)
2021: YEAR OF THE SOUTHERN PINE BEETLE?	Dr. Claire Rutledge, assisted by Ms. Mioara Scott and Ms. Ashley Martone
DURATION OF PROTECTION PROVIDED BY DIFFERENT FUNGICIDES IN BOXWOOD AGAINST BLIGHT DISEASE	Dr. Srikanth Kodati and Dr. James LaMondia
THE PAVILION AT LOCKWOOD FARM	
NATIVE WOODY SHRUBS	Dr. Jeffrey S. Ward, assisted by Mr. Joseph P. Barsky and Ms. Erin Reilly
BIRD & BUTTERFLY GARDEN	Mr. Jeffrey Fengler and Ms. Lisa Kaczenski-Corsaro
THE PUBLIC HEALTH AND ENTOMOLOGY TENT:	
STATEWIDE MONITORING PROGRAM FOR MOSQUITO-BORNE VIRAL DISEASES IN CONNECTICUT	Dr. Philip Armstrong, Mr. John Shepard, Dr. Andrea Gloria-Soria, Ms. Angela Bransfield, Mr. Michael Misencik, and Ms. Tanya Petruff
THE BLACKLEGGED TICK (DEER TICK) *IXODES SCAPULARIS* AND LONE STAR TICK, *AMBLYOMMA AMERICANUM*	Dr. Kirby C. Stafford III, assisted by Ms. Heidi Stuber, Ms. Jamie Cantoni, and Ms. Elizabeth Triana
AN INTEGRATED TICK MANAGEMENT PROJECT FOR THE CONTROL OF THE BLACKLEGGED TICK, *IXODES SCAPULARIS*	Dr. Scott C. Williams, Dr. Kirby C. Stafford III, and Dr. Megan A. Linske, assisted by Mr. Michael Short, Ms. Heidi Stuber, and Ms. Elizabeth Triana
TRACKING TICKS AND TICK-ASSOCIATED DISEASES IN CONNECTICUT	Dr. Goudarz Molaei, assisted by Ms. Noelle Khalil, Ms. Alyssa Marini, Ms. Fiona Quigley, Ms. Tiba Alani, and Ms. Kayla Musante
ECOLOGY AND MANAGEMENT OF GRAPEVINE VIRUSES IN CONNECTICUT	Dr. Washington da Silva
HOW DO PLANT PATHOGENS ENTER PLANTS?	Ms. Felicia Millett and Dr. Quan Zeng
GROWING CANNABIS IN CONNECTICUT – CROP PRODUCTION AND PEST MANAGEMENT	Dr. Quan Zeng
INVASIVE AQUATIC PLANT PROGRAM	Mr. Gregory Bugbee and Ms. Summer Stebbins, assisted by Ms. Sunayna Wahi and Mr. Adam Pakalnis
HEMP DEMONSTRATION PLOT	Dr. Walter Krol, Ms. Terri Arsenault, Mr. Richard Cecarelli, and Dr. Christian Dimkpa

CHESTNUT SPECIES AND HYBRIDS	Dr. Sandra Anagnostakis
HEALTHY PLANTS – HEALTHY BUSINESS: SUPPORT OF THE GREEN INDUSTRY BY INSPECTION	Dr. Victoria Lynn Smith, assisted by Ms. Tia Blevins, Mr. Mark Creighton, and Mr. Jeffrey Fengler
THE COOPERATIVE AGRICULTURAL PEST SURVEY (CAPS) PROGRAM AND PLANT PROTECTION ACT SURVEYS	Ms. Gerda Magana
BIOLOGICAL CONTROL OF HEMLOCK WOOLLY ADELGID	Dr. Carole Cheah
THE ROCK	
ASIAN CHESTNUT GALL WASP ON CHESTNUT	Dr. Sandra Anagnostakis
BEACH PLUM TRIALS	
PAWPAW TRIALS	
HYBRID AND VINIFERA GRAPE CULTIVARS PLOT	Dr. Washington da Silva and Dr. Gale E. Ridge
HOPS – VARIETY EVALUATION AND INTEGRATED PEST MANAGEMENT	Dr. James A. LaMondia and Dr. Srikanth Kodati, assisted by Ms. Michelle Salvas
USE OF NANOPARTICLES FERTILIZERS ON PLANT DISEASE	Dr. Wade Elmer, Dr. Yi Wang, Dr. Yu Shen, and Dr. Jason White
CONNECTICUT FARM BUREAU ASSOCIATION	Joan Nichols
CONNECTICUT DEPARTMENT OF AGRICULTURE	Jaime L. Smith and Rebecca Eddy
US DEPT. OF AGRICULTURE, ANIMAL AND PLANT HEALTH INSPECTION SERVICE, PLANT PROTECTION AND QUARANTINE (APHIS-PPQ)	Eric Chamberlain
UNITED STATES DEPARTMENT OF AGRICULTURE - FARM SERVICE AGENCY (USDA-FSA)	Teresa Peavey
THE FEDERATED GARDEN CLUBS OF CONNECTICUT, INC.	Nan Merolla
WILD ONES – MOUNTAIN LAUREL CHAPTER	Lydia Pan
LEVO INTERNATIONAL, INC.	Bill Heiden

THE CONNECTICUT TREE PROTECTIVE ASSOCIATION	Cathy Dvorsky
SLEEPING GIANT PARK ASSOCIATION	Julie Hulten
US DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE (USDA-NRCS)	Jacob Isleib
US DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE SoilSHOP (USDA-NRCS SoilSHOP)	Meg Harvey (CT DPH), Tarah Somers (ATSDR), Debbie Surabian and Jacob Isleib (USDA-NRCS)
CONNECTICUT FARMLAND TRUST	Maddie Dres
CONNECTICUT PROFESSIONAL TIMBER	Brennan Sheahan
SOUTHWEST CONSERVATION DISTRICT	Chris Sullivan and Melissa Mostowy
UCONN EXTENSION MASTER GARDENER PROGRAM	Cheryl Cappiali

Lockwood Farm made a beautiful appearance due to the hard work of the farm crew: Richard M. Cecarelli (Farm Manager) and Rollin J. Hannan, Jr., who worked on the plots, grass, trimming, and setup. The barns, buildings, and grounds were cleaned by the Maintenance crew – Eric Wagner (Supervisor), Eric Flores, Brian Hart, Ronald A. LaFrazier, and Miguel Roman. They also delivered all items needed for the day to the farm. Tent setups were done by Eric Flores, Brian Hart, Ronald LaFrazier, and Miguel Roman. The podium, tables, and chairs setup in the pavilion, washing tables and chairs, and the cleaning of the cement floor were all done by Richard Cecarelli, Eric Flores, Brian Hart, Ronald LaFrazier, and Miguel Roman.

At 10:45 a.m., Director Jason C. White announced that the winner of the Outstanding Young Farmer Award is Suzie Flores, Stonington Kelp Co., Stonington, CT and the winner of the Century Farm Award is March Farm, Bethlehem, CT.

OUTSTANDING YOUNG FARMER AWARD

Suzie Flores
Stonington Kelp Co.
Stonington, CT

Proclamation from Governor Ned Lamont:

The 2021 Connecticut Outstanding Young Farmer award was presented to Suzie Flores, a former market development executive who owns and operates Stonington Kelp Co. with her husband Jay and three children. The vision for the farm began five years ago in 2016 and the following year was up and running through a partnership with GreenWave, a non-profit dedicated to supporting the next generation of ocean farmers. Today, the farm is one of the largest commercial seaweed farms in the state selling food grade sugar kelp to local restaurants and shops.

Sugar kelp is the only variety of seaweed that can be legally grown in Connecticut and has a slightly sweeter flavor. While the nutritional benefits of sugar kelp are well known, the positive role this native sea vegetable can have on the environment is what really drives Flores. Her farming methods highlight the importance of regenerative and sustainable farming for the ocean. Sugar kelp absorbs carbon and nitrogen from the water while it grows, directly addressing climate change and mitigating the impacts of ocean acidification.

CENTURY FARM AWARD

March Farm
Bethlehem, CT

The Century Farm Award is given to a farm that has been in family operation for more than 100 years. The recipient is selected by the Connecticut Agricultural Information Council.

Proclamation from Governor Ned Lamont:

March Farm is a fourth-generation family farm located in Bethlehem among the beautiful rolling hills of Litchfield County. Purchased in 1915 by Thomas and Rose Marchukaitis, the farm consisted of 114 acres and supported 15 cows and 2 horses. In 1937, Thomas and Rose's son Matthew and his wife Anastasia bought the land and stock. At that time, a diversified farm was started and was operated as such for many years. The first tractor was purchased in 1939.

During the 1940s, poultry and dairy barns were added to accommodate 50 cows and approximately 600 chickens. During the 1950s, 14 acres of adjoining land was purchased and apple orchards were planted. Throughout the next 3 decades, stock and fruit production were increased until there were 100 dairy cattle, 40 acres of fruit trees, 5 acres of blueberries, and many acres of sweet corn, cabbage, potatoes, squash, pumpkins, other vegetables, and hay.

On July 1, 1977, the farm was purchased from Matt and Anastasia by their son Thomas and his wife Susan. In 1988, some changes were made. Thomas decided to sell the cows and concentrate more on producing vegetables and fruit. A commercial kitchen was also installed in order to accommodate a bakery business to supplement produce and other items sold at the farm store.

The next year, a greenhouse was added to produce quality tomatoes. Since that time, 11 more greenhouses have been added to produce a variety of tomato types, cucumbers, squash, lettuce, and salad greens in addition to many outdoor vegetable fields. Orchard sizes have been increased, as has the production of sweet corn. During the 1990s, "Pick-Your-Own" became increasingly popular and has been encouraged for berries, fruit, and pumpkins.

At 11:15 a.m., Director Jason C. White introduced Mr. Brent Peterkin, Executive Director, Gather New Haven, as the Samuel W. Johnson Memorial Lecturer. He gave a talk titled "Urban Ecosystems and Cultivating Communities."

EVENTS HELD AT THE STATION

Forest Health Monitoring Workshop 2022

On March 8, 2022, Dr. Victoria Smith organized and participated in the annual CAES Forest Health Monitoring Workshop held on Zoom with more than 54 attendees.

Time	Speaker or Segment	Presentation Title
8:30 a.m.	Event begins on Zoom	
8:45-9:15 a.m.	Jeffrey Ward	"Altered Carbon"
9:15-9:45 a.m.	Amanda Bunce	"Adaptive Silviculture on the Exurban Landscape: Progress Update"
9:45-10:00 a.m.	Yonghao Li	"2021 Tree Disease Highlights"
10:00-10:15 a.m.	Robert Marra	"Beech Leaf Disease Update"
10:15-10:30 a.m.	Tom Worthley	"A Fresh Look at Preparatory Treatments in Shelterwood Systems to Foster Oak Regeneration"
10:30-10:40 a.m.	Break	
10:40-11:00 a.m.	Claire Rutledge	"Progress on Biological Control of EAB"
11:00-11:15 a.m.	Victoria Smith	"LDD Outbreak in Litchfield County? It Happened!"
11:15-11:45 a.m.	Carole Cheah	"Collaborations in HWA Biological Control"
11:45-12:15 p.m.	Susanna Keriö	"Sweet Dreams--Carbohydrates and Stress in Urban Trees"
12:15-12:30 p.m.	Discussion and wrap-up	

The CAES Vector-borne Disease Symposium 2022

On May 10, 2022, Dr. Goudarz Molaei organized the Vector-borne Disease Symposium in Jones Auditorium assisted by Dr. Megan Linske, Dr. Rebecca Johnson, and Dr. Zannatul Ferdous.

Speaker	Presentation Title
Jason White	Opening remarks
Goudarz Molaei	"Tick and Tick-borne Disease Surveillance in Connecticut"
Kirby Stafford	"Historical Perspective and Current Challenges for Tick Control"
Philip Armstrong	"Mosquito-based Surveillance to Detect and Monitor Arbovirus Risk in Connecticut"
Andrea Gloria-Soria	"Invasion Biology of *Aedes Mosquitoes*"
John Shepard	"Biology, Ecology, and Feeding Behavior of Mosquitoes in Connecticut"

The International Festival of Arts and Ideas 2022

On June 16 and 24, 2022, the Station participated in the International Festival of Arts and Ideas. Dr. Goudarz Molaei spoke to visitors about the tick and tick-borne pathogen surveillance and tick testing program and provided a tour of the CAES Tick Testing Laboratory both days. Dr. Philip Armstrong spoke to visitors about the mosquito trapping and testing program. Ms. Katherine Dugas and Dr. Gale Ridge spoke to visitors about their work at the CAES Insect Information Office; and Dr. Yonghao Li talked about the Plant Disease Information Office and disease diagnosis to the tour groups. Dr. Lindsay Triplett presented her talk "CAES Then and Now" to members of the public as part of the festival's events. The presentation was followed by campus tours guided by Drs. Lindsay Triplett, Christian Dimkpa, and Jason White; tour stops in addition to the ones listed above were presented by Drs. Carlos Tamez, Claire Rutledge, and Washington da Silva (12 adults) (*June 16*) and (22 adults, 3 children) (*June 24*).

The Plant Health Fellows Internship Program

On June 6, 2022, Dr. Lindsay Triplett coordinated the SCSU/CAES Plant Health Fellows internship program for its fifth year. Ten undergraduate students began mentored research projects in four departments at The CAES campus. In addition to research, they are participating in a group field project, five communication and leadership activities, and conversing with seventeen Zoom panelists in weekly career panels focusing on different types of plant health careers.

Plant Health Fellows field trip to Enko Chem in Mystic, CT. Pictured left to right: Dr. Rebecca Silady, Naomi Allen, Emilie Kendrick, Oliver MacKinnon, Conor Bendett, Sofia Shubin, Dr. Lindsay Triplett, Mia Varney, Aaliyah Walker, and Brooke Isaacson.

Plant Health Fellows mix soil to set up an urban gardening experiment. Pictured left to right: Juniper Allen-Cantu, Emilie Kendrick, Renee Smith, Brooke Isaacson, and Dr. Leigh Whittinghill.

EVENTS HELD AT LOCKWOOD FARM

The 2021 Connecticut-FFA Forestry Career Development Event

On November 19, 2021, the Department of Forestry and Horticulture hosted the Connecticut-FFA Forestry Career Development Event (CDE) at the Lockwood Farm Pavilion. This year's Forestry CDE evaluated students' general forestry knowledge, forest mensuration, forestry business management, forestry related equipment, tree disorder identification, and tree identification.

Thirty-six students from nine State FFA Chapters participated in this year's event, with the four-student team from E.O. Smith High School Agricultural Education Program taking first place. Students from E.O. Smith FFA will represent The State of Connecticut in regional and national competition at the 2022 Eastern States Exposition and the 2022 National FFA Convention in Indianapolis, IN.

We would like to thank Eric Hansen of Ferrucci & Walicki, Alex Amendola of South Central Connecticut Regional Water Authority, and Annie Shutts Mixsell of the City of New Haven for their assistance. Dr. Scott Williams, Michael Short, Joseph P. Barsky, and Erin Reilly of the Department of Forestry and Horticulture, and Dr. Megan Linske of the Department of Entomology organized and oversaw the event.

The 2021 Connecticut-FFA Forestry Career Development Event, November 19, 2021

Hosted Cheshire Pack 92 Fourth Grade Webelos Scouts at Lockwood Farm

On May 5, 2022, Dr. Quan Zeng and Dr. Lindsay Triplett hosted Cheshire Pack 92 fourth grade Webelos Scouts on a tour of Lockwood Farm to help them earn their "Adventures in Science" pin. Dr. Zeng explained the apple life cycle and talked about his apple blossom experiments (6 children and 6 adults).

Dr. Quan Zeng (left) with Webelos 92 Den and their Den Leader, Kevin Koch (right)

EVENTS HELD AT THE VALLEY LABORATORY

The Valley Laboratory 100th Anniversary Celebration

The Connecticut Agricultural Experiment Station Valley Laboratory on Cook Hill Road in Windsor was founded as the Tobacco Experiment Station in 1921 and celebrated its 100-year anniversary on September 10, 2021. The day included grower meetings consisting of plot tours and talks and featured a mid-day program welcome by Director Dr. Jason White, a short history of the Tobacco Station/Valley Laboratory by Dr. James LaMondia, a reminiscence from Nancy Taylor, daughter of former head of the Valley Laboratory Dr. Gordon Taylor, who also presented a plaque and congratulations from the Tobacco museum, comments and congratulations from the CAES Board of Control by Terry Jones presented by Joan Nichols, of the Board and Connecticut Farm Bureau, as well as a message of congratulations from Lancaster Leaf and Imperial Tobacco by Ben Refuge, ITG and Vaughan Stevens of Universal Tobacco. Midday music and food were provided by Lancaster Leaf and Imperial Tobacco to growers, dignitaries, and friends. Nearly 200 people attended this day-long event.

The day ended with a Valley Laboratory hopyard tour regarding "Integrated Pest Management of Hop Pests and Diseases" by Drs. James LaMondia and Srikanth Kodati. Pesticide certification credits were available for all grower meetings. James Preste, Ethan Paine, Diane Riddle, Michelle Salvas, and Christine Grant from the Valley Laboratory, Joseph P. Barsky from Forestry and Horticulture, and Richard Cecarelli and Rollin Hannan of Lockwood Farm assisted with all of the arrangements and logistics that made the day go well.

The Valley Laboratory 100th Anniversary Celebration, September 10, 2021

Dr. James LaMondia giving a field plot tour and talk at Valley Laboratory's 100th Anniversary Celebration

The CAES Booth at the Big E in Massachusetts

On September 23, 2021, Dr. Gale Ridge with Ms. Katherine Dugas, Meghan Cahill, Jamie Cantoni, and Drs. Nubia Zuverza-Mena and Jaya Borgatta, staffed the Experiment Station exhibit at the Big E in West Springfield, MA (37,604 attendees at the fair that day).

The CAES booth at the Big E. Left to right: Meghan Cahill, Dr. Gale Ridge, Jamie Cantoni, Katherine Dugas, Dr. Nubia Zuverza-Mena, and Dr. Jaya Borgatta.

The CAES Exhibit at the Woodstock Fair

September 3-6, 2021, Dr. Gale E. Ridge and Ms. Katherine Dugas staffed the Experiment Station Exhibit at the Woodstock Fair in Woodstock, CT (over 200,000 attendees).

New Arboretum at Sleeping Giant to Restore Tornado Damage

On October 3, 2021, Mr. Joseph P. Barsky coordinated the installation of a new arboretum at Sleeping Giant State Park in Hamden, CT to replace white pines destroyed by the tornadoes in May 2018. The trees were planted, mulched, and watered in under three hours with the assistance of roughly forty volunteers and CT DEEP staff. Eleven trees representing eight genera native to the eastern United States are shown being offloaded from a delivery truck.

Testified on Behalf of the Pollinator Advisory Committee

On February 25, 2022, Dr. Kimberly Stoner testified on behalf of the Pollinator Advisory Committee to the Environment Committee in their public hearing on Senate Bill 120, An Act Concerning the Use of Chlorpyrifos on Golf Courses and Neonicotinoids for Nonagricultural Use.)

Honey Bee Program at Marianapolis Preparatory School in Thompson, CT

From March 7-10, 2022, Mr. Mark H. Creighton presented a comprehensive honey bee program at Marianapolis Preparatory School in Thompson. The program involved several lectures on honey bees, workshops on beehive construction, and a class on external anatomy dissection. The 23 students also discovered how to use a cell phone camera to take pictures through a dissection microscope lens and entered them into the school's bridge week photo contest. The wooden bee boxes that were assembled were then donated to the Huneebee Project in New Haven.

150th Arbor Day Anniversary Ceremony

On April 29, 2022, Dr. Andrea Gloria-Soria helped to organize a ceremony commemorating the 150th anniversary of the Arbor Day creation at Church St. Elementary School in Hamden, CT together with the US Forest Service Northern Research Station during Arbor Day (300 participants).

DONATIONS MADE TO THE COMMUNITY

Lockwood Farm

A total of 22,380 pounds of fresh produce grown at the Lockwood Farm were donated to various organizations in the community.

Valley Laboratory

A total of 12,833 pounds of fresh produce including squash, cucumbers, watermelons, peppers, eggplant, zucchini, tomatoes, cabbage, and broccoli grown at the Valley Laboratory were donated to Foodshare of Hartford. Mr. Preste and Dr. DeWei Li generated the fresh produce, and Jim Preste organized the distribution effort.

AWARDS AND RECOGNITION RECEIVED BY STATION STAFF

On July 6, 2021, Dr. Christian Dimkpa was appointed an Affiliate of the Center for Sustainable Nanotechnology (CSN), which is a multi-institutional partnership aimed at developing a molecular-level understanding of the fundamental chemical and physical processes governing the transformation and interactions of nanoparticles in the environment.

On July 13, 2021, Dr. Kimberly Stoner was awarded the Bill Duesing Organic Living on the Earth Award by CT-NOFA.

On August 26, 2021, Dr. Kirby Stafford was appointed to the Health and Human Services Tick-Borne Disease Working Group, which was originally established by Congress in 2016, and participated in the first TBDWG meeting for this current two-year cycle.

On October 12, 2021, Dr. Megan Linske was elected chairperson of The CAES Post-Doctoral Association.

In October 2021, Dr. Victoria L. Smith received the 2020 Deputy Administrator's Safeguarding Award for contributions to the Unsolicited Seed Response Team. The Team helped PPQ recover nearly 20,000 improperly imported seed packages and identified over 13,000 seeds. Team members also responded to more than 170 media inquiries and countless calls and emails from the public, who received the seeds. The Award consisted of a letter from APHIS Deputy Administrator Osama El-Lissy and a certificate.

On November 3, 2021, Dr. Victoria Smith, Ms. Tia Blevins, and Mr. Jeff Fengler received Certificates of Appreciation from USDA Associate Deputy Administrator Carlos Martinez, for "Partnership, Cooperation, and Leadership in Safeguarding American Agriculture from Ralstonia Race 3 Biovar 2."

On November 5, 2021 Dr. Megan Linske was nominated to serve on the Wildlife Society Leadership Institute Committee.

On November 18, 2021, Dr. Megan Linske was elected to serve on the 2022 Northeast Fish and Wildlife Agency's Annual Conference Planning Committee.

On November 29, 2021, Dr. Megan Linske was nominated to serve on the Wildlife Society's Wildlife Publications Awards Committee as the Northeast Section Representative.

On December 9, 2021, Dr. Nubia Zuverza-Mena received recognition for five years of service to the Station.

On December 9, 2021, Dr. Susanna Keriö was awarded the Magnarelli Postdoctoral Scientist Award.

On January 8, 2022, Dr. Jeffrey Ward was elected as a Trustee of the Great Mountain Forest Corporation.

On February 1, 2022, Dr. Joseph Pignatello was appointed as Technical Editor of Soil Science Society of America Journal overseeing submissions handled by Associate Editors.

On February 15, 2022, Dr. Jeffrey Ward was awarded the David M. Smith Outstanding Forester Award by the Yankee Division, Society of American Foresters.

On February 28, 2022, Dr. Wade Elmer received his recognition award with Dr. Jason White. Governor Ned Lamont signed his award thanking Dr. Elmer for his 35 years of service to the State of Connecticut.

On March 10, 2022, Dr. Sara Nason was appointed as a co-chair of the Stakeholder Outreach Committee and re-appointed as a webmaster for the Benchmarking and Publications for Non-Targeted Analysis working group.

On March 24, 2022, Dr. Itamar Shabtai received the Experiment Station Associates Early Career Scientist Award.

On May 5, 2022, Dr. Sara Nason and Dr. Nubia Zuverza-Mena received the CAES Board of Control Research Award.

On May 19, 2022, Dr. Susanna Keriö was elected Secretary at the CT Urban Forestry Council's Annual Meeting in Hartford.

On May 25, 2022, Dr. Blaire Steven was nominated to the Editorial Board of the American Society of Microbiology journal Microbiology Spectrum.

THE PUBLIC SPEAKS

On July 29, 2021, Rhoda Senteio wrote the following to Dr. Gale Ridge, "Thank you so much for the information about the Indian meal moths. Using the information you so kindly sent, I will do my best to get rid of them as I have never had anything like that in my kitchen. The kitchen part of the house is where I see most of them. I will also be very careful about bringing whole grain foods into the house. Wanting to cook with health in mind, I do purchase and cook with a lot of whole grain foods. I shall be very careful from now on. Thanks again for your prompt reply to my problem and thanks also for the handout you kindly emailed to me."

On July 29, 2021, Susan Whetstone wrote the following to Dr. Gale Ridge, "Thank you so much for all your help, advice and guidance yesterday regarding my drain fly problem. It was tremendously helpful to have the identification of the hump fly but I don't recall the name of the other drain fly you identified. I've taken your advice about the glasses over the drains and I have a plumber coming to repair what I believe has been a long term leak inside a bathroom wall. I am hoping that might actually be the source of the problem given your story of a similar drip in the operating room. Fingers crossed!!! If that doesn't change anything I thank you for giving me a great action plan...(toilet rings to be replaced, mechanical cleaning of all drains). And thank you for the referral to Ryan Currier. I will be in touch with him. I want to apologize for cutting you off during our conversation. This problem started in May 2019 and I had gotten to a place of feeling overwhelmed by it. I appreciate your patience with me and willingness to guide me through to a viable plan of action. You are amazingly knowledgeable and an equally amazing educator. Thank you again for your help."

On August 3, 2021, Marcello Marvelli wrote the following to Yonghao Li, "Thank you very much for your help and prompt reply. This is a fantastic resource for gardeners. I am thrilled that I learnt about the CT Agricultural Experiment Station."

On August 3, 2021, Robert Fossity, a gardener at Weir Farm, wrote the following to Yonghao Li:" We certainly appreciate all the work you and the entire staff at the CT Agricultural Experiment Station do for us here at Weir Farm, National Historical Park!"

On August 15, 2021, Pat Flynn, President of the Connecticut Tree Protective Association, wrote the following to Dr. Jason White, "I am writing on behalf of myself and the Board of Directors of the Connecticut Tree Protective Association to thank the station scientists and staff who participated in our summer meeting on July 15, 2021. Due to the uncertainty of COVID, our decision to hold the meeting was delayed until May, leaving us little time to arrange for speakers. Fortunately for us, CAES has a deep bench of scientists with knowledge on many topics of interest to arborists. And importantly, were willing to attend our meeting and present that knowledge at short notice. Our goal for the meeting was to have all the talks take place in the open air. Rose Hiskes and Dr. Todd Mervosh presented a walking tour around the edge of venue's property about invasive plants. Dr. Jeff Ward gave a walking tour of some of the trees at the venue. Five scientists presented 'plant science day' style table displays allowing the arborists to interact one-on-one with the scientists. Dr. Yonghao Li presented research on the impacts of drought on arborvitae. Dr. Robert Marra presented information about beech leaf disease {a very hot topic as many arborists saw it this year on ornamental beeches). Dr. Claire Rutledge presented research on the southern pine beetle to alert arborists about the potential influx of beetles and to educate them on how to identify infestations. Dr. Victoria Smith and her crew presented information and the latest updates on the spotted lantern fly, and the boxwood moth. Finally, Dr. Kirby Stafford had updates on the tick situation in Connecticut, a perennial topic of interest to a group of people who primarily work outdoors. As you can see from the list above, our summer meeting had a huge range of information for our arborists. We have received many positive reviews for the meeting in general, and the presentations by station scientists in particular. We are grateful to CAES helping us to make our summer meeting a success."

On August 31, 2021, Patrick Colburn wrote the following to Yonghao Li, "Wow thank you for your instant, helpful, and seeming pin point assessment. Pleasantly delighted that I discovered you and your services. Wish more departments in CT were that sharp."

On October 14, 2021, Alice Wyman, Conservation Co-chair of The New Canaan Garden Club, wrote the following to Robert Marra, "On behalf of The New Canaan Garden Club, I would like to thank you for your enthusiastic and comprehensive talk on Fungi. You opened our eyes, challenged our minds, and brought light to the powerful Kingdom we do not appreciate as much as we should! Many thanks for sharing your impressive and extensive work!"

On October 15, 2021, Peggy Ruddy wrote the following to Dr. Gale Ridge in a handwritten letter, “Sincerest appreciation to you for your help with our apple trees dilemma…both in understanding and hopeful solutions! You’re a gem!”

On December 20, 2021, Pete Gorman, President of the Connecticut Environmental Council, wrote the following to Robert Marra, “I wanted to thank you for taking the time to share your presentation with our audience at the CTEC education seminar.”

On February 8, 2022, Lynn Kearcher from the Sharon Inland Wetlands & Watercourse Commission wrote the following to Dr. Jason White and Gregory Bugbee, “While researching material for a small tri-fold brochure regarding the disposal of invasive plants, to be published by the Sharon Inland Wetlands & Watercourses Commission, I came across a copy of "Connecticut's invasive Aquatic Plant, Clam and Mussel Identification Guide," 3rd edition. Chuck Lee of the DEEP put me in touch with Mr. Bugbee, one of the authors of the book, who graciously sent me copies and opened his door for further questions we might have regarding aquatic invasives. In 1992, a group of residents launched a lake association in Sharon working closely with Chuck Lee and limnologist Priscilla Baillie. I only wish at the time, we had such an informative, smart, well designed book as CAES published. The addition of "easily confused species," was intuitive and insightful; the information is straightforward without being overwhelming to the layman. Thank you and your team for this useful and intelligent publication which I am sure we will refer to often.”

On March 10, 2022, Tom DeSimone, an arborist at Green Cross, wrote the following to Yonghao LI, “As always, your analysis is concise and easily understood (considering the complexity underlying plant pathology)”

On March 22, 2022, Dianne Colgan wrote the following to Yonghao Li, “You came highly recommended by Christine Reid from Bespoke Gardening in Stamford…and your prompt reply lived up to my expectations.”

On March 24, 2022, David Fox wrote the following to Dr. Jason White and Gregory Bugbee, "I write to you to commend and thank you and your team for exemplary service to those of us who garden and need assistance on matters of the environment and soil. Your services are invaluable. I am 77 years old and live in Old Greenwich. My wife and I have lived here for more than 40 years tilling and caring for our gardens. My interests and responsibilities focus on roses of which I have about 70 bushes. My wife does perennials and together we work on other aspects of the gardens. Periodically I turn to your team for help in evaluating the soil and to receive their thoughts and recommendations. I am so pleased to report that each and every time my requests are met quickly and with user-friendly reports that tell me what to do and why. Your information has made a huge difference in our success. I have been asked to talk to a local garden club about taking care of roses and I will be telling them that working with your staff is absolutely key to one's success. As you know, without proper soil conditions roses in particular are lost despite one's hard labors. I so hope you and your associates feel recognized and appreciated for your fine work. I thank you."

On March 25, 2022, Carol Redelsheimer from Maine wrote the following to Joseph P. Barsky, "Thanks for your efforts in participating in the planning and arrangements for the 2022 New England Society of American Foresters Annual Meeting. Great to be back in person, thanks for all the efforts with the NQ, great news all the time."

On May 30, 2022, Jim Ballentine, of the Guilford Land Conservation Trust and Westwoods Trails Committee, wrote the following to Robert Marra, "I want to thank you again for spending the time with us here on Saturday in Guilford. I think we all feel a little better knowing what there is to know about this situation and your passion for furthering the understanding of this disease is inspiring."

On June 10, 2022, Cheryl Cappiali, of the Experiment Station Associates, wrote the following to Robert Marra, "Hi Bob…yesterday was so great! Thank you for your presentation which broke down the processes that are affected by the increasing extremes in weather and the intensity of weather events. I have found the increase in high wind occurrences to be of great concern, particularly late winter into early spring of 2022. I was so pleased that you stayed and talked after your presentation. Thank you for being part of our hope."

On June 13, 2022, Tomas Luby the following wrote to Yonghao Li, "Thank you for your prompt and careful attention. I feel so fortunate to have an expert listen to my problems."

On June 14, 2022, Kathleen wrote the following to Yonghao Li, "We thank you for all your help and as always it is a pleasure to work with you and The Connecticut Agricultural Experiment Station."

On June 30, 2022, Adam Moore wrote the following to Yonghao Li, "Thank you so much for your help! Your rapid identification of the problem is so helpful, as is the fact sheet that you provided. I so appreciate your help and the great work of the CT Agricultural Experiment Station!"

On July 20, 2022, Matt Gallagher, Director of Programs and Operation at Great Mountain Forest, wrote the following to Robert Marra, "Thank you for presenting this last Saturday. Your presentation opened a lot of attendees' eyes to the world of forest diseases and plant pathology and provided forest professionals the opportunity to gain CEU's that are difficult to acquire in this part of the state. You are always welcome here for research. Look forward to future discussions on research and grants."

On July 22, 2022, Mark Ashton, Morris K. Jesup Professor of Silviculture and Forest Ecology, Director of Yale Forests, and Senior Associate Dean of The Forest School, wrote the following about Robert Marra, "Bob was invited to teach a module on forest pathology to our graduate students in forestry this past spring. He participated in a full 3 credit forest health course for Master of Forestry Students titled ENV. 654, "Forest ecosystem health and stability in a changing climate." This course is part of the curricula for graduate professional students at The Forest School of the Yale School Environment. For this class Bob was instrumental in providing students with a basic background in mycology and forest pathogens. I would like to commend Bob for his efforts. The students loved him and fully recognized and appreciated his participation in the course. We were delighted with his contribution and we really hope he can contribute as an equal partner next time we teach the class in the Spring of 2024."

SCIENTIFIC OFFICERSHIPS AND MEMBERSHIPS ON STATE, NATIONAL, OR REGIONAL COMMITTEES

ADMINISTRATION

JASON C. WHITE

- Immediate Past President, International Phytotechnology Society
- Managing Editor, International Journal of Phytoremediation
- Editorial Board, Environmental Pollution
- Editorial Board, NanoImpact
- Editorial Advisory Board, Environmental Science & Technology
- Editorial Advisory Board, Environmental Science & Technology Letters
- Science Advisory Board, Annual International Conference on Soils, Sediments, Water, and Energy
- Advisor, Nanotechnology Advisory Group, Society of Environmental Toxicology and Chemistry
- Member (ad-hoc), FDA Food Emergency Response Network (FERN) Method Coordination Committee (MCC)
- Member, FDA Flexible Funding Model (FFM) Workgroup
- Committee member of the ISO/TC 229/WG 3 on Health, Safety and Environmental Aspects of Nanotechnology
- Member, Sustainable Nanotechnology Organization (SNO)
- Member, Society of Environmental Toxicology and Chemistry (SETAC)
- Member, American Chemical Society (ACS)

DEPARTMENT OF ANALYTICAL CHEMISTRY

CHRISTIAN O. DIMKPA

- Affiliateship of the Center for Sustainable Nanotechnology
- Senior Editor, Journal of Basic Microbiology
- Guest Editor for Frontiers in Soil Science for the Special Issue on the topic “Towards 2030: A Soils and Human Health Perspective on Achieving Sustainable Development Goal 2 Zero Hunger”
- Committee member of the ISO/TC 229/WG 3 on Health, Safety and Environmental Aspects of NanotechnologyGuest Editor for Environmental Pollution for Special Issue on the topic “Interactions between micro/nano particles in the environment: Assessing the impact on soil and water ecosystems”
- External Graduate Dissertation Examiner, School of Life and Environmental Sciences Deakin University, Australia.
- External Graduate Dissertation Examiner, Faculty of Natural and Agricultural Sciences North-West University, South Africa.

CHRISTINA S. ROBB

- Board Member of Eastern Analytical Symposium
- Executive Committee member of Eastern Analytical Symposium
- Associate Editor of the Journal of Liquid Chromatography
- Member of Flanders Nature and Land Trust LEARN Committee
- Member of the Association of Public Health Laboratories (APHL) Food Chemistry Working Group
- Member and subject matter expert (SME) of APHL Laboratory Curriculum Framework Working Group

YI WANG

- Member, Sustainable Nanotechnology Organization
- Guest Editor, MDPI Plants

NUBIA ZUVERZA-MENA
- Member, Sustainable Nanotechnology Organization
- Member, Materials Research Society
- Topics Board Editor, MDPI Biomolecules

DEPARTMENT OF ENTOMOLOGY

GOUDARZ MOLAEI
- Associate Clinical Professor, Department of Epidemiology of Microbial Diseases, Yale School of Public Health
- Editorial Board Member, Tropical Medicine and Infectious Diseases
- Lead, Vector-borne Disease subtopic of the Public Health Section of Connecticut Governor Council on Climate Change
- Leadership Team, Northeast Regional Center for Excellence in Vector-Borne Diseases
- Member, Multi-State Research Project NE-1443, "Biology, Ecology, and Management of Emerging Disease Vectors"

THEODORE G. ANDREADIS (Retired as of April 1, 2020 with Emeritus status)
- Adjunct Professor, Department of Pathobiology, University of Connecticut
- Clinical Professor, Epidemiology of Microbial Disease Division, Yale University School of Public Health
- Member, Editorial Board, *Journal of Medical Entomology*
- Subject Editor, *Journal of Medical Entomology*
- Member, Connecticut Academy of Science and Engineering

PHILIP ARMSTRONG
- Clinical Associate Professor, Department of Epidemiology of Microbial Diseases, Yale School of Public Health
- Member, Multi-State Research Project NE-1443: Biology, Ecology, and Management of Emerging Disease Vectors
- Member, State of Connecticut Mosquito Management Program

DOUGLAS E. BRACKNEY
- Assistant Adjunct Professor, Section of Infectious Diseases, Yale School of Medicine
- Assistant Adjunct Clinical Professor, Microbial Diseases Division, Yale School of Public Health
- Associate Editor, *PLoS Neglected Tropical Diseases*
- Adjunct Assistant Professor, Department of Pathobiology and Veterinary Sciences, University of Connecticut

ANDREA GLORIA-SORIA
- Laboratory Associate, Department of Ecology and Evolutionary Biology, Yale University
- Member, Multi-State Research Project NE-1943: Biology, Ecology, and Management of Emerging Disease Vectors

MEGAN A. LINSKE
- Postdoctoral Association Chairperson, The Connecticut Agricultural Experiment Station
- Diversity, Equity and Inclusion Committee Member, The Connecticut Agricultural Experiment Station
- Mentoring Girls in STEM Committee Member, The Connecticut Agricultural Experiment Station
- Postdoctoral Trainee, The Northeast Regional Center of Excellence in Vector-Borne Diseases
- President-Elect, The Wildlife Society, Northeast Section
- Workshop Committee Chairperson, The Wildlife Society, Northeast Section
- Publication Awards Committee Member, The Wildlife Society
- Leadership Institute Mentor, The Wildlife Society
- Leadership Institute Selection Committee Member, The Wildlife Society
- Network and Engagement Committee Member, The Wildlife Society
- Adjunct Faculty, Unity College Distance Education Program

- Ph.D. Committee Member for Rebecca Birmingham, University of Memphis

JOHN SHEPARD
- Treasurer, Northeastern Mosquito Control Association

VICTORIA L. SMITH
- Member, American Phytopathological Society
- Member and Past President, Eastern Plant Board
- Member, New England Wildflower Society, Connecticut Task Force
- Member, Northeast Area Association of State Foresters Firewood Working Group
- Member, USDA-APHIS-PPQ Early Detection-Rapid Response Committee
- Member, National Clean Plant Network Fruit Tree Committee
- Administrator for eLicense for the CAES

GALE E. RIDGE
- Chair, Connecticut Coalition Against Bed Bugs
- Assistant Clinical Professor, Department of Medical Sciences, Frank H. Netter MD School of Medicine, Quinnipiac University
- Member, EPA FIFRA Scientific Advisory Board
- Member, State Health Improvement Plan (SHIP)
- Honorary member, Connecticut Pest Management Association (CPCA)
- Co-Chair, Sustainable Bethany

CLAIRE E. RUTLEDGE
- Entomological Society of America
- The Connecticut Tree Protective Association
  - Vice President
  - Member Board of Directors

KIRBY C. STAFFORD III (Retired as of June 1, 2022, with Emeritus status)
- Member, Board, Connecticut Coalition Against Bed Bugs
- Member, Tick IPM Working Group
- Member, NEVBD Tick Working Group
- Assistant Clinical Professor, Department of Medical Sciences, Frank H. Netter MD School of Medicine, Quinnipiac University

KIMBERLY A. STONER (Retired as of June 1, 2022, with Emeritus status)
- Member, Multi-State Research Project NC1173 – Sustainable Solutions to Problems Affecting Bee Health
- Guest Editor of Research Topic "Pollen as Food for Bees: Diversity, Nutrition, and Contamination" for the journal *Frontiers in Sustainable Food Systems*
- Organizer and Member, Connecticut Native Plant, Pollinator, and Wildlife Working Group
- Member of the Connecticut Friends of Right-of-Way Habitat Stakeholder Group
- Member of the Bee Nutrition Task Force of COLOSS (Society for the Prevention of Honey Bee Colony Loss)
- Member of the US National Native Bee Monitoring Research Coordination Network
- Member American Association for the Advancement of Science
- Member Entomological Society of America

TRACY ZARRILLO
- Member, IUCN SSC Wild Bee Specialist Group
- Member, Advancing Pollinator Conservation throughout North America Project, Commission for Environmental Cooperation

- Member, US National Native Bee Monitoring Research Coordination Network (RCN)
- Secretary (Board Member), Hamden Land Conservation Trust
- Member, Connecticut Native Plant, Pollinator, and Wildlife Working Group
- Member, Pollinator Pathway Group of Hamden

DEPARTMENT OF ENVIRONMENTAL SCIENCE AND FORESTRY

SCOTT C. WILLIAMS
- Adjunct Professor, Department of Natural Resources and the Environment, University of Connecticut, Storrs
- Certified Wildlife Biologist, The Wildlife Society
- Executive Treasurer, Northeast Section of The Wildlife Society
- Associate Editor, *Animals*
- Editorial Advisory Board Member, *The Wildlife Professional*
- Commissioner, Town of Guilford Inland Wetlands Commission
- Commissioner, Town of Guilford Conservation Commission
- Vice Chair, Town of Guilford Land Acquisition Commission

JOSEPH P. BARSKY
- Vice-Chair, State Consulting Committee for Agricultural Science and Technology Education
- Editor, *NESAF News Quarterly*, New England Society of American Foresters
- Chair, Management and Utilization Working Group, New England Society of American Foresters
- Park Naturalist, Sleeping Giant Park Association
- Member, Connecticut Environmental Review Team

GREGORY J. BUGBEE
- President, Northeast Aquatic Plant Management Society
- Panelist, Northeast Aquatic Nuisance Species Panel
- Director, Clear Lake Improvement Association

MARTIN P. N. GENT (Emeritus)
- Associate Editor, *Journal of Plant Nutrition*

SUSANNA KERIÖ
- Secretary, Connecticut Urban Forestry Council
- Secretary, Connecticut Tree Protective Examination Board
- Member, Forest Pathology Committee, American Phytopathological Society
- Member, Society of American Foresters

ABIGAIL A. MAYNARD (Retired as of August 1, 2021 with Emeritus status)
- Member, Editorial Board, *Compost Science & Utilization*
- Ex-Officio Member, Connecticut Council on Soil and Water Conservation
- Member, State Technical Committee
- Member, Steering Committee, 2019 New England Vegetable and Berry Conference
- Member, Agriculture/Soils Sub-Working Group of the Working and Natural Lands Working Group
- Member, Soil Health Subcommittee, Connecticut Council on Soil and Water Conservation

SARA L. NASON
- Adjunct Assistant Research Scientist, Department of Plant Science and Landscape Architecture, University of Connecticut
- Website Manager, Benchmarking and Publications for Non-Targeted Analysis Working Group

- Co-Chair, Stakeholder Outreach Committee, Benchmarking and Publications for Non-Targeted Analysis Working Group

JOSEPH J. PIGNATELLO (Emeritus)
- Editorial Board, *Molecules*
- Editorial Board, *Environmental Engineering Science*
- Appointed Technical (Associate) Editor, *Soil Science Society of America Journal*
- Editorial Board, *Environmental Research*
- Secretary, The Connecticut Agricultural Experiment Station Research Foundation, Inc.
- Technical Board Chair of Agriculture, Food & Nutrition, Connecticut Academy of Science and Engineering

ITAMAR SHABTAI
- Member, Soil Health Subcommittee, Connecticut Council on Soil and Water Conservation
- Vice-Chair, Multi-State Research Project NC-1178, "Land use and management practice impacts on soil carbon and associated agroecosystems services"

BLAIRE STEVEN
- Adjunct Assistant Research Professor, Department of Natural Resources and the Environment, University of Connecticut
- Editorial Board, *Canadian Journal of Microbiology*
- Editor for the American Society of Microbiology journal *Microbiology Spectrum*
- Member American Society of Microbiology
- Member International Society of Microbial Ecology

JEFFREY S. WARD (Retired as of June 1, 2022 with Emeritus status)
- Chair, Connecticut Forest Ecosystem Monitoring Cooperative
- Executive Board, Connecticut Forest and Park Association
- Trustee, Great Mountain Forest
- Secretary, Connecticut Tree Protection Examination Board
- Member, New England Forestry Foundation's North Central & Transition Hardwoods Exemplary Forestry Standards Technical Advisory Committee
- Member, Yankee Division, SAF, Forest Management and Carbon Task Force
- Member, Audubon Connecticut Science Committee
- Ex-Officio Member, Goodwin Scholarship Committee

LEIGH J. WHITTINGHILL
- Ex-Officio Member, Connecticut Council on Soil and Water Conservation
- Member, Soil Health Subcommittee, Connecticut Council on Soil and Water Conservation
- Member, Scientific Committee, Urban Food Systems Symposium
- Member, Planning Committee, Connecticut Vegetable and Fruit Conference
- Member, Transition Grant Review Panel, Connecticut Department of Agriculture

DEPARTMENT OF PLANT PATHOLOGY AND ECOLOGY

LINDSAY R. TRIPLETT
- Senior Editor, Plant Disease
- Organizing Committee, 12th Japan-US Seminar in Plant Pathology
- Faculty Affiliate, Colorado State University
- Gratis Faculty, University of Connecticut

- Chair, APHIS Widely Prevalent Bacteria Committee
- Member, Dissertation Advisory Committee, University of Connecticut
- Member, Bacteriology Committee, American Phytopathological Society

WASHINGTON DA SILVA
- Professor Collaborator, Universidade Federal Rural do Semi-Árido (UFERSA), Brazil
- Adjunct Assistant Professor, University of Connecticut (UConn)
- Member, Research Thesis Advisor, Southern Connecticut State University
- Member, New England, New York, and Canada Tree Fruit Pest Working Group
- Member, Thesis Advisory Committee, Universidade Federal Rural do Semi-Árido (UFERSA), Brazil
- Member, Thesis Advisory Committee, Universidade Federal de Lavras (UFLA), Brazil
- Member, Research Thesis Advisor, Universidade Federal de Viçosa (UFV), Brazil
- Chair, Working Group, American Phytopathological Society (APS) and the Brazilian Society of Plant Pathology (SBF)
- Scientific Member, Connecticut Farm Wine Development Council
- Member, Science/Education Committee, Connecticut Farm Wine Development Council
- Editor, Portuguese Translations for the Plant Health Instructor/APS Education Center
- Member, Review Panel for the USDA-NIFA AFRI Nanotechnology for Agriculture and Food Systems (A1511) competitive grants program

WADE H. ELMER (Retired as of March 1, 2022 with Emeritus status)
- Director, The Connecticut Agricultural Experiment Station Research Foundation, Inc.
- Associate Editor, *Crop Protection*
- Member, APS Foundation Committee, American Phytopathological Society
- Member, APS Press, American Phytopathological Society
- Member, Widely Prevalent Fungi List Committee, American Phytopathological Society
- Member, Northeast Research, Extension and Academic Programs Committee for IPM
- Member, Thesis Advisory Committee, University of Texas at El Paso
- Member, Thesis, Advisory Committee, Federal University, Lavras, Brazil
- Member, Thesis Advisory Committee, Federal University, Lavras, Brazil

YONGHAO LI
- Member, Tree Improvement Committee, Connecticut Christmas Tree Grower Association
- Member, Scholarship Committee, Connecticut Nurserymen's Foundation
- Member, Online Communication and Web Portal Committee, National Plant Diagnostic Network
- Member, Honorary Advisory Board, Edgerton Park Conservancy

ROBERT E. MARRA
- Gratis Faculty, University of Connecticut
- Member, Phytopathology Committee, Mycological Society of America
- Member, Forest Pathology Committee, American Phytopathological Society
- Member, Connecticut Conference on Natural Resources Steering Committee. Founding Member.
- Connecticut Tree Protection Examining Board, ex-officio member as CAES pathologist.
  Member, Multi-state Beech Leaf Disease Working Group
- Co-Chair, West Haven Tree Commission

NEIL P. SCHULTES
- Fellow, The Linnaean Society of London
- Vice President and Executive Board Member, Quinnipiac Chapter of Sigma Xi
- Adjunct Faculty, University of Connecticut (UConn)

QUAN ZENG

- Associate Editor, *Phytopathology*
- Guest Editor, *Frontiers in Plant Science*
- Review Editor, *Frontiers in Microbiology*
- Member, New England, New York and Canada Tree Fruit Pest Working Group
- Member, Bacteriology Committee, American Phytopathological Society
- Member, Graduate Student Research Committees: Michigan State University, University of Wisconsin-Milwaukee, and University of Connecticut
- Adjunct Scientist, University of Connecticut

VALLEY LABORATORY

DEWEI LI

- Associate Editor of *Aerobiologia* (journal)
- Editorial board member of *Fungal Biology and Biotechnology* journal
- Review editor of *Frontiers in Allergy - Environmental Determinants* journal

JATINDER AULAKH

- Northeastern Weed Science Society
- Weed Science Society of America
- International Weed Science Society
- The Connecticut Invasive Plants Working Group
- Connecticut Invasive Plant Council

CAROLE CHEAH

- Fellow of the Cambridge Philosophical Society, UK
- Member, Nearctic Regional Section of IOBC (International Organization for BioControl of Noxious Animals and Plants)
- Member of Honorary Advisory Board, Edgerton Park Conservancy, New Haven
- Fellow of Cambridge Philosophical Society

RICHARD COWLES

- Secretary, Connecticut Christmas Tree Growers' Association
- Entomological Society of America
- Connecticut Entomological Society, Treasurer
- Connecticut Urban Forest Council, Grant Review Panel Leader, Small and Large Grants

ROSE HISKES

- Co-Chair, Connecticut Invasive Plant Working Group

JAMES A. LAMONDIA (Retired as of March 31, 2022 with Emeritus status)

- Northeast Regional Project NE-2140, "Sustainable Management of Nematodes in Horticultural and Field Crop Production Systems."
- Connecticut Agricultural Information Council Chair
- Member, Century Farm Award Selection Committee
- Ex-Officio Member, Connecticut Tree Protection Examining Board
- Worker Protection Standards Trainer for the Valley Laboratory
- CT Vegetable & Small Fruit Growers' Conference Steering Committee
- GLOBAL Globodera Alliance Advisory Board

LECTURES, SEMINARS, AND INTERVIEWS

During the year, staff members present formal lectures and seminars to organized groups outside The Station. They also describe their research to organized groups visiting The Station. Occasionally they report their research to elected officials. At still other times newspaper, radio, and TV reporters interview our staff. These occasions are listed below.

ARMSTRONG, PHILIP M.

- Was interviewed about the wet summer and the unusually high number of mosquitoes collected this season by NBC CT (*July 19, 2021*).
- Was interviewed about the wet summer and the unusually high number of mosquitoes collected this season by the News-Times (*July 20*).
- Was interviewed about the wet summer and the unusually high number of mosquitoes collected this season by WTIC (*July 22*).
- Was interviewed about the long-term impacts of climate change on mosquito populations by Pest Control Technology (*July 27*).
- Was interviewed about West Nile virus activity in the state by the Connecticut Post (*August 18*).
- Was interviewed about the potential impacts of Tropical Storm Henri on mosquito populations and West Nile virus risk by NBC CT, News Channel 8, Fox CT, the Connecticut Post, and WTIC (*August 24-25*).
- Spoke to reporters from Channel 3 News (*September 13*), NBC CT (*September 13*), and Channel 8 News (*September 15*) about West Nile virus activity in the State.
- Spoke to the Connecticut Health Investigative Team about long-term changes to mosquito populations and arbovirus risk observed during 25 years of statewide surveillance (*September 23*).
- Was interviewed about the record number of mosquitoes collected during 2021 by The Connecticut Observer (*October 7*).
- Was interviewed about the impact of climate change on mosquito populations and virus transmission by Channel 3 News and NBC CT (*October 4*) and by AccuWeather (*October 20*).
- Was interviewed about the impact of climate change on mosquito species distribution and seasonality in Connecticut by a reporter from the journal Front Matter (*November 12*).
- Gave the talk, "Synchrony of Mosquito and Arbovirus Collections in Connecticut, USA" at the virtual Annual Northeastern Mosquito Control Association Meeting (100 attendees) (*December 7*).
- Gave the talk, "Vector Competence of Three Human-Biting Tick Species for Powassan Virus" at the virtual Northeastern Center of Excellence in Vector-Borne Diseases meeting (50 attendees) *(December 9*).
- Gave a lecture titled "What To Do If Your Grant Isn't Funded" for the Grants Writing Workshop of the CAES Post-Doctoral Association (~25 attendees) (*March 4, 2022*).
- Gave a lecture titled "Mosquito-based Surveillance to Detect and Monitor Arbovirus Risk in Connecticut" at the Vector Day Symposium at CAES (*May 10*).
- Spoke about the start of the mosquito trapping and testing program to WFSB Channel 3 (*May 31*).
- Spoke to a reporter from the CT public radio about recent changes in mosquito species composition and abundance that were identified after analyzing more than 20 years of statewide surveillance data (*June 1*).
- Spoke to visitors about the mosquito trapping and testing program as a part of the Arts and Ideas Festival (*June 16 and 24*).

AULAKH, JATINDER S.

- Spoke about "New Herbicides for Weed Control in Christmas Trees" and "Nursery Weed Management" at the 100th Anniversary Celebration of the Valley Laboratory, (45 attendees) (*September 10, 2021*).
- Participated in the annual fall meeting of the Connecticut Christmas Tree Growers Association (*September 11*).
- Visited a goldencreeper (*Thladiantha dubia*) site in Kent, CT and confirmed its presence in Connecticut (*October 13*).
- Was interviewed by Brian Scott-Smith, media consultant with WSHU Public Radio, about the goldencreeper discovery in Connecticut (*October 29*).
- Attended the Connecticut Invasive Plant Working Group steering committee meeting and Invasive Plant Council meeting (*November 9*).

- In collaboration with Cristina Rodriguez, Senior Registration Manager of the FMC corporation, got approval for a special local need label for Zeus XC (Sulfentazone) herbicide for haircap moss control in Connecticut cranberries (*April 2, 2022*).
- Submitted a grant proposal to the Connecticut Christmas Tree Board for a project titled "Horsenettle Control with Woodchips and Pre- and Post-emergence Herbicides" (*April 27*).
- Attended the Connecticut Invasive Plant Council Meeting (*June 2*).
- Talked about weed management at the Connecticut Christmas Tree Growers twilight meeting at the Bees, Fleas and Trees Farm in Litchfield, CT (~40 attendees) (*June 21*).
- Reviewed a manuscript titled "Response of *Vincetoxicum nigrum* (Black Swallowwort) to Herbicides plus Mowing" for Invasive Plant Science and Management journal (*June 29*).
- Submitted an article titled "Summer Weed Management in Christmas Trees" to the Real Tree Line Magazine of the Connecticut Christmas Tree Growers Association (*June 30*).

BARSKY, JOSEPH P.

- Participated in the Annual Business Meeting of the Sleeping Giant Park Association (*September 14, 2021*).
- Participated in the quarterly meeting of the New England Society of American Foresters Executive Committee (*September 16*).
- Attended the Society of American Foresters-Yankee Division Fall Field Meeting in North Madison (*September 21*).
- Was interviewed about hickory and oak mast seed production by the Stamford Advocate (*October 1*).
- Coordinated installation of a new arboretum at Sleeping Giant State Park in an area impacted by tornadoes in May 2018 (*October 3*).
- Participated in the monthly board meeting of the Sleeping Giant Park Association (*October 12*).
- Presented a talk on "Trees and Forests" to students from Amity High School (28 students, 8 teachers and staff) (*October 22*).
- Was interviewed about the establishment of a new arboretum at Sleeping Giant State Park by Giant News (*October 22*).
- Met with Donald Parizek and Milton Vega (USDA-NRCS) to discuss the results of a cooperative project regarding soil mapping on CAES forest research sites (*November 29*).
- Participated in a virtual quarterly meeting of the New England Society of American Foresters Executive Committee (*December 15*).
- Participated in the quarterly Executive Committee meeting (virtual) of the New England Society of American Foresters (*January 19, 2022*).
- Attended the virtual Connecticut Tree Protective Association annual meeting (*January 20*).
- Attended the virtual annual meeting of the Yankee Division, Society of American Foresters (*February 15*).
- Attended the virtual meeting of The CAES Annual Forest Health Monitoring Workshop (*March 8*).
- Participated in the formal review of the Agricultural Science and Technology Education Program at Rockville High School (*March 10*).
- Met with individuals from the Mt. Grace Land and Conservation Trust to discuss a collaborative research project on slash walls to protect forest regeneration from browsing by overabundant deer (5 attendees) (*March 16*),
- Participated in an Executive Committee meeting of the New England Society of American Foresters in Portland, ME (*March 22*).
- Presented a research poster titled "Connecticut Oak Mast Surveillance Program" at the 102nd NESAF Annual Winter Meeting (415 attendees) (*March 23*).
- Was elected to serve as New England Society of American Foresters Silvicultural Working Group Chair (*March 24*).
- Spoke on the history of Naugatuck State Forest for a Yale Forest Health class (9 attendees) (*April 8*).
- Gave a talk titled "Ecological and Economic Importance of Precommercial Crop Tree Release on White Oak" at the spring field tour and meeting of the Society of American Foresters and Forest Stewards Guild Yankee Division in Rutland, MA (50 attendees) (*April 13*).
- Gave a presentation on tree identification to attendees of the Spring Workshop of the Tree Warden's Association of Connecticut in Pomfret (35 attendees) (*April 14*).
- Gave a presentation on trees and vines to 3rd grade students at St. Thomas's Day School in New Haven (15 students, 1 teacher) (*April 20*).

- Attended the Forest Ecosystem Monitoring Cooperative State Partnership Meeting (*April 26*).
- Attended the 2022 Forest Ecosystem Monitoring Cooperative Field Training and Calibration Session in Northfield, VT (*June 7-8*).
- Participated in the quarterly virtual meeting of the New England Society of American Foresters Executive Committee (*June 15*).
- Attended the quarterly virtual meeting of the Connecticut State Consulting Committee for Agricultural Science and Technology Education and presented an update on CAES current events and activities (*June 16*).

BLEVINS, TIA M.

- Participated in a webinar update from UMass on trapping, research, and monitoring efforts for the invasive pest, spotted lanternfly (*Lycorma delicatula*) (*August 31, 2021*).
- Completed the Invasive Insect Certification Program: For Landscape, Nursery and Urban Forest Pests, a six-session virtual webinar presented by the University of Massachusetts. Topics included Impact and Cost of Invasive Insects, Invasive Forest and Agricultural Insects, and Management of Invasive Forest and Landscape Insect Pests (*September 28-29; October 12-13, 26-27*).
- Participated in a quarterly Microsoft Teams call with our region's Export Certification Specialist from USDA-APHIS-PPQ where he answered questions from Authorized Certification Officials, provided export program updates, and gave brief trainings on topics including certifying nursery stock to Canada, and certifying house plants (*November 17*).

BRACKNEY, DOUGLAS E.

- Organized and co-hosted a 13-week long virtual vector biology seminar series titled "Virtual Vector Biology Seminar Series V" (*August-November 2021*).
- Gave a talk titled "Catch Me If You Can: A Tale of Arbovirus Evolution and Innate Immunity" at The University of Connecticut Department of Pathobiology and Veterinary Sciences (~35 attendees) (*October 21*).
- Gave an invited virtual lecture titled "Anatomical Barriers to Transmission: An Arbovirus Tale" in the Department of Biological Sciences at Texas Tech University (~35 attendees) (*November 3*).
- Gave the talk "Navigating anatomical barriers to transmission: an arbovirus tale" in the Virtual Vector Biology Seminar Series (99 attendees) (*February 25, 2022*).
- Participated and presented in the Vector-borne Diseases Symposium hosted at CAES. The title of the talk was "Emerging tick-borne viruses in the NE" (*May 10*).

BRANSFIELD, ANGELA B.

- Participated in the Federal Select Agent Program's Responsible Official Webinar Series eFSAP "Did You Know?"; eFSAP System Updates (*August 18, 2021*).
- Participated in BioRAFT's EHS Community Connection webinar "Chemical Safety for Non-Chemical Hygiene Officers" (*September 9*).
- Participated in the Federal Select Agent Program's Responsible Official webinar series "Decontamination vs. Inactivation; Inactivation Guidance" (*September 15*).
- Participated in the American Biological Safety Association's BSAT Discussion Forum "The Impact of the Pandemic on Your Select Agent Program"; and participated in a CAES Health and Safety Committee meeting (*September 24*).
- Participated in the Federal Select Agent Program's Responsible Official webinar series on "Incident Notification and Reporting," "Best Training Practices," and "Work Objective Guidance" (*October 13*).
- Participated in BioRAFT's EHS Community Connection webinar "Self-Inspections – How Should We Use Them Best?" (*October 21*).
- Attended the American Biological Safety Association's (ABSA) Business Meeting via Zoom (*October 28*).
- Participated in the Association of Public Health Laboratories' Educational Activity Biorisk Management Perspectives: Then and Now (*November 1*).
- Participated in the Federal Select Agent Program's Multiagency Informational Meeting to discuss select agent and toxin reporting requirements (*November 3*).

- Participated in the American Biological Safety Association's 2021 Select Agent Workshop Session #1 Updates from FSAP Directors and DOT Inspections – PHMSA Inspection Process and Division 6.2 Transportation (*November 4*).
- Participated in the American Biological Safety Association's 2021 Select Agent Workshop Session #2 select agent and biosafety topics (*November 9*).
- Participated in BioRAFT's EHS Community Connection webinar Safety Culture: A JEDI approach via org-culture? (*December 2*).
- Provided biosafety, biocontainment, security, and incidence response training to BSL3 laboratory personnel (16 attendees) (*February 15, 2022*).
- Participated via Zoom in Yale's Biosafety Committee Meeting (*February 17*).
- Participated in a discussion forum for ABSA International members (*March 2*).
- Participated virtually in Yale's Biosafety Committee Meeting (*March 17*).
- Participated virtually in Yale's Biosafety Committee Meeting (*April 21*).
- Provided animal training to ABSL3 and mosquito lab personnel (*April 27*).
- Attended the CAES Vector-borne Disease Symposium (*May 10*).
- Participated virtually in Yale's Biosafety Committee Meeting (*May 19*).
- Participated in the Federal Select Agent Program's Responsible Official webinar series "Interim Final Rule: SARS-CoV/SARS-CoV-2 Chimeric Viruses; Procedures for Adding New Registered Spaces" (*May 25*).
- Participated virtually in a Yale's Biosafety Committee meeting (*June 16*).

BUGBEE, GREGORY J.

- Gave a talk titled "Bashan Lake - Aquatic Plant Update" at the annual meeting of the Bashan Lake Association held at the East Haddam Grange (~75 attendees) (*July 21, 2021*).
- As President of the Northeast Aquatic Plant Management Society, presided over the society's mid-term Executive Committee meeting (*July 27*).
- Gave a virtual "Brown Bag" seminar titled "Hydrilla Invades the Connecticut River" to staff of the Connecticut Department of Environmental Protection (~40 attendees) (*August 3*).
- Gave a talk titled "Aquatic Plant Survey and Management of Vegetation in Long and Bush Ponds" to the Lantern Hill Association in North Stonington (~50 attendees) (*August 21*).
- Participated as a panelist in the mid-term meeting of the Northeast Aquatic Nuisance Species Panel (*August 25*).
- Gave a talk titled "Aquatic Plant Survey and Management of Variable Watermilfoil in Staffordville Reservoir" to the Staffordville Reservoir Association in Staffordville (~50 attendees) (*August 30*).
- As President of the Northeast Aquatic Plant Management Society, oversaw its annual preconference executive committee meeting in Hyannis, MA (*September 13-14*).
- With Ms. Summer Stebbins, gave a tour of Lake Quonnipaug to the Guilford Conservation Commission Lake Quonnipaug Subcommittee (*September 15*).
- Toured the Croton Reservoir and River hydrilla control projects with officials from the US Army Corps of Engineers, New York City Department of Environmental Protection, and New York Department of Environmental Conservation (*September 20*).
- Gave a virtual seminar titled "Aquatic Plants" to the National Garden Club Environmental School (~50 attendees) (*September 22*).
- Gave a tour of the lower Connecticut River and the Salmon River's hydrilla infestation to officials from the US Army Corps of Engineers, Lower Connecticut River Valley Council of Governments, and SePRO Corp. (*September 22*).
- Spoke on "Hydrilla in the Connecticut River" at the annual meeting of the Connecticut River Gateway Commission held on the riverboat "RiverQuest" (~65 attendees) (*October 7*).
- Gave a virtual presentation on composting, sponsored by the C.H. Booth Library (~30 attendees) (*November 9*).
- Was interviewed about composting by the Newtown Bee: https://www.newtownbee.com/11292_021/library-welcomes-soil-scientist-speaking-about-composting/ (*November 10*).
- With Ms. Summer Stebbins, gave a talk titled "Lake Chaffee Aquatic Plant Survey Results 2021" to the Lake Chaffee Improvement Association in Ashford (~25 attendees) (*November 10*).
- Gave a talk on lawn care to the North Haven Garden Club at the North Haven Recreation Center (~25 attendees)

(*November 23*).
- As a member of the Northeast Aquatic Nuisance Species Panel spoke in two virtual meetings on "Hydrilla in the Connecticut River" (*December 3 and 8*).
- As a member of the Connecticut River Hydrilla Task Force gave a virtual update on hydrilla in the Connecticut River (*December 13*).
- Chaired a meeting of the Northeast Aquatic Plant Management Society Scholarship Committee (*January 7, 2022*).
- As President of the Northeast Aquatic Plant Management Society, provided opening remarks for the 23rd Annual Conference and gave a talk titled "Hydrilla in the Connecticut River: The Management Conundrum" (~200 attendees) (*January 11*).
- With Ms. Summer Stebbins, proctored the virtual pesticide license recertification program for the Northeast Aquatic Plant Management Society (~50 attendees) (*January 11-13*).
- Updated the National Aquatic Nuisance Species Task Force Research Committee on hydrilla in the Connecticut River (*February 2 and 24*).
- Served as a panelist on the Northeast Aquatic Nuisance Species Panel (*February 4*).
- Participated as Past President at an Executive Committee meeting of the Northeast Aquatic Plant Management Society (*February 23*).
- Provided an update with Ms. Summer Stebbins at the Connecticut River Hydrilla Stakeholders meeting (*March 23*)
- Gave a seminar with Ms. Summer Stebbins on Connecticut's Invasive Aquatic Plant Problem at Three Rivers Community College (~50 attendees) (*March 23*).
- Gave a virtual seminar with Ms. Summer Stebbins on Connecticut's Invasive Aquatic Plant to a class of Master Gardeners (~30 attendees) (*March 24*).
- Along with Ms. Summer Stebbins, staffed the CAES table at Agriculture Day in the Hartford Armory (*March 25*).
- Gave a talk titled "Composting" to the Newtown Horticulture Club at the Newtown Community Center (~40 attendees) (*April 14*).
- Gave a talk titled "Container Gardening Indoors and Out" to the West Haven Garden Club at the West Haven Public Library (~30 attendees) (*April 19*).
- Judged the Quinnipiac University Science Fair (*April 25*).
- Updated the National Aquatic Nuisance Species Control panel on hydrilla in the Connecticut River (*April 26*).
- Participated as a panelist on the National Aquatic Nuisance Species Research panel (*April 29*).
- Served as a panelist on the Northeast Aquatic Nuisance Species Panel at the Spring meeting (*May 10 and 12*).
- With Ms. Summer Stebbins, gave a talk titled "Hydrilla in the Connecticut River" at a seminar sponsored by the Connecticut River Conservancy (~30 attendees) (*May 18*).
- With Ms. Summer Stebbins, held an Invasive Aquatic Plant Workshop for staff of the Aquarion Water Company in Trumbull (~25 attendees) (*May 31*).
- Gave a talk titled "Rogers Lake Aquatic Plant Survey 2021" at a public meeting of the Rogers Lake Authority at the Rogers Lake Association Clubhouse in Lyme (~40 attendees) (*June 8*).

CANTONI, JAMIE L.
- With Dr. Gale Ridge, Ms. Katherine Dugas, Dr. Nubia Zuverza-Mena, Dr. Jaya Borgatta, and Ms. Meghan Cahill attended and staffed the CAES booth at the Big E in West Springfield, MA (*September 23, 2021*).
- With Ms. Katherine Dugas, staffed the CAES booth and display at the Connecticut Flower and Garden Show at the Connecticut Convention Center (*February 24, 2022*).
- Presented a talk about ticks and the Active Tick Surveillance Program, and the efforts and importance of the Surveillance Program in the state for the Prospect Land Trust's annual banquet dinner (*May 1*).

CHEAH, CAROLE A.
- Instructed two forestry interns from Great Mountain Forest, Norfolk, on hemlock pest identification and damage assessment (*July 13, 2021*).
- Was interviewed about the resurgence of hemlock woolly adelgid (HWA) by Mattie Vandiver for Norfolk Now (*July 14*).
- Was interviewed on the biological control release of *Sasajiscymnus tsugae*, an HWA predator, at the Great

Mountain Forest in Norfolk in July 2021 by Mary Neill for the Great Mountain Forest Newsletter (*July 30*).

- Assessed HWA infestations at Doolittle Lake, a private lake association in Norfolk, and gave a presentation on biological control of HWA (8 attendees) (*August 26*).
- Spoke about "Biological Control of Hemlock Woolly Adelgid" as part of the 100th Anniversary Celebration of the Valley Laboratory (*September 10*).
- Gave an evening Zoom presentation through the Woodbury Library on resurgence of hemlock woolly adelgid (HWA) and expanding biological control of HWA for towns and homeowners (41 attendees) (*September 28*).
- Was interviewed on the effects of winter 2022 on hemlock woolly adelgid (HWA) survival by Bob Miller of the News-Times (*February 8, 2022*).
- Gave a talk via Zoom on collaborations for the biological control of HWA at the Forest Health Monitoring Workshop (*March 8*).
- Gave an evening presentation on the biology, threat, and resurgence of HWA and expanding biological control of HWA on land trust properties to Flanders Land Trust (17 attendees) (*March 24*).
- Trained volunteers for the Wyndham Land Trust on techniques for hemlock health field assessments (*April 8*).
- Was interviewed about biological control agents of hemlock woolly adelgid (HWA) by Bob Miller of the News-Times (*April 26*).
- Released *Sasajiscymnus tsugae* for biological control of HWA at the Town of Glastonbury Cotton Hollow preserve and Wickham Park, Manchester, with town and park staff (*May 5*).
- Released *S. tsugae* along the Farmington River watershed forest at the American Legion State Forest with DEEP forestry staff (*May 11*).
- Gave a talk on biological control of HWA and led a tour for releases of *S. tsugae* for an event by the Friends of American Legion and Peoples State Forests (*May 14*).
- Trained foresters and interns from Great Mountain Forest, Norfolk, and implemented releases of *S. tsugae* for HWA control (6 attendees) (*May 19, 20, and 23*).
- Trained property owners at two private lake communities in Norfolk, and guided releases of *Sasajiscymnus tsugae* for hemlock woolly adelgid (HWA) control at Tobey Pond (13 attendees) (*June 1-3*), and Doolittle Lake (11 attendees) *(June 7*).
- Gave a talk on collaborations in HWA biological control for the forest health lecture program at Great Mountain Forest, Norfolk (25 attendees) (*June 11*).
- Gave a talk to the Appalachian Trail Conservancy Ridge Runners and volunteers at the North West Camp, Connecticut Chapter of the Appalachian Mountain Club on Mt. Riga, Salisbury (7 attendees) (*June 15*).

COWLES, RICHARD S.

- Presented display posters of "Response of Bare-Root Christmas Tree Transplants to Fertilizer at Planting" and (for the children's passport) "What Essential Minerals Do You Need?" for Plant Science Day in Hamden (*August 4, 2021*).
- Presented "Soil Health" to the Massachusetts Christmas Tree Growers Association meeting in Hatfield, MA (45 participants) (*August 14*).
- Hosted the Twilight Meeting for the Connecticut Christmas Tree Growers Association and discussed "After-Effects of Drought on Cone Production and Spruce Spider Mites" and "Phytophthora, Drainage and Soil Health" in Broad Brook (50 attendees) (*August 18*).
- Presented "Phytophthora Root Rot Management" (50 attendees) and "The Box Tree Moth" (20 attendees) at the 100th Anniversary Celebration of the Valley Laboratory (*September 10*).
- Spoke on the subjects of "Phytophthora Root Rot, Armored Scale, and Mite Management" to the Christmas Tree Growers Association meeting in East Haddam (50 attendees) (*September 11*).
- Presented "Ticks and Spotted Lanternfly Biology" to the Connecticut Rose Society in Plainville (25 attendees) (*October 3*).
- Spoke about the "Spotted Lanternfly" to the Fairfield County Farm Bureau via Zoom (10 attendees) (*October 4*).
- Discussed "Global Warming Science and Impacts to Agriculture" at the Cornell Club of Fairfield County hayride in Shelton (20 attendees) *(October 24*).
- Presented "Neonicotinoids and Bee Safety" to the North Central Conservation District via Zoom (12 attendees) (*October 27*).

- Presented "Application of Kaolin to Pumpkins to Improve Flower Bud Formation" to the Climate Adaptation Fellowship Program, University of Maine (40 attendees) (*January 5, 2022*).
- Spoke about "Neonicotinoid Alternatives" to Valley Green's pesticide training for turf professionals, Marlborough, MA, remotely (50 attendees) (*January 13*).
- Presented "Neonics and Their Alternatives" to the Northeast Regional Pesticide Education Safety Conference via Zoom (30 participants) (*March 1*).
- Presented "Update on Projects Supported by the Christmas Tree Promotion Board" for the Connecticut Christmas Tree Growers Association (60 participants) (*March 5*).
- Discussed "Climate Weirdness: Implications for Insect and Disease Outbreaks" at ArborEXPO, West Springfield, MA (120 participants) (*March 31*).
- Presented "Climate Change Basics and Threats to Growing Roses" to the regional meeting of rose growers hosted by the CT Rose Society in Mystic (60 participants) (*April 2*).
- Presented "Insect and disease management" at the CCTGA twilight meeting, Litchfield (40 attendees) (*June 21*).

CREIGHTON, MARK H.

- Spoke at the annual Connecticut Beekeepers Association bee school on "Basic Honey Bee Health" which had a primary focus on Varroa destructor and the proper use of acaricides. Special focus was placed on the proper use of oxalic acid as was requested by the Pesticide Management Program at the Connecticut Department of Energy and Environmental Protection (84 new beekeepers) (*January 29, 2022*).
- Attended a lecture on Bumble Bee Basics with Heather Holm sponsored by the Connecticut Beekeepers Association (*February 3*).
- Presented a comprehensive honey bee program at Marianapolis Preparatory School in Thompson, CT. The program involved several lectures on honey bees, workshops on beehive construction, and a class on external anatomy dissection. Students also discovered how to use a cell phone camera to take pictures through a dissection microscope lens and entered them into the school's bridge week photo contest. The wooden bee boxes that were assembled were then donated to the Huneebee Project in New Haven (23 students) (*March 7-10*).
- Presented a talk on "Straw Bale Gardening" to the Daytime Gardeners in North Haven, who committed to starting a straw bale garden this year using the information provided (14 attendees) (*March 22*).
- Coordinated a meeting at CAES with the Presidents of Connecticut's three beekeeping clubs, the Apiary Inspector, State Entomologist, and Deputy State Entomologist. The goal of the meeting was to establish a working relationship and identify future joint projects to improve the health of honey bees statewide (*March 24*).
- Spoke on Straw Bale Gardening in support of pollinators at Stonington Vineyard hosted by The Stonington Land Trust (*June 14*).

da SILVA, WASHINGTON

- Traveled to Minas Gerais state in Brazil and, as part of a professional development program sponsored by the local city hall to encourage the young local students to pursue higher education, he presented two seminars titled "The Roads I Have Travelled: A Journey from Rural Brazil to the Establishment of a Modern Virology Lab in Connecticut USA" at a local college and high school in Divinolândia de Minas in Brazil (300 attendees) (*September 9, 2021*).
- Participated and helped to organize the 2021 Grower Education presented by the Connecticut Farm Wine Development Council. Dr. Wayne Wilcox, a professor emeritus from Cornell University, shared his years of experiences on vineyard disease control and management to Connecticut grape growers via a virtual meeting on WebEx (50 attendees) (*October 27*).
- Taught a two-week long General Virology Class on Zoom to graduate students from the Universidade Federal Rural do Semiárido (UFERSA). During his lectures, he showcased the research performed at CAES with special emphasis on CAES's plant virology program (20 attendees) (*December 6-17*).
- Presented a Zoom seminar at the first conference on plant protection and diagnosis of plant pathogens affecting important crops in Brazil titled "Interference RNA (RNAi): A New Perspective on Plant Disease Management" (160 adults) (*February 15, 2022*).
- Upon invitation, visited the universities UFRN and UFERSA in northeastern Brazil, to meet with faculty members, students, and local growers of melon and papaya. He discussed potential collaborations with local universities and

agro-industries; and the prospect of bringing students to spend a year in the da Silva Lab at The CAES to be trained in molecular virology (*February 19-March 10*).

- Presented a seminar at the Universidade Federal do Rio Grande do Norte (UFRN) in Natal, Rio Grande do Norte state, Brazil, titled "Nano-enabled Technologies: Prospective Weapons to Tackle Destructive Plant Viruses" (20 adults in person, 60 adults via Zoom) (*February 22*).
- Presented a seminar at the Universidade Federal Rural do Semiárido (UFERSA), in the city of Mossoró, Rio Grande do Norte state, Brazil, titled "Nanotechnology: an arsenal of options in the control of phytoviruses and other plant pathogens" (20 adults in person, 100 adults via Zoom) (*March 7*).
- Presented a seminar for the Department of Plant Pathology at Cornell University titled "Nano-enabled Technologies: Prospective Weapons to Tackle Destructive Plant Viruses" (75 attendees) (*April 26*).
- Presented a seminar at Cornell University to the Department of Plant Pathology titled "Nano-enabled Technologies: Prospective Weapons to Tackle Destructive Plant Viruses" (75 attendees) (*April 26*).
- Presented a seminar at Flagship Pioneering, an RNA biology company based in Cambridge, MA, titled "Small Things Considered: Using RNAi and Nanotechnology to Control Plant Pathogens" (25 attendees) (*May 6*).
- Participated in the CT Farm Wine Development Council meeting as the Scientific Border Advisor Member (10 participants) (*June 23*).
- Was interviewed by journalist Brian Scott-Smith for the WSHU regarding the USDA-NIFA grant that he and his group were awarded to study nanocarriers of dsRNA molecules (*June 27*).

DUGAS, KATHERINE

- With Dr. Gale Ridge, Ms. Jamie Cantoni, Dr. Nubia Zuverza-Mena, Dr. Jaya Borgatta, and Ms. Meghan Cahill attended and staffed the CAES booth at the Big E in West Springfield, MA (*September 23, 2021*).
- Presented an evening insect program about pollinators, beneficials, pests, and invasive species for the Hillstown Grange in East Hartford, CT (*May 5, 2022*).
- Spoke to visitors about her work at the CAES Insect Information Office as part of the Arts and Ideas Festival (*June 16 and 24*).
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EITZER, BRIAN D.

- Attended the Food and Drug Administration (FDA) Laboratory Flexible Funding Model (LFFM) kick-off call (*July 1, 2021*).
- Moderated a panel discussion on the analysis of pesticides during the 57th North American Chemical Residue Workshop, which was held online (110 attendees online during pesticide forum) (*July 26-30, 2022*).

ELMER, WADE H.

- Attended via Zoom the NIFA plan of work conference webinar (51 attendees) *(July 7, 2021*).
- With Drs. Jason White and Yi Wang, participated via Zoom with in the CAES-UMass Nano S update (6 attendees) (*July 9*).
- Attended the CAES Art Open House in Jenkins-Waggoner Laboratory (25 attendees) (*July 13*).
- Held a Zoom conference with Drs. Robert McGovern and Meg McGrath concerning their Springer publication (*July 16*).
- Attended via Zoom the CNS Plant Nano Group meeting (26 attendees) (*July 20*)
- Attended via Zoom the monthly APS Foundation Committee meeting (9 attendees) (*July 21*).
- Attended the APS Ornamental Disease Committee meeting (43 participants) (*July 26*).
- Had a Zoom conference with Ms. Jaya Borgatta for nano P research at CAES (*July 27*).
- Gave a virtual presentation titled "Nano Cu for Plant Disease Management" at the University of Punjab, Pakistan (102 participants) (*July 29*).
- Attended the annual meeting of the American Phytopathological Society via Zoom (*August 3-5*).
- Attended the NIFA plan of work conference webinar (51 attendees) (*August 7*).
- With Drs. Jason White, Christian Dimkpa, Jaya Borgatta, and Yi Wang, participated via Zoom in the CAES-UMass Nano S update (6 attendees) (*August 10*).
- Attended via Zoom the CNS Plant Nano Group meeting (26 attendees) (*August 17*).
- Attended via Zoom the monthly APS Foundation committee meeting (9 attendees) (*August 18*).

- Attended the CT Management Advisory Council Meeting (148 attendees) (*August 18*).
- Presented the Keynote lecture titled "Nanotechnology and Plant Disease Management" at the 52nd Conference at the Brazilian Phytopathology meeting (493 participants) (*August 25*).
- With Dr. Jason White, participated in Carolina Valdes Bracamontes' Ph.D. Proposal B Defense (UTEP) (3 attendees) (*September 2*).
- With Drs. Jason White, Yi Wang, and faculty from UMass, attended the CAES-UMass Nano S update (7 attendees) (*September 9*).
- With Drs. Jason White and Neil Schultes, Mr. Michael Last, Mr. Craig Musante, and Ms. Terri Arsenault, attended the CAES P-4 Association council (6 attendees) (*September 13*).
- Attended the CT Management Advisory Council meeting (162 attendees) (*September 15*).
- Attended the NIFA plan of work conference webinar (122 attendees) (*September 23*).
- With Dr. Jason White and Mr. Michael Last, attended the CAES Board of Control meeting in Windsor (7 attendees) (*October 13*).
- Attended a NIFA plan of work conference webinar (122 attendees) (*October 14*).
- Attended an APS Press Committee meeting (5 attendees) (*October 15 and 27*).
- Moderated the CNS Plant Nano Group meeting (26 attendees) (*October 19*).
- Attended via Zoom the monthly APS Foundation Committee meeting (11 attendees) (*October 20*).
- Attended via MS Teams the CT Management Advisory Council Meeting (126 attendees) (*October 20*).
- Held a Zoom conference with Drs. Robert McGovern and Meg McGrath concerning their Springer publication (*October 21*).
- Attended the CT Management Advisory Council Meeting (162 attendees) (*October 26*).
- Participated in Workplace Discrimination Investigation UPDATE Training (75 attendees) (*November 3*).
- Participated in the APS Press Quarterly Conference call (9 attendees) (*November 3*).
- Participated in a Working Lands Alliance meeting (76 attendees) (*November 10*).
- Gave a presentation via Zoom titled "Nano-Cu for Plant Health" at the online Materials Innovation for Sustainable Agriculture 2021 conference (34 participants) (*November 12*).
- Attended the Sussex Plant Biology Symposium (*November 12*).
- Attended via Teams the CT Management Advisory Council Meeting (82 attendees) (*November 17*).
- Participated in the monthly APS Foundation Committee meeting (9 attendees) (*November 17*).
- Participated via Zoom in a monthly APS Press Update conference with authors of the Compendium of Citrus Diseases (5 attendees) (*November 19*).
- With Drs. Jason White, Christian Dimkpa, Jaya Borgatta, Ishaq Adisa, and colleagues from Johns Hopkins University, held a Zoom conference for a NIFA grant project on nano P (7 attendees) (*November 23*).
- Held a Zoom conference with Drs. Robert McGovern and Meg McGrath concerning their Springer publication (3 attendees) (*November 23*).
- Attended via Zoom a NIFA reporting webinar (81 attendees) *(December 9 and 16*).
- Attended via Zoom the Nano Plant Group for the Center for Sustainable Nanotechnology meeting (12 attendees) (*December 14*).
- Presented via Zoom "Nanoscale Copper for Plant Disease Management" to the Jubilee lecture series of the Indian Phytopathological Society's Annual Meetings (55 attendees) (*December 14*).
- Attended via Teams the CT Management Advisory Council Meeting (84 attended) (*December 15*).
- Participated in the monthly APS Foundation Committee meeting (9 attended) *(December 15*).
- Participated via Zoom in a monthly APS Press Update conference with authors of Citrus compendium (5 attended) (*December 17*).
- Attended via Zoom the Nano Plant Group meeting for the Center for Sustainable Nanotechnology (12 attendees) (*January 11, 2022*).
- Attended via Zoom the Connecticut Commission on Human Rights and Opportunities (*January 12*).
- Attended the NIFA reporting webinar (81 attendees) (*January 13*).
- With Dr. Jason White and Mr. Michael Last, attended the CAES Board of Control Meeting in Wethersfield (10 attendees) (*January 18*).

- With Dr. Yonghao Li, participated in a discussion with members of the National Plant Diagnostic Network and UConn (*January 19 and 25*).
- Participated in the monthly APS Foundation Committee meeting (9 attendees) (*January 19*).
- Presented a seminar via Zoom titled "Nanoscale Copper for Plant Disease Management to the Purdue University, Department of Horticulture and Landscape Architecture (33 attendees) (*January 20*).
- Participated via Zoom in a monthly APS Press Update conference with authors of the Citrus compendium (5 attendees) (*January 21*).
- Presented a talk titled "Earthworms and Soil Health" to the Branford Land Trust in Branford, CT (16 attendees) (*March 8*).
- With Carlos Mendez, attended via Zoom the Nano Plant meeting for the Center for Sustainable Nanotechnology (11 attendees) (*April 13*).
- Along with Dr. Jason White and Mr. Michael Last, attended the Board of Control meeting in the director's board room in Slate building (*April 14*).
- With Drs. Jason White and Christian Dimkpa, Zoom conferenced with Dr. Swadesh Santra about nano fertilizers (*April 15*).
- Participated as a member of the UConn search committee for the PSFL department head via WebEx in the candidates' interviews (*April 15*).
- With Drs. Christian Dimkpa, Ishaq Adisa, and Carlos Mendez, visited with Dr. Ben Hsiao of Stony Brook University, New York, about nano fertilizers (*April 15*).
- Attended via Teams in the CT Management Advisory Council Monthly Meeting (*April 21*).
- Participated via Zoom in the American Phytopathological Society Foundation meeting (*April 21*).
- Participated as a member of the UConn search committee for the PSFL department head via WebEx in Dr. Mengmeng Gu's interviews (*April 27-28*).
- Attended the NIFA POW reporting webinar (*April 28*).

GLORIA-SORIA, ANDREA

- Gave an invited presentation titled "Highlights in Medical Entomology 2021" before the Medical, Urban, and Veterinary (MUVE) Section of the Entomological Society of America at the annual Entomological Society of America hybrid meeting in Denver, CO (100 on-site attendees, 25 virtual attendees) (*October 31-November 3, 2021*).
- Attended the Arthropod Genetics Symposium virtual Session III: Arthropod Genomics and Genome Engineering (*April 12, 2022*).
- Participated virtually on a grant review panel for the AAPG2022, CE15 – Immunologie, Infectiologie et Inflammation, from Agence Nationale de la Recherche, France (*several days in April*).
- Helped organize a ceremony commemorating the 150th anniversary of the Arbor Day creation at Church St. Elementary School in Hamden, together with the US Forest Service Northern Research Station during Arbor Day (300 participants) (*April 29*).
- Gave a talk titled "Invasion Biology of *Aedes* Mosquitoes" at the CAES Vector Biology Day symposium (104 attendees) (*May 10*).
- Gave a talk titled "Population Genetics of an Invasive Mosquito Vector; *Aedes albopictus* in the Northeastern USA" at the 5th International Workshop on *Aedes albopictus*, Montpellier, France (~120 attendees) (*May 11-13*).

HISKES, ROSE T.

- With Dr. Todd Mervosh, led a walk and talk on invasive plants at the summer Connecticut Tree Protective Association meeting at the Farmington Club (~100 attendees) (*July 15, 2021*).
- Organized a Connecticut Invasive Plant Working Group "Invasive Plant Walk, Talk and Cut" at The Preserve state park in Old Saybrook (17 attendees) (*July 17*).
- Gave a talk titled "Insects: The Good, the Beautiful, the Bad and the Just Plain Ugly" to the Daytime Gardeners of North Haven (11 attendees) (*October 26*).
- Presented "What's New in the Diagnostic Office" to the Hill and Dale Garden Club of South Glastonbury (20 attendees) *(November 11*).

- Was interviewed by Nancy Marek, a Ph.D. Student in Natural Resource Economics at UConn, on invasive plant management as part of a National Science Foundation grant for building an invasive plant removing robot (*November 15*).
- Confirmed via USDA APHIS PPQ the first detection of *Paracorsia repandalis* in Connecticut: https://bugguide.net/node/view/2048795#3388896 (*December 1*).
- With Connecticut Invasive Plant Working Group (CIPWG) Symposium Planning Committee members Anne Rowlands and Lisa Brodlie to select a venue for CIPWG's 2022 Symposium (*December 13-14*).
- Participated in a Zoom meeting conducted with Ms. Lorraine Muha, LiveNation, and CIPWG to hold its 2022 fall symposium at the Oakdale Theater, Wallingford, CT (*December 17 and 29*).
- Organized and conducted a Connecticut Invasive Plant Working Group Symposium planning committee meeting via Zoom (16 attendees) (*January 6, 2022*).
- Participated in the Connecticut Tree Protective Association Virtual Annual Meeting (*January 20*).
- Attended the UMass Jumping Worms Virtual Conference (*January 26-27*).
- Conducted a Connecticut Invasive Plant Working Group (CIPWG) Symposium planning committee meeting via Zoom (16 attendees) (*February 3*).
- Participated in the Connecticut Invasive Plants Council virtual meeting (*February 15*).
- Set up and staffed the Connecticut Invasive Plant Working Group booth at The Connecticut Flower and Garden Show in Hartford, CT (*February 23, 26, and 27*).
- Conducted a Connecticut Invasive Plant Working Group (CIPWG) Symposium planning committee meeting via Zoom (16 attendees) (*March 3*).
- Participated in a meeting with Mr. Peter Hearn, Council on Environmental Quality, along with Ms. Victoria Wallace and Mr. Emmett Varrichio, CIPWG Co-chairs regarding information on CIPWG for the report "'Invasives': Previously Described and Newly Arrived" (*March 7*).
- Gave a talk titled "Earthworms, Soil Health and Jumping Worms," to the Canton Garden Club at the Canton Community Center in Canton (27 attendees) (*March 8*).
- With Dr. Yonghao Li, instructed "Tree Diseases" in the Hands-on Night for the Connecticut Tree Protective Association Arboriculture 101 Course in Jones (36 adults) *(March 10*).
- Notified the CAPS Committee regarding the new insect find, *Paracorsia repandalis*, a caterpillar pest of mullein (20 adults) (*March 22*).
- Met with Ms. Elisabeth Tonkin of Seabury Life Plan Community regarding holding a CIPWG Walk and Talk on the property in May (*March 25*).
- Participated in an invasive plant pulling party at Spicebush Swamp Park in West Hartford (*March 26*).
- Conducted a Connecticut Invasive Plant Working Group (CIPWG) Symposium planning committee meeting via Zoom (16 attendees) (*April 7*).
- Staffed a CIPWG booth at the Hamden Earth Day Celebration at Hamden Middle School (~50 visitors) (*April 23*).

KERIÖ, SUSANNA

- Attended the Connecticut Tree Protective Association summer meeting in Farmington (*July 15, 2021*).
- Served on the CT Urban Forestry Council's RFP committee (*July 20*).
- Participated in the CT Urban Forestry Council (*July 22*).
- Served as a reviewer on a USDA NIFA grant panel (*August 17*).
- Assisted with administering examinations to arborist candidates for the Connecticut Tree Protection Examining Board at Lockwood Farm (*September 8*).
- Participated in the annual meeting for the Multistate Research Project NE1833 - Biological Improvement of Chestnut Through Technologies that Address Management of the Species and its Pathogens and Pests (*September 10*).
- Attended a seminar about citizen science research projects (*September 15*).
- Served on the Yale Biological Safety Committee (*September 16*).
- Gave an invited talk titled "Trends in Urban Tree Stress in New England" at the New England International Society of Arborists 2021 Annual Conference and Trade Show in Manchester, NH (250 attendees) (*October 4*).
- Gave a seminar titled "From Genomics to Forest Management" for the Department of Horticulture and Landscape Architecture seminar series at the University of Connecticut Storrs campus (6 attendees) (*October 15*).

- Attended the Society of American Foresters virtual convention (*November 3-6*).
- Gave a talk titled, "Nanoparticles as Tree Care Agents: Chestnuts as a Case Study" at the Society of American Foresters virtual convention (37 participants) *(November 4*).
- Participated on Yale's Biosafety Committee (*November 18*).
- Participated in the CT Urban Forestry Council's virtual meeting (*November 18*).
- Participated on the Connecticut Urban Forestry Council's grant committee (*December 6*).
- Assisted in administering the arborist exam (*December 8*).
- Served on the Connecticut Urban Forestry Council's grant committee (*December 14*).
- Served on the Yale Biosafety Committee (*December 16*).
- Participated in a meeting of the Yale Biosafety Committee (*January 20, 2022*).
- Participated in a virtual meeting of the Connecticut Urban Forestry Council (*January 27*).
- Participated in a meeting of the Yale Biosafety Committee (*February 17*).
- Presented a talk titled "Sweet Dreams - Carbohydrates and Stress in Urban Trees" in the Forest Health Monitoring Workshop (42 participants) (*March 8*).
- Assisted the administration of the arborist exam (*March 9*).
- Participated in a CT Urban Forestry Council meeting (*March 24*).
- Participated in a Zoom meeting to discuss collaboration with USFS related to sentinel trees (*April 7 and 27*).
- Presented a webinar on chestnut research plans in The American Chestnut Foundation's (TACF) Science and Tech committee meeting (40 attendees) (*April 8*).
- Served on a Connecticut Urban Forest Council (CUFC) conference planning meeting (*April 13*).
- Served on a CUFC grant review panel (*April 19*).
- Served on the Yale Biosafety Committee (*April 21*).
- Judged posters for the Quinnipiac Chapter of Sigma Xi Student Research Symposium (*April 25*).
- Gave a talk titled "Right Tree for the Right Place" for the Daytime Gardeners of North Haven meeting (15 attendees) (*April 26*).
- Discussed chestnut-related research with TACF collaborators (*April 29*).
- Served on the CT Urban Forestry Council's conference planning committee (*May 16*).
- Administered the arborist exam at Lockwood Farm (*June 8*).

LAMONDIA, JAMES A.

- Spoke about "Fungicides and Management Implications for Boxwood Health" during the AmericanHort Cultivate21 meeting held in Columbus, OH (50 attendees) (*July 11, 2021*).
- Met with Lewis Flowers of Universal Leaf to discuss breeding varieties for resistance to pathogens (*July 13*).
- Met virtually with SCRI colleagues to revise a boxwood chapter in an APS Press book on woody ornamental diseases (*July 19*).
- Participated in a Society of Nematologists Honors and Awards Committee meeting (*July 27*).
- Participated in the online American Phytopathological Society meeting (*August 2-6*).
- Met virtually with SCRI colleagues to present research results in boxwood blight epidemiology (*August 10*).
- Participated in the Beech Leaf Disease Update Zoom meeting (20 attendees) (*August 17*).
- Participated in a SCRI Boxwood Blight Grant project Zoom progress update meeting (15 attendees) (*August 18*).
- Participated in the virtual SCRI progress update meeting for the Advisory Panel (25 attendees) (*September 3*).
- Participated in the 100-Year Anniversary Celebration of the Tobacco Station/Valley Lab, speaking about "No-Till/Reduced-Till Tobacco," "Weather, Water, Early Flowering and Disease, the Story of 2021," "Breeding for Disease Resistance in Connecticut Broadleaf," "Boxwood Blight Management," and "Beech Leaf Disease" (175 people) (*September 10*).
- Was interviewed about the history, research, and services at the Valley Laboratory by Brian Scott-Smith of WSHU (*September 10*).
- Virtually attended the Society of Nematologists meeting and presented a poster titled "Effects of Planting Density on Litchi Tomato (*Solanum sisymbriifolium*) Trap Crop Efficacy Against the Tobacco Cyst Nematode, *Globodera tabacum*" (*September 12-15*).

- Participated in the annual meeting of the Northeast Regional Multistate Nematology Technical Committee (NE-1640) held virtually (17 attendees) (*September 16*).
- Was interviewed about the status of the Connecticut Valley tobacco crop in 2021 by Chris Bickers for the Tobacco Farmer Newsletter (*September 22*).
- Spoke about "Epidemiology and Technical Integration for Boxwood Blight Management" during the virtual SCRI grant annual meeting (23 attendees) (*October 5*).
- Participated in a virtual research update meeting on beech leaf disease (20 attendees) (*October 15*).
- Participated in the virtual Boxwood Blight Insight Group Epidemiology meeting (17 attendees) (*October 25*).
- Was interviewed about goldencreeper, a new invasive weed in Connecticut, by Earth Matters columnist Robert Miller of the News-Times (*November 2*).
- Gave a talk titled "Connecticut Cigar Wrapper Leaf: Disease Management Approaches" to the North Carolina Tobacco Extension Agent Training meeting (50 attendees) (*November 9*).
- Taught a lecture and laboratory section about Nematology as a part of the University of Connecticut Fundamentals of Plant Pathology class (22 attendees) (*November 10*).
- Provided a recorded webinar titled "Fungicides and Management Implications for Boxwood Health" to AmericanHort (*November 12*).
- Participated virtually in the Boxwood Blight SCRI Annual Meeting (*December 6*).
- Conducted oral exams for candidates for the Connecticut arborist license and participated in the quarterly meeting of the Connecticut Tree Protection Examining Board in New Haven (*December 8*).
- With Dr. Richard Cowles, conducted a webinar hosted by Rainbow EcoScience about "Beech Leaf Disease in Connecticut" (231 attendees) (*February 1, 2022*).
- Participated in a virtual Boxwood Blight Insight Group Epidemiology meeting (17 attendees) (*February 7*).
- Participated in Agriculture Day at the Capitol, speaking about the 2021 Century Farm Award recognizing March Farms (100 people) (*March 25*).
- Spoke about "The History of Tobacco in Connecticut" at the Enfield Public Library (50 attendees) (*March 29*).
- Participated in a research discussion about Beech Leaf Disease with personnel from Bartlett Tree, Davey Tree, and Cleveland MetroParks (*April 18*).
- Spoke about 2022 research projects and plant breeding goals at the Nutrien Tobacco Growers meeting in Somers (80 attendees) (*May 4*).

LI, DEWEI

- Participated in the International Society for Mushroom Science (ISMS) e-Congress 2021 (*September 14-17, 2021*).
- Participated in the virtual 2021 Biennial MassMyco Meeting and gave a presentation titled "De-Wei's Recent Mycological Research" (40 attendees) (*November 6*).
- Participated in the virtual 64th Annual Forest Pest Management Forum (*December 7-9*).
- Presented a seminar titled "Fungi Found in CT: Good and Bad" at Real Art Ways in Hartford (53 attendees) (*May 11, 2022*).

LI, YONGHAO

- Was interviewed about vegetation management and plant diseases for the Forest Management Research via WebEx by UConn graduate student researchers Jacob Cabral and Emlyn Crocker (*July 1, 2021*).
- Was interviewed about climate change and food production by Ms. Jan Spiegel from the CT Mirror (*July 2*).
- Was interviewed about summer weather and plant diseases by Robert Miller from the News-Times (*July 14*).
- Staffed the CAES booth and presented a poster titled "Impacts of Drought Stress on Arborvitae in 2020" at the Connecticut Tree Protective Association summer meeting held in Farmington (*July 15*).
- Presented "Backyard Composting 101" for the Avon Free Public Library Education Program via Zoom (38 adults) (*August 18*).
- Presented a talk about "Abiotic Stress and Needle Cast Diseases" at the Connecticut Christmas Tree Growers Association Twilight Meeting in East Windsor (40 adults) (*August 18*).
- Presented "Principles of Organic Gardening" for the Conning Wellness Program via Zoom (51 adults) (*August 19*).
- With Drs. Robert Marra and Claire Rutledge, staffed the CAES disease and insect tables at the Tree Warden

Association of Connecticut Fall Gathering in Madison (*September 18*).

- Participated in the National Plant Diagnostic Network National Meeting's Poster Committee meeting via Zoom (*September 20*).
- Gave a lecture on "Tree Diseases" to the Connecticut Tree Warden School via Zoom (30 adults) (*September 23*).
- Participated in the National Plant Diagnostic Network Poster and Exhibit Committee meeting via Zoom (5 adults) (*October 4*).
- Gave a talk titled "Gardening with Native Plants" for the Hill and Dale Garden Club in Glastonbury (25 adults) (*October 7*).
- Participated in the National Plant Diagnostic Network Online Communication and Web Portal Committee meeting via Zoom (6 adults) (*October 13*).
- Gave a lecture on "Diseases of Trees" for the Connecticut Tree Protective Association's Arboriculture 101 Course held in the Station's Jones Auditorium (31 adults) (*October 13*).
- Instructed "Tree Diseases" in the Hands-on Night for the Connecticut Tree Protective Association's Arboriculture 101 Course held in the Station's Jones Auditorium (25 adults) (*October 20*).
- Participated in the National Plant Diagnostic Network Online Communication and Web Portal Committee meeting via Zoom (6 adults) (*November 10*).
- Presented a lecture, "Phytophthora bleeding canker of beech" in the Review Night of the Connecticut Tree Protective Association Arboriculture 101 Course in New Haven (24 adults) (*December 1*).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (8 adults) (*December 8*).
- Attended the Connecticut Tree Protective Association Annual Meeting via Zoom (*January 20, 2022*).
- With Dr. Wade Elmer, participated in the National Plant Diagnostic Network grant discussion with UConn, regional centers, and the national executive director via Zoom (8 adults) (*January 19*) and (4 adults) (*January 25*).
- Attended the Connecticut Nursery and Landscape Association Winter Symposium and presented "Principles of Disease Management" (77 adults) and "Use of Fungicides in Nursery and Landscape Settings" (73 adults) via Zoom (*January 25-26*).
- Attended the National Plant Diagnostic Network IT Meeting via Zoom (*January 26-27*).
- Presented "2021 Plant Disease Update – CAES" at the Northeast Plant Diagnostic Network meeting via Zoom (18 adults) (*January 31*).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (6 adults) (*February 9*).
- Gave a lecture titled "Diseases of Trees" for the Connecticut Tree Protective Association Arboriculture 101 Course in Jones (40 adults) (*February 10*).
- Presented "Diagnosing Plant Disease Problems – Basics and Steps" at the CT NOFA Winter Conference via Zoom (42 adults) (*February 16*).
- Presented "2021 Tree Disease Highlights" at the Forest Health Monitoring Workshop via Zoom (54 adults) (*March 8*).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (6 adults) (*March 9*).
- Instructed "Tree Diseases" in the Hand-on Night for the Connecticut Tree Protective Association Arboriculture 101 Course in Jones Auditorium (36 adults) (*March 10*).
- Attended the National Plant Diagnostic Network Seed Pathogen Testing Workshop via Zoom (*March 17*).
- Was interviewed about "Prospective Role Model in the Industry" by Ms. Christa Lessing at the University of Vermont via Zoom (*March 18*).
- Attended the 2022 Yankee District Rose Convention in Mystic, CT (*April 2*).
- Presented "Plant Propagation" to Branford Garden Club members in Branford, CT (18 adults) (*April 5*).
- Instructed "Phytophthora Bleeding Canker" for the Review Night of the Connecticut Tree Protective Association's Arboriculture 101 Course in Jones Auditorium (24 adults) (*April 7*).
- Attended the Northeastern American Phytopathological Society virtual meeting and presented "Ornamental Disease Updates" (26 adults) (*April 21*).
- Attended the 2022 National Plant Diagnostic Network National Meeting via Zoom (*April 27-28*).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting

via Zoom (5 adults) (*May 11*).
- Presented "Summer Gardening Tips" to Kensington Garden Club members in Berlin (32 adults) (*May 19*).
- Participated in the National Plant Diagnostic Network Northeast Regional meeting and presented "Plant Disease Updates – CAES" via Zoom (12 adults) (*May 24*).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (5 adults) (*June 8*).
- Talked about the Plant Disease Information Office and Disease Diagnosis to the Station Tour from the International Festival of Arts and Ideas in New Haven (13 adults) (*June 16*) and (17 adults and 5 children) (*June 24*).
- Discussed "Career Paths in Public Service as a Plant Diagnostician" to summer interns in Plant Health and Protection Program in New Haven (9 adults) (*June 20*).
- Presented "Backyard Composting" to Windsor Garden Club and Windsor Conservative Commission members via Zoom (17 adults) *(June 21*).
- Participated in the National Plant Diagnostic Network Northeast Regional Meeting via Zoom (13 adults) (*June 28*).

LINSKE, MEGAN A.
- Participated in a Diversity, Equity, and Inclusivity Tactics discussion for The Wildlife Society (TWS) as both President of the Northeast Section of TWS and as a Leadership Institute alumna (*August 31, 2021*).
- Participated as a panelist on women in wildlife for SUNY ESF undergraduate students (*October 5*).
- Participated in a conference call with collaborators for the Department of Defense project titled "Novel Evaluation of Control and Prevention Strategies for Ticks and Tick-borne Diseases" (*October 27*).
- Held the first CAES Post-Doctoral Association Committee meeting as Chairperson (*November 9*).
- Held the annual fall meeting for the Northeast Section of the Wildlife Society's Executive Committee as Section President (*November 15*).
- Participated in a call with the Wildlife Society's (TWS) Diversity, Equity, and Inclusivity meeting to discuss program development and application (*January 18, 2022*).
- Participated in a call with members of the Annual Northeast Fish and Wildlife Agencies Conference 2022 planning committee as President and Workshop Chairperson of the Northeast Section of TWS (*January 20*).
- Participated in a call with members of TWS Leadership Institute to prepare for the class of 2022 call for applications (*January 20*).
- Participated in the Centers for Disease Control and Prevention's "Vector Week" for CDC grantees (*January 25-27*).
- Participated in a call with members of the Annual Northeast Fish and Wildlife Agencies Conference 2022 planning committee as President and Workshop Chairperson of the Northeast Section of the Wildlife Society (TWS) (*March 14*).
- Gave an invited lecture titled "Tick Ecology: Host and Habitat Dynamics and Their Influence on Integrated Tick Management" at the Northeast Regional Center for Excellence in Vector-borne Diseases (NEVBD) Research and Training Seminar (*March 21*).
- Attended the Annual Northeast Fish and Wildlife Agencies Conference (*April 4-5*).
- Lead the Northeast Section of the Wildlife Society (TWS) annual Spring meeting as Section President (*April 13*).
- Participated in the TWS Diversity, Equity and Inclusivity networking call as a committee member (*April 18*).
- Reviewed and submitted the final selection of ten individuals for the Class of 2022 TWS Leadership Institute from 65 applications as a committee member (*April 26*).
- Reviewed and submitted the final selection of the TWS 2022 Publication Award recipients from 107 nominated submissions in five categories as a committee member (*April 29*).
- Attended the Ph.D. dissertation defense of Rebecca Bingham titled "Lyme Disease: Risk, Prediction and Vaccine Deployment Model Development" as a doctoral committee member (*April 29*).
- Held a meeting with Dr. Richard Poche of Genesis Labs Inc. to provide an update on the collaborative novel rodent targeted tick treatment project (*June 14*).
- Participated in a networking call with the Wildlife Society (TWS) Diversity, Equity, and Inclusivity (DEI) committee as an active member (*June 20*).
- Participated in TWS Leadership Institute Mentoring Meet and Greet for the Class of 2022 (*June 28*).

MARRA, ROBERT E.

- Participated in a Beech Leaf Disease Working Group Zoom meeting with collaborators from Ohio, West Virginia, Ontario (Canada), New York, USDA-ARS, and the US Forest Service (45 participants) (*August 17, 2021*).
- Met with USFS pathologist Dr. Cameron McIntire, who assisted Dr. Marra in taking annual measurements at three of Dr. Marra's beech leaf disease long-term monitoring plots across CT: in Tunxis State Forest, Barkhamsted; Yale Myers Forest, Eastford; and Nathan Hale State Forest, Coventry (*September 20-21*).
- Presented a talk titled "Fungi and Their Role in the Forest" to the New Canaan Garden Club at the New Canaan Nature Center (21 participants) (*October 12*).
- Participated in a Beech Leaf Disease Working Group Zoom meeting with collaborators from Ohio, West Virginia, Ontario Canada, New York, USDA-ARS, and the US Forest Service (45 participants) (*October 15*).
- Participated via MS Teams in the Forest Ecosystem Monitoring Cooperative State Coordinator's meeting (25 participants) (*October 21*).
- Was interviewed via phone and email about beech leaf disease with Science News writer Grant Segall (*October 26*).
- Presented a talk titled "Tropical Storms, Hurricanes, Super Storms" to the New Britain Garden Club at the Shuttle Meadow Country Club in Kensington, CT (17 participants) (*November 11*).
- Met with Dr. Craig Broderson, Yale School of the Environment, to discuss a research collaboration on beech leaf disease (*November 12*).
- Administered oral examinations to arborist candidates for the Connecticut Tree Protection Examining Board (*December 8*).
- Presented a talk on Beech Leaf Disease and Oak Wilt to the annual meeting of the CT Environmental Council at the Oakdale Theater in Wallingford (300 participants) (*December 14*).
- Presented a talk on Beech Leaf Disease and Oak Wilt for the Valley Green Winter Seminar Series, at the Villa Bianca in Seymour (80 participants) (*January 12, 2022*).
- Presented three lectures on mycology and forest pathology for the Yale Forest School M.S. program (12 adults) (*March 7, 9, and 14*).
- Presented a "Beech Leaf Disease Update" at the Forest Health Monitoring Workshop via Zoom (54 adults) (*March 8*).
- Presented a "Beech Leaf Disease Update" for the CT CAPS Committee Meeting via Zoom (20 adults) (*March 22*).
- Presented his fourth lecture on root/butt rots and foliar diseases of trees for the Forest Health class at the Yale Forest School, as part of the Forestry M.S. program (15 adults) (*April 4*).
- With Dr. Jeffrey Ward and Talbot Trotter (USFS), co-led a field trip to Naugatuck State Forest for the Forest Health class (15 adults) (*April 8*).
- Presented a talk titled "Beech Leaf Disease and Oak Wilt" at the annual meeting of the Experiment Station Associates held in Jones Auditorium (20 adults) (*April 20*).
- With Dr. Jeffrey Ward and Talbott Trotter, co-led a field trip for the Yale Forest Health class to the Killingworth and Cockaponsett State Forest (15 adults) (*April 29*).
- Was interviewed about Beech Leaf Disease by Brian Scott Smith for WSHU radio (*June 10*).
- Co-led, with Dr. Jeffrey Ward, a forest pest and pathogen walk at Naugatuck State Forest for the Connecticut Forest and Park Association (CFPA) Master Woodland Manager certification program (17 adults) (*June 18*).
- Was interviewed by Brendan Crowley for the CT Examiner (*June 22*).
- Attended the International Union of Forest Research Organizations (IUFRO) conference on Foliage, Shoot, and Stem Diseases, where he co-led field trips, presented on beech bark disease, non-destructive assessment of internal decay using sonic and electrical impedance tomography, beech leaf disease, and co-authored an oral presentation titled "Early in situ detection of beech leaf disease using near infrared spectroscopy and machine learning" (*June 26-July 2*).

MOLAEI, GOUDARZ

- Gave a virtual invited talk titled "Public Health Challenges of Ticks and Tick-Associated Diseases" to the West Hartford Public Library (60 attendees) (*July 13, 2021*).
- Was interviewed on the state of tick activity this season by the *Hartford Courant*, https://www.courant.com/news/connecticut/hc-news-ct-more-ticks-20210816-eafwrhehkbhspacc7r5q rw4m4m-

story.html (*August 13*).

- Was interviewed on tick activity this year by WTIC-1080 AM, https://www.audacy.com/wtic/news/state/ct-is-experiencing-an-increase-in-the-tick-population?media_suffix=WTICAM (*August 16*).
- Was interviewed on invasive tick species in Connecticut by NBC Connecticut (*August 16*).
- Was interviewed on the established population of the Asian longhorned tick in New Haven County by WTNH Channel 8 (*August 31*).
- Presented an invited talk titled "Bracing for the Worst: Invasion & Range Expansion of Tick Vectors of Human Diseases," to the 59th Annual Yankee Conference on Environmental Health, "The Herculean Effort of Environmental Health," Mashantucket, CT (20 attendees) *(September 23*).
- Hosted Dr. Sajjad Hassan, MD, a Clinical Microbiology Fellow at the Yale School of Medicine, provided a tour of the Tick Testing Laboratory, and discussed tick and mosquito research projects (*October 6*).
- Presented an invited talk titled "A Grim Public Health Outlook: Climate and Ecological Changes, Accelerating Range Expansion of Tick Vectors, and Rising Tide of Tick-borne Diseases" to the Guilford Garden Club (50 attendees) (*November 10*).
- With Dr. Andrea Gloria-Soria, submitted a joint proposal titled "Influence of Genetic Background on the Host Choice of *Culex pipiens* Complex and the Risk of Human Infection with West Nile Virus" for consideration by The Louis A. Magnarelli Post-Doctoral Program (*November 19*).
- Submitted a joint proposal with Dr. Doug Brackney titled "Using Xenosurveillance to Decipher the Eco-Epidemiology of Eastern Equine Encephalitis Virus in the Northeast United States" for consideration by The Louis A. Magnarelli Post-Doctoral Program (*November 22*).
- Presented an invited talk (virtually) titled "Eco-epidemiology of Vector-borne Diseases and the Risk of Human Infection in the Northeastern USA" to the Central Connecticut State University (20 attendees) (*February 23, 2022*).
- Presented a joint talk titled "Emerging Ticks and Tick-borne Diseases in the Northeastern USA" with Dr. Eliza Little to the annual meeting of the Northeast Regional Center for Excellence in Vector-borne Diseases (*March 7*).
- Was interviewed on the most important tick species and the risk of human infection with tick-borne pathogens in the Northeast by Rich Kirby, Patch Media (*March 31*).
- Was interviewed by Ashley of Chaz & AJ PLR 99.1 Radio on the public health challenges associated with ticks and tick-borne diseases in Connecticut; and preventing tick bites (*April 11*).
- Was interviewed by Dennis Valera, of Channel 3 WFSB Eyewitness News, in an article titled, "Experts Warn of Rising Tick Population in CT," https://www.wfsb.com/2022/04/18/experts-warn-rising-tick-population-ct/ (*April 18*).
- Presented an invited talk titled, "Bracing for the worst--Climate and ecological changes, accelerating range expansion of tick vectors, and rising tide of tick-borne diseases," to the Connecticut Entomological Society (*April 22*).
- Was interviewed by Jesse Leavenworth, a reporter for the Hartford Courant, in an article titled "Ticks are on the Rise in Connecticut: Here Is What They Look Like and the Diseases They Carry" https://www.courant.com/news/connecticut/hc-news-ct-tick-update-20220427-jfkcddpfgfg3fhj5gyrffxolwi-story.html (*April 27*).
- Was interviewed by Jennifer Joas, a reporter for NBC Connecticut, in an article titled "Busy Tick Season Expected in Connecticut" https://www.nbcconnecticut.com/news/local/busy-tick-season-expected-inconnecticut/2773293/ (*April 29*).
- Was interviewed by reporters from WFSB Channel 3 on Powassan virus (*May 4*); Fox 61 News on Powassan virus (*May 4-5*); WTNH on Powassan virus (*May 5*); WNPR on climate change and increasing tick activity (*May 5*); and the Hartford Courant on Powassan virus (*May 5*).
- Organized a Vector-borne Disease Symposium in Jones Auditorium assisted by Dr. Megan Linske, Dr. Rebecca Johnson, and Dr. Zannatul Ferdous (*May 10*).
- Presented a talk titled "Tick and Tick-borne Disease Surveillance in Connecticut" to the Vector-borne Disease symposium in Jones Auditorium (*May 10*).
- Was interviewed by WSHU/NPR on climate change and tick-borne diseases (*May 11*); the New York Times on Alpha gal syndrome or red meat allergy (*May 13*); News-Times on public health risks of tick bites and tick-borne diseases (*May 14*); and Cheddar TV News, New York, on Alpha gal syndrome (*May 16*).
- Was interviewed by reporters for the Connecticut Post (*June 3*), WTNH (*June 8*), Fox 61 (*June 8*), WSHU/NPR (*June 10*), Journal Inquirer (*June 14*), and WTIC-AM Radio (*June 16*) on Powassan virus, ticks and tick-borne

disease activities, infections and co-infections in ticks.
- Spoke to visitors about tick and tick-borne pathogen surveillance and the tick testing program, and provided a tour of the CAES Tick Testing Laboratory (CAES-TTL) as part of the Arts and Ideas Festival (*June 16 and 24*).

NASON, SARA L.
- Met virtually with Bryan Berger from the University of Virginia to discuss a joint proposal (*July 26, 2021*).
- Attended a virtual meeting of the Benchmarking and Publications for Nontargeted Analysis working group (*July 28*).
- Attended a virtual networking event and capstone presentations for the Doris Duke Conservation Scholars program (*July 29-30*).
- Participated in a virtual meeting on PFAS with colleagues from the Maine Bureau of Agriculture, the University of Maine, the University of Virginia, the University of New Castle, and citizen scientists (*September 2*).
- Participated in virtual meetings for the Benchmarking and Publications for Non-Targeted Analysis working group (*September 9 and 28*).
- Presented a poster titled "Phytoremediation of PFAS: Strategies for Improving Efficacy" at the FLUOROS Global conference in Providence, RI (~40 on-site attendees plus virtual attendees) (*October 3-7*).
- Was interviewed about her recent articles on sewage sludge analysis during the COVID-19 pandemic by Wiley Publicity (*October 5-7*; and *October 19-20* via email).
- Attended meetings of the Benchmarking and Publications for Non-Targeted Analysis working group (*October 14, 18, 22, and 27*).
- Hosted a visiting student researcher from Princeton University (*October 19-21*).
- Served as a panelist for the virtual SETAC Exploring Career Choices event (~30 students) (*November 10*).
- Presented a poster titled "Effects of Stormwater Infiltration on Composition of Treated Wastewater" at the virtual 2021 Society of Environmental Toxicology and Chemistry (SETAC) North America Meeting (*November 14-18*)
- Attended virtual meetings of the Benchmarking and Publications for Non-Targeted Analysis Working Group (*November 19, 22, and 30*).
- Had her work on chemicals in municipal wastewater found during COVID-19 featured in various press articles during November:
  - https://newsroom.wiley.com/press-releases/press-release-details/2021/Chemicals-in-wastewater-may-help-track-COVID-19-/default.aspx
  - https://www.miragenews.com/chemicals-in-wastewater-may-help-track-covid-665323/
  - https://www.news-medical.net/news/20211103/Research-could-lead-to-new-methods-for-tracking-COVID-19.aspx
- Participated in virtual meetings for the Benchmarking and Publications for Non-Targeted Analysis working group (*December 9 and 22*; *January 13 and 18, 2022*).
- Was interviewed on hemp phytoremediation of per- and polyfluoroalkyl substances by WHSU https://www.wshu.org/connecticut-news/2022-01-27/connecticut-scientists-use-hemp-to-start-cleaning-up-pfas-on-tribal-lands-in-maine (*January 21*).
- Met with Jane Philbrick and colleagues to discuss a new phytoremediation project on brownfield sites in Bridgeport (*January 28*).
- Participated in meetings of the Benchmarking and Publications for Non-Targeted Analysis working group (*multiple days in February*).
- Was interviewed by Grist Media regarding PFAS phytoremediation project (*February 14*).
- Hosted a virtual stakeholder event for the Benchmarking and Publications for Non-Targeted Analysis working group (12 attendees) (*February 17*).
- Gave an invited virtual seminar as part of the LC-GC PFAS Summit titled "Analysis of PFAS in Environmental and Human Samples" (221 attendees) (*February 18*).
- Coached students from the Sound School in New Haven on science fair projects (*March 2 and 8*).
- Was interviewed about PFAS phytoremediation research by Sinclair Broadcast Group (*March 4*).
- Gave a virtual talk titled "Phytoremediation – A Plant-based Approach to Removing Pollutants, Case Study: Using Industrial Hemp to Extract Soil Pollutants" at the Cornell Cooperative Extension of Suffolk County 2022 Winter Webinar Series for Ornamental Horticulture (37 attendees) (*March 10*).

- Attended virtual meetings of the Benchmarking and Publications for Non-Targeted Analysis working group and subcommittees (*March 10, 15, and 22*).
- Presented a virtual seminar titled "Collaborative PFAS Research on High Resolution Mass Spectrometry Methods and Phytoremediation: Challenges and Progress" for the Wayne State University Department of Environmental Science and Geology (22 attendees) (*March 23*).
- Judged undergraduate presentations for the virtual Quinnipiac Chapter Sigma Xi Student Research Conference (*April 25*).
- Attended virtual meetings with the Benchmarking and Publications for Non-Targeted Analysis working group (*May 5, 10, and 12*).
- Met virtually with colleagues from the CT Department of Public Health, University of Connecticut and the office of Connecticut State Senator Christine Cohen to discuss PFAS laboratory capacity in Connecticut (*May 6*).
- Spoke on "Understanding and Enhancing PFAS Phytoremediation Mechanisms Using Hemp Plants" as part of an NIEHS Superfund Research Program (SRP) Progress in Research webinar (259 attendees) (*May 13*).
- Gave a hybrid talk titled "Building Stakeholder Relationships to Facilitate Expanded Application of Non-Targeted Analysis Methods" at the SETAC NonTargeted Analysis focused topic meeting in Durham, NC, (60pprox.. 100 in-person attendees) (*May 26*).
- Attended virtual meetings for the Benchmarking and Publications for Non-Targeted Analysis working group (*June 1, 9, and 21*).

PATEL, RAVIKUMAR R.

- Presented "Populations of *Pseudomonas syringae* pv. *Phaseolicola* Use Different Kinds of Persistence to Survive Biological and Chemical Control Treatments" as a Research on Demand presentation in the Plant Health 2021 virtual meeting (*August 3, 2021*).
- With Dr. Christina Robb, presented "The Analysis of Phytohormones" at the Eastern Analytical Symposium (EAS) in Princeton, NJ (870 attendees) (*November 14*).

PETRUFF, TANYA A.

- Gave a talk titled "Expansion of Connecticut's Mosquito Trapping and Arbovirus Surveillance Program in Response to the EEE Outbreak of 2019" at the 2021 annual meeting of the Northeastern Mosquito Control Association (~150 attendees) (*December 6-8, 2021*).

PIGNATELLO, JOSEPH J.

- Met virtually with Asst. Attorney General David Wrinn and Director Jason White on eligibility status of CAES with the National Science Foundation (*July 6, 2021*).
- Participated in virtual update meetings with co-investigators on grants (*September 3*).
- Gave an invited lecture titled "Modified Biochars for Use in Environmental Remediation" at the 2021 Yankee Conference of the Connecticut Environmental Health Association, Foxwoods (~30 attendees) (*September 22-24*).
- Participated in virtual update meetings with co-investigators from Villanova University, Pacific Northwest National Laboratory, and Oregon Health and Science University on a SERDP grant (*October 1*).
- Met with co-investigators from the University of Maryland and GeoSyntec Corp. on a SERDP grant (*October 13*).
- Met with co-investigators from the University of California Davis on a grant proposal (*October 15*).
- Met with Lockwood Lecture speaker Prof. Swadeshmukul Santra from the University of Central Florida (*October 27*).
- Gave a talk titled "Newly Discovered Driving Forces for Sorption of Some Organic Compounds to Pyrogenic Carbons" (~30 attendees), and co-authored a second talk by Dr. Zhengyang Wang titled "Dynamic Aggregation of Humic Acid in the Absence and Presence of Added Low-Molecular-Weight Acids" (~30 attendees) at the annual meeting of the Soil Science Society of America in Salt Lake City, UT (*November 9*).
- Gave a talk titled, "Absorption and Hydrolysis of Sulfuryl Fluoride in Alkaline Hydrogen Peroxide Solutions" at the virtual Methyl Bromide Alternatives and Outreach annual meeting (~40 attendees) (*November 16*).
- Met with co-investigators from University of Maryland and GeoSyntec Corp. on a SERDP grant (*December 8*).
- Met virtually with several CAES scientific staff and faculty from UConn to discuss potential collaborations on nutrient and PFAS fate (*December 13*).

- Met with co-investigators from University of Maryland and GeoSyntec Corp. on a SERDP grant (*January 11, 2022*).
- Met with Janet Rowley of Douglas Products and Dr. Spencer Walse of USDA-ARS, Parlier, California, to discuss patent and licensing opportunities (*January 27*).
- Met virtually with co-investigators from Villanova University, Pacific Northwest National Laboratory, and Oregon Health and Science University on a SERDP grant (*January 28*).
- Met with Christopher Conners, Technology Commercialization Services, University of Connecticut, to discuss patent and licensing opportunities for an invention (*February 11 and 16*).
- Met with Christopher Conners, Technology Commercialization Services, University of Connecticut, to discuss patent and licensing opportunities for an invention (*March 3*).
- Gave a lecture titled "General Structure of the Proposal and Approaches to Writing It" for the Grants Writing Workshop of the CAES Post-Doctoral Association (~25 attendees) (*March 4*).
- Met with co-investigators from the University of Maryland and GeoSyntec Corp. on a SERDP grant (*March 8*).
- Met virtually with co-investigators from Villanova University, Pacific Northwest National Laboratory, and Oregon Health and Science University on a SERDP grant (*March 11*).
- Met with Christopher Conners, Technology Commercialization Services, University of Connecticut, and representatives from Douglas Products to discuss patent and licensing opportunities for an invention (*April 1, 6, and 12*).
- Met virtually with co-investigators from the University of Maryland and GeoSyntec Corp. on a SERDP grant (*April 5*).
- Attended the M.S. oral thesis defense of Tyler Swanson at Central Connecticut State University, New Britain (*April 20*).
- Met virtually with co-investigators from Villanova University, Pacific Northwest National Laboratory, and Oregon Health and Science University on a SERDP grant (*April 25*).
- Participated in the virtual SERDP Interim Progress Report Workshop on his grant project on remediation of munitions chemicals (61pprox.. 25 attendees) (*May 2*).
- Attended the virtual Connecticut Academy of Science and Engineering Annual Dinner and Meeting (*May 26*).

PRAPAYOTIN-RIVEROS, KITTY

- With Ms. Megan Cahill and Mrs. Terri Arsenault, attended the Animal Feed Regulatory Program Standard (AFRPS) annual meeting in Wilmington, NC (*March 14-17, 2022*).

RIDGE, GALE E.

- Participated in the Colin McEnroe WNPR radio show about flies, talking about experience in forensic entomology, maggot therapy, and rabbit bot fly infesting a Middlebury man (*August 19, 2021*).
- With Ms. Katherine Dugas, staffed an Experiment Station Exhibit at the Woodstock Fair with over 200,000 attendees (*September 3-6*).
- With Ms. Katherine Dugas, Meghan Cahill, Jamie Cantoni, and Drs. Nubia Zuverza-Mena and Jaya Borgatta, staffed the Experiment Station exhibit at the Big E in West Springfield, MA with 37,604 attendees at the fair that day (*September 23*).
- Staffed a table at the Bethany Town Harvest Festival. She combined the Sustainable Connecticut-Bethany and the Experiment Station programs into a single focus of addressing invasive species found in Connecticut. There were approximately 5,000 visitors who attended the one-day event (*October 3*).
- Was interviewed about the invasive jumping worms by Liz Dupont Diehl for the Windsor and Bloomfield Journals (*November 9*).
- Presented a talk titled "Introduction to Delusional Infestation (DI). It Takes a Village to Care for DI Sufferers. Definition, History, and Understanding" to an international audience and presenters hosted by the University of New Hampshire (125 attendees) (*January 18, 2022*).
- Participated in a webinar led by Nancy Hinkle (University of Georgia) and hosted by the City of New Orleans, Mosquito, Termite and Rodent Control Board on the subject of delusional infestation (*January 25*).
- Presented a talk on bed bugs and delusional infestation to pest management professionals and health departments personnel in a program hosted by the University of New Hampshire (55 attendees) (*February 3*).
- Was interviewed about current cold winter weather and its impact on overwintering insects and ticks for an article

in the News Times (*February 8*).
- Published a revision of the "Jumping Worms (Megascolecidae: Pheretima) in Connecticut" fact sheet for the Station website (*March 11*)
- Presented a talk on jumping worms to the Westport Garden Club (*March 14*).
- Repeated the same jumping worm talk at the New Haven Rotary Club luncheon (*March 15*).
- Was quoted by The Patch in an article titled "Jumping Worms that Destroy Soil Spotted in Connecticut." She suggested some corrective measures to manage the worms (*May 15*).
- Was interviewed by Harlan Levy from the Journal Inquirer about pantry moths (*May 24*), and about mosquitoes, public health, and how to manage them in and around home settings (*May 27*).
- Was interview on Asian jumping worms by reporters from NPR's Science Friday (*June 6*), Hartford Courant (*June 7*), NBC TV News (*June 13*), Channel 8 (*June 14*), News 12 CT (*June 14*), Chaz and AJ morning radio (*June 15*), Fox 61 (*June 17*).
- Spoke to visitors about her work at the CAES Insect Information Office as part of the Arts and Ideas Festival (*June 16 and 24*).
- Presented a talk about the worms to the Big Pond Association in Otis, MA (*June 18*).
- Was interviewed by a reporter from Republican American Newspaper on spongy moth (*June 19*).
- Along with Dr. Li, spent the lunch hour talking with CAES interns about careers in biological sciences (*June 20*).
- Was interviewed by Chaz and AJ morning radio on the Asian longhorned ticks (*June 23*).

ROBB, CHRISTINA S.
- Attended the Food and Drug Administration (FDA) Laboratory Flexible Funding Model (LFFM) kick-off call (*July 1, 2021*).
- Attended an Eastern Analytical Symposium (EAS) Program meeting (*July 1*).
- Attended an EAS Executive Committee meeting (*July 5*).
- Attended FDA sampling funding meetings (*July 15*).
- Became a member of the European Chemical Society-Division of Analytical Chemistry (EuChemS-DAC) study group and network, which has Green Sample Preparation as the 2021 theme of the year (*July 19*).
- Participated in the Executive Committee meetings of the Eastern Analytical Symposium (EAS) (*August 2, 9, 16, 23, and 30*).
- Attended FDA LFFM Human and Animal Food and Food Defense calls (*August 9*).
- Attended the Eastern Analytical Symposium (EAS) program meeting (*September 7*), board meeting (*September 10*), and executive committee meetings (*September 7, 13, and 15*).
- Attended the Pittcon webinar, "Analysis of Microplastics in Water" by Damia Barcelo of the Catalan Institute for Water Research (*September 7*).
- Participated in the APHL Food Chemistry Workgroup Monthly Call (*September 8*).
- Attended the Food and Drug Administration (FDA) Laboratory Flexible Funding Model (LFFM) Chemistry Human and Animal Food (C-HAF) Monthly Conference Call – 2021 Series (*September 13*).
- Was an analytical chemistry judge for the EAS Student Virtual Symposium (*September 14*).
- Attended the Separation Science webinar, "Mass Spectrometry to Fight Food Fraud" (*September 15*).
- Discussed mutual interest in microplastics detection with the Coast Guard Academy (*September 20*).
- Spoke with NOAA about the 2022 Marine Debris Prevention grant (*September 21*).
- Met with visiting scientist Lidija Jakobek Barron (*September 21*).
- Attended the ChromSoc "Advances in Gas Chromatography" symposium (*September 22*).
- Attended several homeland security talks of 908 devices Critical Mass 2021 (*September 23*).
- Met with the board of the Great Scientific Exchange Conference (SciX) 2021 (*September 29*).
- Met with Chemistry and Biochemistry professors at the University of Rhode Island (URI) (*September 30*).
- Presented "Career Paths of Analytical Chemists" to the URI senior seminar series of the Department of Cell and Molecular Biology, URI (30 attendees) (*September 30*).
- Met with the Editor-in-Chief of Journal of Liquid Chromatography (*October 3, 13, and 28*).
- Attended Executive Committee meetings of the Eastern Analytical Symposium (EAS) (*October 4, 11, 18, and 25*).

- Was the co-presenter of "Applications and Uses of Portable and Handheld Infrared Spectroscopy" at Western Connecticut State University (WCSU) with John A. Seelenbinder of the American Chemical Society (*October 13*).
- Participated in the APHL Food Chemistry Workgroup monthly call (*October 13*).
- Attended the LC-GC virtual symposium "Emerging Trends in Liquid Chromatography" (*October 13-15*).
- Met with the Chemistry and Nuclear Physics Portfolio Manager from Taylor and Francis (*October 19*).
- Attended the FDA LFFM Chemistry Human and Animal Food (C-HAF) monthly conference call (*October 20)*.
- Received training on the ON24 virtual platform *(October 25*).
- Participated in the 2021 Eastern Analytical Symposium (EAS) as well as the following events: Executive Committee meetings of the EAS (*November 1, 8, and 15*); EAS Board Meeting (*November 14*); with Dr. Ravikumar Patel, co-presented "The Analysis of Phytohormones" (*November 14*); Presented "Molecular Indicators of *Abrus precatorius*" in conjunction with Kirk Gaston of the Forensic Chemistry Center of the FDA, in the EAS Forensic Analysis session (*November 15*).
- Attended the Renishaw webinar on Raman Spectroscopy (*November 2*).
- Attended the SelectScience Virtual Biopharmaceuticals Summit presentation titled "Protein LC-MS Evolved: Characterization Tools for New Assays in Bioanalysis" by Dr. John Kellie, GSK (*November 9*).
- Participated in the APHL Food Chemistry Workgroup Monthly Call (*November 10*).
- Attended the annual board meeting of the Eastern Analytical Symposium (EAS) (*December 3*).
- Participated in the EAS Program meeting (*December 10*).
- Attended the EAS executive committee meetings (*December 6, 13, 20, and 27*).
- Participated in the American Public Health Laboratory (APHL) Food Chemistry workgroup meeting (*December 8*).
- Met with the Journal of Liquid Chromatography editorial staff (*December 30*).
- Attended executive committee meetings of the Eastern Analytical Symposium (EAS) (*January 3, 10, 17, 24, and 31, 2022*).
- Worked with the Journal of Liquid Chromatography (*January 19*).
- Attended Executive Committee meetings of the Eastern Analytical Symposium (EAS) (*March 7, 14, 21, and 28*).
- Discussed the LEARN committee with Flanders Nature Center and Land Trust (*March 9 and 31*).
- Participated in the American Public Health Laboratory (APHL) Food Chemistry Workgroup meeting (*March 10*).
- Attended "Ion Mobility Mass Spec - A 4th Dimension Gets More Information Faster Than Ever Before" (*March 10*).
- Attended Food Integrity online 2022 "Closer to Zero with Conrad Choiniere from the Office of Analytics and Outreach Director at the Department of Health and Human Services, FDA" and "Preparing for the Baby Food Safety Act 2021 and Closer to Zero" (*March 22*).
- Attended FDA LFFM Grants Management webinar (*March 22*).
- Attended "Emerging Trends and Future Directions in Food Testing" (*March 23*).
- Attended the LCGC Data Integrity symposium (*April 4*).
- Participated in the Eastern Analytical Symposium (EAS) Executive Committee meetings (*April 4, 11, 18, and 25*).
- Attended the Select Science "Emerging Trends and Future Directions in Food Testing" webinar (*April 7*).
- Participated in the Association of Public Health Laboratory (APHL) Chemistry workgroup meeting (*April 13*).
- Participated as a subject matter expert for the APHL Laboratory Chemistry Framework (LCF) Chemistry track in defining the knowledge, skills and abilities and constructing competencies for a mid-level analytical chemist performing gas chromatography (*April 11-14*).
- Participated in the Eastern Analytical Symposium (EAS) Executive Committee meeting (*May 2, 9, 16, and 23*).
- Attended the Chemistry FDA LFFM calls on Food Defense (C-FD) and Human and Animal Food (C-HAF) (*May 9*).
- Attended the EAS May board meeting (*May 13*).
- Provided expertise for the EAS Virtual Student Symposium (*May 20*).
- Participated in the Association of Public Health Laboratory (APHL) Chemistry working group meeting (*May 23*).
- Participated as a subject matter expert for the APHL Laboratory Chemistry Framework (LCF) Chemistry track in defining the knowledge, skills, and abilities and constructing competencies for an advanced analytical chemist performing liquid chromatography (*May 23-24*).
- Participated in the FDA FoodShield Rapid Response Team monthly call (*June 2*).

- Attended executive committee meetings for the Eastern Analytical Symposium (EAS) (*June 6, 13, 20, and 27*).
- Participated as a subject matter expert for the APHL Laboratory Chemistry Framework (LCF) Chemistry track in defining the knowledge, skills and abilities and constructing competencies for an analytical chemist performing advanced liquid chromatography (LC) (*June 6-7*).
- Attended the APHL Food Chemistry workgroup monthly meeting (*June 7*).
- Attended the Flanders LEARN committee meeting (*June 9*).
- Attended the virtual GC Symposium (*June 10, 17, and 24*).

RUTLEDGE, CLAIRE E.

- Presented a talk via livestream titled "They're Here, They're Coming and We Don't Want Them: Emerald Ash Borer, Spotted Lanternfly and Asian Longhorned Beetle" to the White Memorial Conservation Center (10 adults) (*August 7, 2021*).
- Supported her student Joselyn Clark in her talk titled "Searching for Resistance to Emerald Ash Borer in Native Ash" to the Roxbury Land Trust via livestream (*August 12*).
- Gave a talk on biological control of emerald ash borer to the Universalist Unitarian Church of Lafayette, IN via live stream (15 adults) (*September 5*).
- Administered the oral portion of the State Arborist's license exam at Lockwood Farm (10 adults) (*September 8*).
- Staffed a table with information about southern pine beetle and spotted lanternfly at the annual picnic of the Connecticut Tree Wardens Association in Madison (40 adults) (*September 18*).
- Taught a class on "Insects that Attack Trees" via live stream for the Connecticut Tree Warden School (35 adults) (*September 23*).
- Was interviewed on the biological control of emerald ash borer in Connecticut by writer Mike Freeman for an article in Northern Woodlands magazine (*September 23*)
- Was interviewed about the biological control of emerald ash borer in Connecticut by writer Carrie Arnold for a web article for National Geographic (*September 24*).
- Gave a presentation on southern pine beetles in Connecticut to the annual meeting of the Northeast-Midwest State Foresters Alliance Public Land Management Committee (representatives from 10 states attended) at Hopeville Pond State Park in Griswold, CT (15 adults) (*October 6*).
- Lectured on "Insects that Attack Trees" for the Connecticut Tree Protective Association's Arboriculture 101 course held in the Station's Jones Auditorium (40 adults) (*October 6*).
- Presented a lecture on "Biological Control of Emerald Ash Borer in Connecticut" via livestream for the Flanders Nature Center seminar series (7 adults) (*October 14*).
- Taught in the "Tree Conditions Laboratory" class for the Connecticut Tree Protective Association's Arboriculture 101 course held in Station's Jones Auditorium (40 adults) (*October 20*).
- Conducted a livestream lecture titled "The Biological Control of Emerald Ash Borer" for a graduate Forest Health seminar at the University of Vermont (45 adults) (*November 1*).
- Gave a livestream lecture for the annual meeting of the Connecticut Association of Conservation and Inland Wetland Committees on "Emerald Ash Borer and Spotted Lanternfly" (90 adults) (*November 6*).
- Gave a livestream lecture for the Town of New Canaan's Conservation Commission on the spotted lanternfly (5 adults) (*November 15*).
- Helped administer the oral portion of the Arborist Licensing Exam in New Haven, CT (5 candidates) (*December 8*).
- Participated in the Annual Meeting of the Connecticut Tree Protective Association via livestream *(January 20, 2022*).
- With Dr. Kirby Stafford, presented a brief update on research at the Station relevant to arborists (200 adults) (*January 20*).
- Was present at the Eastern Analytical Symposium (EAS) Board Meeting (*February 4*).
- Attended the EAS Executive Committee meetings (*February 7, 14, 21, 24, and 28*).
- Attended the American Public Health Laboratory (APHL) Food Chemistry Workgroup meeting (*February 9*).
- Attended the Select Science Virtual Analytical Summit 2022 (*February 15*).
- Taught "Insects that Attack Trees" for the Connecticut Tree Protective Association's Arboriculture 101 class in

Jones Auditorium at The CAES's New Haven location (40 adults) (*February 17*).

- Met with the management of the Flanders Nature Centre and Land Trust to learn more about the mission of the center and the associated committees; participated in the A2LA ISO/IEC 17025:2017 for Cannabis Testing Laboratories (*February 17-18*).
- Attended the EAS Treasury and Finance meeting (*February 21*).
- Presented "Biocontrol of Emerald Ash Borer in Connecticut" for a seminar in Forest Ecosystem Health and Stability in a Changing Climate, Yale School of the Environment in New Haven (20 adults) (*February 21*).
- Attended the Select Science instructional webinar "Proficiency Testing: Optimizing and Maintaining ISO Certification" (*February 22*).
- Attended the Emergency Response TIPS presentation, "Emerging Threats, Emerging Solutions: Responding to Chemical Suicides" (*February 22*).
- Attended the FDA 50 State Conference Call (*February 25*).
- Presented "Bronze Birch Borer in the American Context" in the online UK Forestry Scotland workshop "Bronze Birch Borer Risk" (*March 2*)
- Presented "Update on Biological Control of Emerald Ash Borer" to the online Forest Health Workshop at The CAES (*March 8*)
- Helped to administer the oral portion of the Arborist Licensing Exam (*March 9*)
- Taught the insect proportion of the "Tree Conditions Laboratory" for Arboriculture 101, Connecticut Tree Protective Association, in Jones Auditorium (*March 10*)
- Met via live-stream with members of the Bronze Birch Borer Risk Assessment task force in UK Forestry Scotland to discuss further details of Bronze Birch Borer Biology (*March 11*)
- Met via live-stream with 5th graders from Thomaston to consult on their project concerning ash in Connecticut (*March 14*)
- Attended via live-stream the Spring Meeting of the Connecticut Cooperative Agricultural Survey committee and provided an update on emerald ash borer monitoring and biological control, as well as on the status of southern pine beetle in Connecticut (*March 22*).
- Attended the annual meeting of the Northeastern Forest Pest Council in South Portland, ME (*March 23-25*).
- Volunteered as a judge at the Connecticut Tree Protective Association's tree climbing competition (*May 14*).
- Hosted Priya S., an intern from New Haven Academy high school, as part of their annual internship program for juniors. Priya S. learned some basic insect biology and dissecting scope operation. She assisted Dr. Rutledge in sample sorting to ascertain attraction of southern pine beetle predators to different pheromones. She also shadowed technicians in the laboratory of Dr. Goudarz Molaei, Dr. Quan Zeng, Ms. Tracy Zarrillo, and Ms. Jacquelyn LaReau (*May 15*).
- Helped to administer the oral examination portion of the Tree Protection Exam, Lockwood Farm, Hamden, CT (*June 8*).
- Trained three volunteers for the citizen-scientist program, The Wasp Watchers, in Killingworth and Portland, CT (*June 29-30*).
- Contributed to a chapter, "Toward Successful Biological Control of the Invasive Emerald Ash Borer in the United States" (Jian, J. Duan, J. J., Gould, J. R., Slager, B. H., Quinn…Rutledge, C. E., et al.) in the book "Contributions of Classical Biological Control to the U.S. Food Security, Forestry, and Biodiversity" (Eds. Van Driesche, R. G., Winston, R. L., Perring, T. M., and Lopez, V. M., 2022) (*June 30*).

SCHULTES, NEIL P.

- Presented a seminar titled "Probing Metabolite Requirements for *Erwinia amylovora* Disease Establishment" for the Department of Plant Pathology and Environmental Microbiology at Pennsylvania University, State College, PA (45 adults) (*November 1, 2021*).
- Gave three lectures on "Genetically Modified Plants in Agriculture" to Science Course Sci 031 at Yale University (12 students) (*February 4, 11, and 18, 2022*).
- Drs. Neil Schultes, Mohamed-Amine Hassani, Ravi Patel, and Ms. Regan Huntley from the Department of Plant Pathology and Ecology; Drs. Susanna Keriö and Leigh Whittinghill from the Department of Forestry and Horticulture; Dr. Charles Vossbrinck, Dr. Rebecca Johnson, and Mr. Greg Bugbee from the Department of

Environmental Sciences; and Dr. DeWei Li from the Valley Laboratory served as judges for the Quinnipiac Chapter of Sigma Xi's Student Research Symposium (42 participants) (*April 25*).
- Had a Zoom meeting with students from South Windsor High School for their upcoming science fair project. Part of their project was to interview scientists on the feasibility of using CRIPSR technology in the control of invasive weeds (4 students) (*May 19*).
- Met with Dr. Rosemary Whelan, a biology professor at Albertus Magnus College in New Haven, to discuss student internships at CAES and tours for biology students during the academic year (*May 26*).

SHABTAI, ITAMAR
- Participated in a virtual meeting with NRCS CT staff to discuss the Conservation Innovation Grant program (*March 8, 2022*).
- Attended the annual meeting of the Multi-State Hatch Project (NC1178) at College Station, TX (*June 7-9*).
- Visited the Canadian Light Source synchrotron in Saskatoon, Canada to analyze the interactions between roots exudates and soil clay minerals on the SM (spectro-microscopy) and mid-IR (FTIR microscopy) beamlines (*June 15-19*).

SHEPARD, JOHN J.
- Participated in Arbovirus Situational Awareness conference calls organized by the Northeast Regional Center for Excellence in Vector-Borne Diseases (30 participants) (*July 19, 2021*).
- Provided updates from the CT Mosquito Trapping and Arbovirus Surveillance Program as part of Arbovirus Situational Awareness conference calls organized by the Northeast Regional Center for Excellence in Vector-Borne Diseases (25-37 participants) (*August 2, 16, and 30*).
- Provided an in-person overview of the CT Mosquito Trapping and Arbovirus Surveillance Program to Paul Kowalski and Kelly Tiernan of the West Haven Health Department (*August 18*).
- Participated in a virtual meeting of the Board of Directors for the Northeastern Mosquito Control Association (*August 20*).
- Presented "Arbovirus Activity in Connecticut, 2021" (120 attendees) (*December 6*).
- Participated in the Annual Business Meeting at the virtual 67th Annual Meeting of the Northeastern Mosquito Control Association (*December 7*).
- Met with Lindsay Baxter and Lisa Martin from Cornell University to tour the Station's mosquito rearing facilities (*January 26, 2022*).
- Spoke about mosquitoes and the CT Mosquito Trapping and Arbovirus Surveillance Program with Fox 61 News (*May 5*).
- Spoke on "Biology, Ecology, and Feeding Behavior of Mosquitoes in Connecticut" at the Vector-borne Disease Symposium held in Jones Auditorium (104 attendees) (*May 10*).
- Spoke about the CT Mosquito Trapping and Arbovirus Surveillance Program at a press conference held by the Milford Health Department (*May 13*).
- Provided updates from the CT Mosquito Trapping and Arbovirus Surveillance Program as part of Arbovirus Situational Awareness conference calls organized by the Northeast Regional Center for Excellence in Vector-borne Diseases (*June 6 and 27*).
- Was interviewed by Gautier Dubois about the effect of West Nile virus on birds in 1999 and 2000, as well as mosquito trapping and testing for West Nile virus for a documentary on epizootic viruses for the French production company Kwanza *(June 29*).
- Presented a virtual talk, "Surveillance for Mosquito-Borne Viruses in Connecticut" for the weekly Epidemiology Program Meeting Group at CTDPH (*June 30*).

SMITH, VICTORIA L.
- Recorded a podcast with Brian Scott-Smith, discussing spotted lanternfly and other topics (*July 2, 2021*).
- Participated in the virtual Spring/Summer meeting of the Cooperative Agricultural Pest Survey Committee (*July 14*).

- Participated in the summer meeting of the Connecticut Tree Protective Association, held at the Farmington Club, with a display titled "BOLO: Spotted Lanternfly and Box Tree Moth" (*July 15*).
- Participated in the virtual 95th annual meeting of the National Plant Board, with a presentation titled "Beech Leaf Disease: Why It's Important" (*July 26-29*).
- Participated in a meeting of the Yale Biosafety Committee via Zoom (*August 19*).
- Was interviewed concerning spotted lanternfly by Caren Pinto of News 12 (*August 26*).
- Attended the annual meeting of the US Forest Service Cooperators, held at Hotel Vermont, Burlington, VT where information on aerial survey, gypsy moth egg mass survey, and other forest-related operations were reported (*November 2-3*).
- Presented a talk via Zoom for the UMass Wine and Small Fruit Growers on spotted lanternfly (~160 participants) (*January 11, 2022*).
- Participated in the virtual meeting of the Connecticut Tree Protective Association (*January 20*).
- Presented a talk via Zoom on spotted lanternfly and box tree moth for the Connecticut Nursery and Landscape Association Winter Symposium (~100 participants) (*January 25*).
- Presented a webinar via Zoom for the Coalition for a Sustainable Cheshire and the Cheshire Library Adult Education Services titled, "Be on the Lookout: Spotted Lanternfly!" (*February 7*).
- Participated via Microsoft Teams in a meeting on export certification (*February 16*).
- Participated via Zoom in the UMass Extension Invasive Insect Webinar Series (*February 16-18*).
- Participated via Microsoft Teams in a meeting on the new eFile system of the USDA (*February 23*).
- Attended the Penn State University/Pennsylvania Dept. of Agriculture Spotted Lanternfly Summit (virtual) (*March 1-3*).
- Organized and participated in the Forest Health Monitoring Workshop. The recording of the workshop is available on our website: https://portal.ct.gov/CAES/Publications/Publications/Forest-Health-Monitoring-Workshops/Home (*March 8*).
- Participated in a National Plant Board follow-up to the Spotted Lanternfly Summit (*March 9*).
- Participated in the Spring Meeting of the CT Cooperative Agricultural Pest Survey (CAPS) Committee (*March 22*).
- Participated in a discussion with the presidents of the Connecticut Beekeepers Association, Eastern Connecticut Beekeepers, and Backyard Beekeepers, concerning ways to increase registration among hobbyist beekeepers (*March 24*).
- Participated in the 96th meeting of the Eastern Plant Board, held at the Otesaga Resort Hotel in Cooperstown, NY (*April 4-7*). was interviewed about spotted lanternfly by Amanda Steffen of NBC Connecticut News (*May 9*).
- Was interviewed about a potential outbreak of spongy moth by Brian Scott-Smith of WSHU (*May 17*).
- Participated in a webinar on beech leaf disease, presented by the Maine Department of Agriculture, Conservation, and Forestry (*June 17*).
- Was interviewed by Brendan Crowley of the CT Examiner about spotted lanternfly (*June 24*).
- Was interviewed by Robert Miller of the Danbury News-Times about the spongy moth outbreak in Litchfield County (*June 27*).

STAFFORD, KIRBY C. III

- Participated in a celebration at Massaro Farm in Woodbridge for Dr. Kimberly Stoner being awarded the Bill Duesing Organic Living on the Earth Award by CT-NOFA (*July 13, 2021*).
- Participated in a meeting of the Cooperative Agricultural Pest Survey Committee (*July 14*).
- With Ms. Jamie Cantoni, staffed a table on ticks at the Connecticut Tree Protective Association (CTPA) summer meeting (*July 15*).
- Gave a Zoom presentation on ticks and tick-borne disease for the Essex Library (21 attendees; recorded for later viewers) (*July 27*).
- Was interviewed about spotted lanternfly by Katrina Koerting, News-Times (*July 29*).
- Was interviewed about spotted lanternfly by Abigail Broom, Norwalk Hour (*July 29*).
- Presented a virtual talk on "Strategies and Challenges to the Management of Ticks and Tick-Borne Disease" for the Tick Academy organized by the IPM Institute of North America and the North Central IPM Center (*September 14*).
- Presented a virtual talk on "Strategies and Challenges to the Management of Ticks and Tick-Borne Disease" for the

virtual meeting of the Society for Vector Ecology (SOVE) (*September 16*).

- Was interviewed about the spotted lanternfly on the Ray & Brian show, WTIC (*September 21*).
- Presented a talk on the history of the Experiment Station, as part of the CAES Seminar Series, in the Station's Jones Auditorium (*September 22*).
- Organized and moderated a meeting of the Changing Dynamics of Tick Ecology, Personal Protection, and Tick Control Subcommittee of the Tick-Borne Disease Working Group (*September 29*).
- Conducted a tick identification course for the NEVBD "boot camp" at Fordham University's Louis Calder Center in Armonk, NY (7 attendees) (*October 7*).
- Co-chaired a meeting of the Changing Dynamics of Tick Ecology, Personal Protection, and Tick Control Subcommittee of the Tick-Borne Disease Working Group (*October 13*).
- Presented a keynote virtual talk titled "Strategies and Challenges to the Management of Ticks and Tick-Borne Disease" for the Ohio Regional Tick Symposium (80 attendees) (*October 15*).
- Presented a virtual talk on "Management of Ticks and Tick-Borne Disease" for the Vermont Pesticide Training program (112 attendees) (*October 19*).
- Participated in a meeting of the Midwest Center of Excellence for Vector-Borne Disease (MCEVBD) (21 attendees) (*October 19*).
- Co-chaired a symposium at the annual meeting of the Entomological Society of America in Denver, Colorado (50 attendees) (*October 31*).
- Co-chaired a meeting of the Changing Dynamics of Tick Ecology, Personal Protection, and Tick Control Subcommittee of the Tick-Borne Disease Working Group (*November 10*).
- Was interviewed about ticks by John Silva, WTIC News 1080 (*November 12*).
- Was interviewed about the gypsy moth by Tomoya Ishida, University of Cambridge (*November 16*).
- Co-chaired a meeting of the Changing Dynamics of Tick Ecology, Personal Protection, and Tick Control Subcommittee of the Tick-Borne Disease Working Group (*November 17*).
- Was interviewed about lone star ticks by Theresa MacPhail, an independent writer (*November 23*).
- Participated in a meeting of the Pollinator Advisory Committee (*November 30*).
- Presented a talk on strategies and challenges to tick control for the Texas Tick Working Group (*November 30*).
- Was interviewed by William Hobbs on Station history (*December 1*).
- Co-chaired a meeting of the Changing Dynamics of Tick Ecology, Personal Protection, and Tick Control Subcommittee of the Tick-Borne Disease Working Group (*December 1, 8, and 15*).
- Participated in a meeting of the Pollinator Advisory Committee to discuss recommendations for legislation and policies to protect pollinator populations and health (*December 15*).
- Co-chaired a meeting of the Changing Dynamics of Tick Ecology, Personal Protection, and Tick Control Subcommittee of the Tick-Borne Disease Working Group (*January 5 and 19, 2022*).
- Participated in a meeting of the Pollinator Advisory Committee to discuss recommendations for legislation and policies to protect pollinator populations and health (*January 14, 21, and 24*).
- Presented a talk on Connecticut's Forests, Trees, and CAES: A History of People, Pests & Diseases as part of their 100th anniversary review to the virtual annual meeting of the Connecticut Tree Protective Association and, with Dr. Claire Rutledge, presented a brief up-date on research at CAES relevant to arborists (*January 20*).
- Participated in the Centers for Disease Control and Prevention's "Vector Week" and presented a talk on tick surveillance at the CDC's virtual Vector Week conference (434 attendees) (*January 25-27*).
- Conducted (as co-chair) a meeting of the Changing Dynamics of Tick Ecology, Personal Protection, and Tick Control subcommittee of the Tick-Borne Disease Working Group (13 attendees) (*February 2 and 9*).
- With Dr. Goudarz Molaei, discussed tick-borne disease policy recommendations for climate change and health issue brief with Dr. Laura Bozzi, Director of Programs, Center on Climate Change and Health (*February 10*).
- Participated and presented subcommittee findings to a meeting of the Tick-Borne Disease Working Group (28 attendees) (*February 28*).
- Participated in a meeting of the Tick-Borne Disease Working Group (28 attendees) (*March 1 and 22*).
- Presented a talk titled "Strategies and Challenges to Tick Management" at the International IPM Symposium in Denver, CO (25 attendees) (*March 3*).
- Participated in a discussion with the presidents of CT Beekeepers Association, Eastern CT Beekeepers, and

BackYard Beekeepers, concerning ways to increase registration among hobbyist beekeepers (*March 24*).
- Spoke on ticks and tick-borne disease to the Trillium Garden Club in Groton, CT (32 attendees) (*March 28*).
- Was interviewed about the spongy moth (previously known as the gypsy moth) by Robert Miller from the News-Times (*April 20*).
- Presented an online talk about ticks to master gardeners (32 attendees) (*April 22*).
- Assisted with a meeting of the Connecticut Entomological Society in Jones Auditorium (*April 22*).
- Presented and participated in a meeting of the Tick-Borne Disease Working Group (28 attendees) (*April 27-28*).
- Was interviewed about the emergence of new ticks and tick-borne diseases by Jesse McKinley from the New York Times (*May 4*).
- Was interviewed about tick bite prevention by Theresa Sullivan-Barger for Connecticut Magazine (*May 9*).
- Presented a talk on a historical perspective and current challenges for tick control as part of the Vector-Borne Disease symposium in Jones Auditorium (*May 10*).
- Led and participated in a meeting of a writing group for the Tick-Borne Disease Working Group (*May 12 and 26*).
- Spoke on ticks and tick-borne diseases to the Thames River Garden Club at the Waterford Public Library in Waterford (30 attendees) (*May 19*).
- Spoke on ticks and tick-borne diseases to the Colchester Garden Club at the Cragin Memorial Library in Colchester (33 attendees) (*May 23*).
- Participated in a technical meeting of the Tick-Borne Disease Working Group (*May 24*).
- Retired as Chief Scientist and State Entomologist (*June 1*).
- As an Emeritus Scientist, led and participated in meetings of the writing group for the Tick-Borne Disease Working Group (*June 2, 9, and 23*).
- Presented a talk on ticks and prevention of tick-borne diseases for a virtual vector-borne disease panel at the annual meeting of the County, State, Territorial Epidemiologists (*June 19*).

STEBBINS, SUMMER E.
- With Mr. Gregory Bugbee, gave a tour of the lower Connecticut River and the Salmon River's hydrilla infestation to officials from the US Army Corps of Engineers, Lower Connecticut River Valley Council of Governments, and SePRO Corp. (*September 22, 2021*).
- Gave a talk titled "Invasive Aquatic Plants in Connecticut Lakes and Ponds" to the Long Hill Garden Club (~40 attendees) (*September 27*).
- Gave a virtual talk titled "West Lake Aquatic Plant Survey Results" to the West Lake Health Committee (10 attendees) (*June 27, 2022*).

STEVEN, BLAIRE T.
- Wrote an article co-authored by Zhouqi Cui, Regan B. Huntley, Neil P. Schultes, Blaire Steven, and Quan Zeng titled "Inoculation of stigma colonizing microbes to apple stigmas alters microbiome structure and reduces the occurrence of fire blight disease" was selected as Editor's Pick in Phytobiomes Journal *(In July, 2021*)
- Met with Cary Chadwick and her team at the Center for Land Use Education and Research (CLEAR) to discuss opportunities for collaborative research using GIS technologies (*January 19, 2022*).
- Met virtually with Dr. Hans Bernstein and members of his lab at the University of Tromso to discuss an application to the Research Council of Norway for a visiting researcher award (*March 25*).
- Served virtually on an NSF review panel for the Integrated Organismal Systems in the Organism Response to Climate Change Program (*May 18-20*).
- Attended the American Society of Microbiology Meeting in Washington DC and presented a poster titled "The Axenic and Gnotobiotic Mosquito: Models for Host Microbiome Interactions and Community Assembly" (*June 9-13*).

STONER, KIMBERLY A.
- Participated in an online meeting of the Connecticut Native Plant Working Group (13 participants) (*August 25, 2021*).

- Participated in the annual meeting of COLOSS (Society for the Prevention of Colony Loss of Honey Bees) online (*October 14-15*).
- Participated in the US National Native Bee Monitoring Workshop (*October 22*).
- Met with Sean Cleary, staff of the Environment Committee of the Connecticut state legislature, about possible pollinator health legislation (*November 12*).
- Chaired the Pollinator Advisory Committee to the Environment Committee of the Connecticut state legislature (*November 30*).
- Participated in the National Bee Monitoring Workshop by Zoom with bee researchers from across the US and Canada (*December 2*).
- Convened the Pollinator Advisory Committee to discuss recommendations for legislation and policies to protect pollinator populations and health; committee members are Kimberly Stoner, Kirby Stafford, Richard Cowles, Mark Creighton, and Tracy Zarrillo of The CAES; and Laura Saucier of CT DEEP (*December 15*).
- Chaired a meeting by Zoom of the Pollinator Advisory Committee with five representatives from The Connecticut Agricultural Experiment Station and one representative from CT DEEP, to review the 2016 Connecticut law, An Act Concerning Pollinator Health (Public Act 16-17), and advised the Environment Committee of the Connecticut General Assembly on possible changes or additions to the act (*January 14, 2022*).
- Chaired a meeting by Zoom of the Pollinator Advisory Committee (*January 21*); and another with Diane Jorsey, Supervising Environmental Analyst of the Pesticide Management Program at CT DEEP (*January 24*).
- Sent the "Recommendations from the Pollinator Advisory Committee to the Environment Committee of the Connecticut State Legislature on potential changes in policy or legislation to protect pollinator health" to the Co-Chairs, Vice-Chairs, and Ranking Members of the Environment Committee of the CT State Legislature (*February 17*).
- Sent written testimony on behalf of the Pollinator Advisory Committee to the Environment Committee of the CT State Legislature on Senate Bill 120, An Act Concerning the Use of Chlorpyrifos on Golf Courses and Neonicotinoids for Nonagricultural Use (*February 24*).
- Testified on behalf of the Pollinator Advisory Committee to the Environment Committee in their public hearing on Senate Bill 120, An Act Concerning the Use of Chlorpyrifos on Golf Courses and Neonicotinoids for Nonagricultural Use (*February 25*).
- Participated in a national meeting of the Working Group on Managed Pollinated Protection, discussing pollinator protection for pesticide applicators working in areas like roadsides, rights-of-way, and lawns (35 attendees) (*March 10*).

TAERUM, STEPHEN J.

- Presented "Exploring Protist Communities in the Phyllosphere: Emerging Patterns in Diversity, Structure, and Bacterial Interactions" at the Phyllosphere Fortnight 2021 meeting (60 attendees) (*July 22, 2021*).
- Organized and moderated the special session, "From the Top Down: How Microbial Predators Mediate Plant Disease" for the American Phytopathological Society Plant Health 2021 online meeting (186 adults) (*August 2*).
- Moderated the technical session, "Plant-Associated Microbiome Composition and Activity" for the American Phytopathological Society Plant Health 2021 online meeting; and presented "A Dual Sequence and Culture-Based Survey of Maize Rhizosphere Protists Reveals Dominant, Plant-Enriched, and Culturable Community Members" for the American Phytopathological Society Plant Health 2021 online meeting (132 adults) (*August 4*).
- Presented "Exploring the Protists in the Phytobiome" at the virtual Plant & Animal Genomes XXIX meeting (28 participants) (*January 12, 2022*).

TRIPLETT, LINDSAY R.

- Presented an invited virtual seminar titled "Bacteria at the Interface of Antimicrobials and Predators" for the UC Riverside Department of Microbiology and Plant Pathology (36 attendees) (*October 7, 2021*).
- Served as co-instructor of the Yale course MCDB380/680, "Advances in Plant Molecular Biology" and gave a three-week lecture module on "Plant-Biotic Interactions," led three primary literature discussion sections, and graded student presentations and writing assignments (16 students) (*October 8-November 5*).
- Presented via Zoom a short oral presentation titled "Uncovering the Dark Matter of the Plant Microbiome: The Ecology and Function of Microeukaryotes on Plant Hosts" at the Sussex Plant Biology Symposium (47 attendees) (*November 12*).

- Participated in a virtual grant panel for a federal agency (*April 27, 2022*).
- Was interviewed by Josh Flynn of the Logansport, IN PharosTribune about her career as a CAES scientist and plant pathologist in an article titled "Logansport native breaks boundaries in fields of plant pathology and ecology": https://www.pharostribune.com/news/article_22629d38-cd76-11ec-a0c5- c314f26bad1b.html (*May 6*).
- Gave a presentation titled " Exploring the identity and function of protist-associated bacteria in the rhizosphere" via Zoom as part of the Terrestrial Ecology colloquium at the University of Cologne (15 adults) (*June 1*).
- Twice gave a presentation titled "CAES Then and Now" to members of the public as part of Arts and Ideas Festival events. The presentation was followed by campus tours guided by Drs. Lindsay Triplett, Christian Dimkpa, and Jason White; tour stops were presented by Drs. Goudarz Molaei, Carlos Tamez, Philip Armstrong, Claire Rutledge, Washington da Silva, Gale Ridge, and Yonghao Li (12 adults) (*June 16*) and (22 adults, 3 children) (*June 24*).

VOSSBRINCK, CHARLES R.

- Recorded a lecture about growing figs in Connecticut with Theresa Hennessey from the University of Connecticut Master Gardener program (*August 13, 2021*).
- Gave a lecture titled "Growing Figs in Connecticut," a poster, and a demonstration of fig plantings at Lockwood Farm to students from the University of Connecticut's Master Gardener program (10 attendees) (*August 31*).

WARD, JEFFREY S.

- Spoke on tree identification and curious facts at the Connecticut Tree Protective Association summer meeting held in Farmington (100 attendees) (*July 15, 2021*).
- Participated in a Yankee SAF fall meeting planning Zoom call (*July 30*).
- Met with Aspetuck Land Trust members to discuss invasive species control (7 attendees) (*August 17*).
- Met with Marc Trembley (RIFCO) to discuss effectiveness of slash walls in Foster, RI (*August 24*).
- Met with Gabriel Horton and Pavel Pluhar (USAG West Point, NY) to discuss forest regeneration in areas with high deer density (*August 25*).
- Met with Will Hochholzer and CT DEEP Forestry staff to discuss forest regeneration (*August 26*).
- Administered practical and oral examinations to arborist candidates for the Connecticut Tree Protection Examining Board at Lockwood Farm (*September 8*).
- Was interviewed about the fall foliage forecast by Susan Dunne, Hartford Courant (*September 9*).
- Spoke on "Changes in Forest Carbon During 38 Years of Active Management" to a virtual Connecticut and New York Audubon Science Forum (44 attendees) (*September 10*).
- Spoke on "Forest Management, the Good, the Bad, and the Ugly" at the Valley Laboratory's 100th Anniversary Celebration in Windsor (15 attendees) (*September 10*).
- Participated in a Forest Ecosystem Monitoring Cooperative CT Sprint Project virtual meeting (*September 15*).
- Participated in a Forest Ecosystem Monitoring Cooperative State Coordinators Meeting (*September 16*).
- Spoke on forest management and resiliency at the Yankee Division-Society of American Foresters field workshop in North Madison (58 attendees) (*September 21*).
- Was interviewed about hickory nut masting by Robert Miller, News-Times (*September 28*).
- Participated in a CT Council on Soil and Water Conservation virtual meeting (*September 30*).
- Met with Jerry Milne (CT DEEP Forestry) to discuss forest management in Naugatuck State Forest, Hamden (*September 30*).
- Spoke on forest management and ecology during a Sunday walk at Naugatuck State Forest in Hamden (4 attendees) (*October 3*).
- Gave an invited talk on "Regenerating Oak in Southern New England" at the Northeast-Midwest State Foresters Alliance-Public Land Management Committee (NMSFA-PLMC) annual meeting in Mystic (17 attendees) (*October 5*).
- Spoke on "Defoliation, Drought and Oak Mortality" at the NMSFA-PLMC field tour in Pachaug State Forest (18 attendees) (*October 6*).
- Met with Will Hochholzer and CT DEEP Forestry staff in Portland to discuss influence of soil moisture indices on forest regeneration (*October 14*).
- Spoke on forest management and succession at a Master Woodland Manager Module 2: Forest Ecology field workshop in North Madison (*October 16*).

- Participated in a Forest Ecosystem Monitoring Cooperative State Coordinators Meeting (*October 21*).
- Spoke on developing diverse habitats at the Forest Management for Land Trusts field workshop in Madison (32 attendees) (*October 22*).
- Spoke on "Management Influences Aboveground Forest Carbon Storage and Sequestration in Mature Oak Forests: 38 Year Results" at the virtual Society of American Foresters National Convention (88 attendees) (*November 4*).
- Participated in a virtual Technical Advisory Committee meeting for New England Forestry Foundation's North Central and Transition Hardwoods Exemplary Forestry standards (*November 10*).
- Met with Great Mountain Forest Executive Director Tamara Muruetagoiena, Trustee Chair John Coston, and Vice Chair Heather Thomson to discuss forest management and stewardship (*November 12*).
- Attended the McIntire-Stennis Cooperative Forestry Research and Renewable Resources Extension Act Program FY2021 virtual Administrative Meeting (*November 15*).
- Gave an invited lecture titled "A Short History of the Connecticut Forest" for the Gardeners of Simsbury (19 attendees) (*November 16*).
- Met with Gabriel Horton (USAG West Point, NY), Nels Barrett (NRCS regional ecologist), Donald Parizek and Milton Vega (NRCS CT), Olga Vargas (NRCS NY), and Fred Schoenagel (NRCS NJ) to discuss influence of soils on forest composition (*November 16*).
- Gave a talk titled "A Short History of the Connecticut Forest" at the Waterbury Senior Center (23 attendees) (*November 17*).
- Participated in a Forest Ecosystem Monitoring Cooperative State Coordinators virtual meeting (*December 2*).
- Participated in an Oak Resiliency Project Update conference call (*December 2*).
- Administered practical and oral examination to arborist candidates for the Connecticut Tree Protection Examining Board (*December 8*).
- Gave the talk, "Multiyear defoliations in southern New England increases oak mortality" at the 2021 Forest Ecosystem Monitoring Cooperative Virtual Conference (*December 16*).
- Participated in the Yankee SAF meeting planning committee (*December 21*).
- With Dr. Scott Williams, gave a talk titled "How Deer Browse and Invasive Species Accelerate the Loss of Oak" for the Pennsylvania SAF Deer Forest Committee (28 attendees) (*January 5, 2022*).
- Participated in a (FEMC) Forest Ecosystem Monitoring Cooperative State Coordinators virtual meeting (*January 6*).
- Participated in a Yankee Division - Society of American Foresters Outreach Committee virtual meeting (*January 17*).
- Attended the virtual Connecticut Tree Protective Association annual meeting (*January 20*).
- Participated in a Connecticut Forest and Park Association Board of Directors meeting (*January 26*)
- Participated in a Forest Ecosystem Monitoring Cooperative (FEMC) Joint Committee virtual meeting (*January 27*).
- Participated in a (FEMC) Forest Ecosystem Monitoring Co-operative Joint Committee virtual meeting (*February 1*).
- Participated in a CFPA Governance Committee meeting (*February 8*).
- Attended the virtual annual meeting of the Yankee Division, Society of American Foresters (*February 15*).
- Spoke on "Forest Carbon and Multi-Use Forest Management" for the Cornell University Forest Connect webinar series (277 attendees) (*February 16*).
- Was interviewed about the status of maples in Connecticut by Robert Miller, News-Times (*February 16*).
- Participated in a Yankee SAF spring field meeting planning call (*March 1*).
- Met with NRCS and RWA staff to discuss the impact of forest management on carbon dynamics (5 attendees) (*March 2*).
- Met with Bryan Garcia and Ashley Stewart (Connecticut Green Bank) to discuss forest carbon dynamics and markets (*March 7*).
- Spoke on the relationship of forest management on aboveground carbon storage and sequestration at the Forest Health Monitoring Workshop in New Haven (44 attendees) (*March 8*).
- Met with Cassandra Speight (UConn) to discuss forest structure and Lyme disease risk (*March 8*).
- Administered practical and oral examination to arborist candidates for the Connecticut Tree Protection Examining Board (*March 9*).
- Participated in a (FEMC) Forest Ecosystem Monitoring Cooperative State Coordinators virtual meeting (*March 10*).

- Met with regional foresters to discuss oak resiliency in Oakham, MA (7 attendees) (*March 15*).
- Met with Mount Grace Land Conservation Trust staff in Warwick, MA to discuss forest regeneration (3 attendees) (*March 16*).
- Participated in a meeting of Mountain Forest Trustees (*March 19*).
- Was interviewed about growing forsythias and whether they are listed as invasive by Robert Miller of the News-Times (*March 23*).
- Participated in a Connecticut Forest and Park Association (CFPA) Master Woodlands Managers Partner's meeting (*April 5*).
- Spoke about the impact of tree diseases on forest dynamics at Naugatuck State Forest for the Yale Forest Health class (9 attendees) (*April 8*).
- Spoke on forest regeneration for the CFPA's "Walk with a Forester" at Field Forest in Durham (11 attendees) (*April 9*).
- Participated in a Forest Ecosystem Monitoring Cooperative (FEMC) Steering Committee Meeting (*April 11*).
- Gave an invited lecture titled "A Short History of the Connecticut Forest" for the Cherry Brook Garden Club in Canton (25 attendees) (*April 12*).
- Participated in a CFPA's Governance Committee meeting (*April 12*).
- Participated in the FEMC State Coordinators virtual meeting (*April 14*).
- Organized, hosted, and spoke at the FEMC Connecticut State Partnership (CT SParC) organizing meeting (18 attendees) (*April 26*).
- With Mr. Joseph P. Barsky, advised Andrew Hubbard (MDC) on the status of old-growth forest in Sandisfield, MA (*April 27*).
- Attended the McIntire-Stennis Cooperative Forestry Research and Renewable Resources Extension Act Program FY2021 virtual Administrative Meeting (*April 28*).
- Spoke about the impact of tree diseases on forest dynamics in Madison and Deep River for the Yale Forest Health class (9 attendees) (*April 29*).
- Spoke on "The Biodiversity Crisis" for the Milford Garden Club (23 attendees) (*May 10*).
- Spoke on "White Oak Precommercial Crop Tree Release" at the Yankee Society of American Foresters summer meeting in Oakham, MA (48 attendees) (*May 13*).
- Spoke on "Using Slash Walls to Enhance Oak Regeneration" at the Yankee Society of American Foresters summer meeting in Oakham, MA (29 attendees) (*May 13*).
- Spoke on "The Biodiversity Crisis" for the Great Mountain Forest lecture series in Norfolk (21 attendees) (*May 14*).
- Was interviewed about the impact of beech leaf disease on forest health by the NewsTimes (*May 17*).
- Participated in a Connecticut Forest and Park Association Board of Directors meeting (*May 25*).
- Participated in a Connecticut Forest and Park Association Governance Committee meeting (*June 14*).
- Participated in CT DEEP Forestry 490 training (*June 15*).
- Spoke on impact of diseases and insects on forest dynamics for Connecticut Forest and Park Association's (CFPA) Master Woodlands Managers Partner's in Naugatuck (14 attendees) (*June 19*).
- Met with Jeremy Clark (DEEP Forestry) and Peter Picone (DEEP Wildlife) to offer advice on implementing a crop tree management demonstration area (*June 29*).

WHITE, JASON C.

- Participated in the FDA Laboratory Flexible Funding Model (LFFM) year 2 kick-off call (*July 1, 2021*).
- Participated in the weekly NSF Center for Sustainable Nanotechnology (CSN) All-Hands calls (*July 7, 21, and 28*).
- Participated in the FDA Rapid Response Team (RRT) monthly webinar series (*July 8*).
- Participated in the monthly FDA LFFM Zoom calls for Human and Animal Food and Food Defense (*July 12*).
- Participated in a monthly NSF CSN Faculty Zoom call (*July 13*).
- Hosted a reception and showing of the artwork in the lobby of the Jenkins-Waggoner Laboratory (*July 13*).
- Participated in an Elsevier webinar for new Associate Editors of *NanoImpact* (*July 19*).
- Hosted the NSF CSN monthly Nanochem-Plant working group Zoom call (*July 20*).
- Participated in a meeting with CT Department of Agriculture staff to discuss the upcoming FDA sample requirements and contract (*July 22*).

- Participated in the International Webinar on "Agricultural Nanotechnology: Influencing the Future of Farming Sustainability" at the University of the Punjab in Lahore, Pakistan, and gave a presentation (remotely) titled "The Use of Nanoscale Nutrients to Increase Crop Tolerance to Biotic and Abiotic Stress" (*July 29*).
- Participated in the Yale School of Public Health Summer Research Experience in Environmental Health Sciences Webinar and gave a presentation titled "Environmental Health and Science Research at the CT Agricultural Experiment Station" (*July 30*).
- Participated in the Center for Sustainable Nanotechnology (CSN) Zoom call for the Summer Undergraduate Research Experience (SURE) program conclusion (*August 5*).
- Participated in the monthly FDA LFFM Zoom calls for Human and Animal Food and Food Defense (*August 9*).
- Participated in the monthly NSF CSN Faculty Zoom call (*August 10*).
- Gave a presentation titled "Nano-enabled Agricultural Research at the CT Agricultural Experiment Station" at Nanotechnology Research and Innovation Bootcamp 2021 "Harnessing Nanotechnology for Sustainable Development in Energy, Water, Health, and Agriculture," which was sponsored by the United Nations Economic Commission for Africa and the African Materials Research Society (*August 11*).
- Participated in the weekly NSF CSN All-Hands calls (*August 11 and 18*).
- Participated in a Zoom call with Dr. Hongda Chen of the USDA National Institute of Food and Agriculture (NIFA) to discuss research topics in nano-enabled agriculture (*August 12*).
- Hosted the NSF CSN monthly Nanochem-Plant working group Zoom call (*August 17*).
- Participated by Zoom in a USDA NIFA Agriculture and Food Research Initiative (AFRI) grant review panel (*August 23-27*).
- With Dr. Jaya Borgatta, participated in a Zoom meeting with a Greenwich High School student to discuss a potential internship position (*August 24*).
- Participated by Zoom in a Farmland Preservation Advisory Board (FPAB) meeting (*August 26*).
- Participated in a teleconference call with Dr. Lee Newman of SUNY ESF to discuss the *International Journal of Phytoremediation* (Dr. Newman is the Editor-in-Chief and Dr. White is the Managing Editor) (*August 30*).
- With Dr. Christian Dimkpa, Dr. Wade Elmer, Dr. Ishaq Adisa, and Dr. Jaya Borgatta, participated in a monthly research group call for a joint USDA-funded project on nanoscale phosphorus delivery (*August 31*).
- Participated in the Center for Sustainable Nanotechnology (CSN) Strategic Planning Meeting (*September 1*).
- Participated in the Proposal B Defense and annual Dissertation Committee meeting of Ms. Carolina Valdes Bracamontes of the University of Texas El Paso (remote) (*September 2*).
- Participated in the Center for Sustainable Nanotechnology (CSN) weekly All-Hands call (*September 8, 15, 22, and 29*).
- Participated in the monthly CT Laboratory Preparedness Teams call with the CT Department of Public Health and others (*September 13*).
- Participated in the monthly FDA LFFM Zoom call for the Human and Animal Food program (*September 13*).
- Gave a guest lecture (remote) at the Institute of Science and Technology of Sorocaba, São Paulo State University, titled "Nano-Enabled Agriculture: Sustainable Approaches to Food Security" (*September 15*).
- Hosted the monthly CSN Nanochemistry-Plant Zoom call (*September 15*).
- Participated in Chunyang Li's Ph.D. proposal defense (*September 21*).
- Participated in a meeting of the Experiment Station Associates and gave a Director's Report (*September 22*).
- Chaired the quarterly CAES Safety Committee meeting (*September 24*).
- Participated in the Northeast Regional Experiment Station Directors (NERA) meeting (*September 28*).
- Participated by Zoom in the Editorial Advisory Board meeting of *Environmental Science and Technology Letters* (*September 29*).
- Hosted the monthly CAES J-1 Visa recipient meeting (*September 30*).
- Gave a guest lecture at the European Union Sustainable Innovation of Microbiome Applications in the Food System (SIMBA) online training course "Risk Assessment and Safety Aspects in the Application of Microbial and Nanotechnologies to Agriculture and Food Production"; the lecture was titled "Nano-Enabled Strategies to Enhance Crop Tolerance to Biotic and Abiotic Stress" (*September 30-October 1*).
- Participated in the monthly CT Laboratory Preparedness Teams call with the CT Department of Public Health and others (*October 4*).

- Participated by Zoom in the 2021 USDA AFRI Nanotechnology Annual Grantees' Conference and gave presentations titled "Biodegradable Polymer-Nanoparticle Composites for Controlled Release and Targeted Delivery of Phosphorus During Plant Growth" and "Nanoscale Sulfur for Plant Nutrition, Disease Suppression, and Food Safety" (*October 6-7*).
- Participated in the virtual biannual Center for Sustainable Nanotechnology (CSN) All-Hands meeting (*October 11-12*).
- Hosted the quarterly CAES Board of Control meeting held at the Valley Laboratory (*October 13*).
- Spoke with Professor Philip Demokritou of Rutgers University regarding collaborative research (*October 14*)
- Met with Mr. Frank Greene of the CT Department of Consumer Protection to discuss the state metrology laboratory (*October 14*).
- Attended the 2021 TechConnect World Innovation Environmental Health and Safety Symposium in National Harbor, Maryland, and gave a presentation titled "Enhancing Agrichemical Delivery and Plant Development with Biopolymer-Based Stimuli Responsive Nanoplatforms" (*October 18-20*).
- Participated by Zoom in the bi-monthly Farmland Preservation Advisory Board meeting (*October 21*).
- Attended (remotely) the International Sustainability Workshop 2021 (ISW 2021) at the Center for Sustainable Development of Qatar University, Doha, Qatar, and gave a keynote lecture titled "Nano-Enabled Agriculture: A Path to Global Food Security?" (*October 26*).
- Participated in the CSN weekly All-Hands call (*October 27*).
- Hosted the monthly CAES J-1 Visa recipient meeting (*October 29*).
- Attended (remotely) the American Society of Plant Biologists Northeastern Section Meeting and gave a keynote presentation titled "Nano-Enabled Strategies to Enhance Crop Tolerance to Biotic and Abiotic Stress" (*October 30*).
- Participated in the monthly CT Laboratory Preparedness Teams call with the CT Department of Public Health and others (*November 1*).
- Held a Zoom call with Prof. Soledad Peresin of Auburn University to discuss collaborative research on nano-enabled agriculture (*November 2 and 9*).
- Participated in the CSN weekly All-Hands call (*November 3*).
- With Dr. Joseph Pignatello, participated in a Zoom call with staff of the University of Connecticut Technology Commercialization Services to discuss CAES patenting and intellectual property assistance (*November 4*).
- Gave a virtual seminar at the 2021 Annual Sustainable Nanotechnology Organization (SNO) Conference titled "Nanoscale Sulfur to Suppress Fungal Disease and Increase the Bio-mass and Yield of Tomato" (*November 5*).
- Attended the 2021 Annual American Society of Agronomy-Crop Science Society of America-Soil Science Society of America (ASA-CSSA-SSSA) meeting in Salt Lake City, Utah, and gave an invited lecture titled "Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition, and Yield" (*November 7-10*).
- With Dr. Christian Dimkpa, participated in a Zoom call with colleagues at the Botswana University of Agriculture and Natural Resources and the Botswana Institute for Technology Research and Innovation to explore the possibility of a formalized partnership on nano-enabled agriculture (*November 11*).
- Held a Zoom call with Prof. Vinka Craver of the University of Rhode Island to discuss USDA NIFA research programs (*November 12*).
- Served as a panelist on a virtual NSF grant panel in the Chemical, Bioengineering, Environmental and Transport Systems Division (CBET) (*November 15-16*).
- Participated in a Zoom call with officials from the USDA and the National Nanotechnology Coordination Office (NNCO) to discuss dissemination of CAES research findings on nano-enabled agriculture (*November 17*).
- Met with Professor Swadesh Santra of the University of Central Florida to discuss collaborative research (*November 17*).
- Participated in a Zoom call with representatives from FEMA, USDA, UConn, and the CT Department of Agriculture to discuss preparation of a public webinar on urban agriculture (*November 17*).
- Participated in a Zoom call with representatives of USDA and the University of Massachusetts to begin planning a workshop on toxic metals in food (*November 17 and 23*).
- Traveled to the University of Central Florida in Orlando and gave an invited lecture titled "Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition, and Yield" (*November 18-19*).

- Participated in a CSN All Faculty call (*November 18*).
- Spoke with Bill Hobbs, a reporter for Estuary magazine, about a story he is writing about CAES (*November 23*).
- Participated in the annual Ph.D. Committee meeting of Jesus Cantu, a Ph.D. student at the University of Texas El Paso (*November 30*).
- Participated in the NSF Center for Sustainable Nanotechnology (CSN) weekly All-Hands call (*December 1, 8, and 15*).
- Participated in the annual Ph.D. Committee meeting of Yuqing Ye of the University of Texas El Paso (*December 2*).
- Participated in the monthly CT Laboratory Preparedness Teams call with the CT Department of Public Health and others (*December 6*).
- Hosted a meeting in Jones Auditorium with the representatives of the Community Foundation of Greater New Haven, the New Haven Public Schools Superintendent's office and Wilbur Cross High School, along with 15 CAES staff members, to discuss establishment of Mentoring Girls in Science Program (*December 13*)
- With Dr. Leigh Whittinghill participated in a Zoom call with the Commissioner of the CT Department of Agriculture and staff, as well as representatives from FEMA and USDA, to discuss a series of public webinars on urban agriculture (*December 13*).
- Hosted the monthly CSN Nanochemistry-Plant Zoom call (*December 14*).
- Participated remotely in the NIEHS Superfund Research Program annual Meeting (*December 14-16*).
- Participated by Zoom in the mid-term review of the NRSP3 multistate project (*December 14*).
- Participated by Zoom in the Northeast Experiment Station Directors monthly meeting (*December 15*).
- Participated by Zoom in the monthly Farmland Preservation Advisory Board meeting (*December 16*).
- With Dr. Wade Elmer met with a representative of the International Festival of Arts and Ideas to discuss the potential of The CAES being a tour stop at this year's event (*December 16*).
- Gave an invited lecture titled, "Nanotechnology and Agriculture: Tuning agrochemical chemistry at the nanoscale to maximize crop production" at The International Chemical Congress of Pacific Basin Societies (Pacifichem) 2021 (*December 18*).
- Travelled to Rutgers University to meet with colleagues about a joint NSF Center Grant proposal (*December 22*).
- Participated in the NSF Center for Sustainable Nanotechnology (CSN) weekly All-Hands call (*January 5, 12, and 26, 2022*).
- Participated in the Ph.D. Proposal B Exam of Jesus Cantu of the University of Texas El Paso (Dr. White is on his Ph.D. Committee) (*January 10*).
- Hosted the monthly CSN Nano-Chemistry-Plant Zoom call (*January 11*).
- With Dr. Wade Elmer and Ms. Calanthe Cavadini, testified in front of the Commission on Human Rights and Opportunity (CHRO) and discussed the agency Affirmative Action Plan (*January 12*).
- Participated in the monthly CSN All Faculty meeting and gave a research highlight presentation titled "Nanomaterial Chemistry and Plant Interactions" (*January 13*).
- Hosted the quarterly CAES Board of Control meeting (*January 18*)
- Participated in the oral preliminary exam of Ms. Cheng-Hsin Huang of the University of Minnesota (Dr. White is on her Ph.D. committee) (*January 19*).
- Participated in the Ph.D. proposal defense of Chunyang Li from the University of Massachusetts (Dr. White is on her Ph.D. committee) (*January 19*).
- With Dr. Leigh Whittinghill, participated in a USDA, FEMA, CT DoAg, UConn, and CAES sponsored public webinar on urban agriculture (*January 19*).
- Participated by Zoom in the monthly Farmland Preservation Advisory Board meeting (*January 20*).
- With Mr. Gregory Bugbee, participated in a Zoom meeting with Representative Christine Palm to discuss hydrilla and other invasive aquatic plant species (*January 20*).
- Hosted a Teams meeting with Mr. Troy Ruff of the Department of Consumer Protection Division of Drug Control to discuss adult use cannabis sample collection for analytical method validation (*January 24*).
- Met by Zoom with Dr. Christy Haynes of the University of Minnesota and Dr. Vasilis Vasiliou of Yale University to discuss a Freedom of Information Act request (*January 25*).
- Participated in the bimonthly Experiment Station Associates meeting and gave a Director's report (*January 26*).
- With Dr. Nubia Zuverza-Mena, Dr. Sara Nason, and Dr. Leigh Whittinghill, met by Zoom with Jane Philbrick and colleagues to discuss a phytoremediation project in Bridgeport (*January 28*).

- Participated in an FDA-sponsored Zoom call to discuss sampling for human and animal food projects (*January 28*).
- Hosted representatives of Vulpes Corporation to discuss collaborative research projects on nano-enabled agriculture (*February 2*).
- Participated in the Ph.D. proposal defense of Mr. Sudhir Sharma of the University of Massachusetts Stockbridge School of Agriculture (*February 4*).
- Hosted the monthly CSN Nanochemistry-Plant Zoom call (*February 7*).
- Participated in the NSF Center for Sustainable Nanotechnology (CSN) weekly All-Hands call (*February 9, 16, and 23*).
- Held a Zoom call with staff of Senator Richard Blumenthal's office to discuss additional funding for the CAES Tick Testing Laboratory (*February 9*).
- Visited the University of Rhode Island and gave an invited lecture titled "Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition and Yield" (*February 10*).
- With Dr. Joseph Pignatello, participated in a Zoom call with staff at the University of Connecticut Technology Commercialization Services Office (*February 11*).
- Participated in the monthly FDA Human/Animal Food and Food Defense Zoom calls (*February 14*).
- Participated in a Zoom call with NIH staff regarding participation in an upcoming study section (*February 16*).
- Participated in a webinar hosted by the Environmental Health Project titled "Shale Gas and Public Health: Translating Science into Policy" (*February 22*).
- Participated in a Zoom call with Prof. Vasilis Vasiliou of Yale University regarding a graduate student applicant for the Yale School of Public Health (*February 22*).
- Participated in an FDA workshop on submitting applications for a new MFRPS grant program titled "Manufactured Food Flexible Funding Model Compliance and Enforcement Expansion Supplement" (*February 23*).
- Participated in an FDA FERN-wide Zoom call (*February 24*).
- Participated in a National Nanotechnology Initiative webinar titled "What We Know About NanoEHS: Building International Bridges" (*March 1*).
- Participated in the Northeast Regional Association of Agricultural Experiment Station Directors (NERA) Multistate Advisory Committee meeting (*March 2*).
- Participated in the NSF Center for Sustainable Nanotechnology (CSN) weekly All-Hands call (*March 2, 9, 16, and 23*).
- Participated in an NIH webinar regarding service on an upcoming Study Section (*March 2*).
- Participated in a CT Department of Agriculture statewide call concerning Avian influenza response (*March 3*).
- Met with representatives of ABSCIEX regarding installation of a new LC-MS instrument (*March 3*).
- Held a Zoom call with Dr. Hongda Chen of the USDA National Institute for Food and Agriculture (NIFA) to discuss a joint publication for the National Academy of Engineering (*March 4 and 8*).
- Participated in the monthly Laboratory Preparedness Advisory Committee Meeting via Teams (*March 7*).
- Participated in the 5th annual Nanyang Technology University - Harvard T.H. Chan School of Public Health virtual symposium (*March 8*).
- Hosted the monthly CSN Nanochem-Plant call (*March 8*).
- Participated in the monthly FDA LFFM Zoom calls for the Food Defense and the Human and Animal Food Programs (*March 14*).
- Attended the quarterly NERA business meeting and gave a presentation titled "Nanotechnology and Agriculture: Sustainably Achieving Food Security" (*March 15*).
- Participated in the Search Committee meeting for a new scientist position in the Department of Plant Pathology and Ecology (*March 16*).
- Spoke by Zoom with Hannah Brown of the University of Florida about her work at CAES this summer as a Yale Conservation Scholar (*March 16*).
- Participated in the Farmland Preservation Advisory Board meeting (*March 17*).
- Participated in an FDA-sponsored LFFM Grants Management Webinar (*March 22*).
- Participated in an NIH Study Section by Zoom (*March 24*).
- With Dr. Nubia Zuverza-Mena, Dr. Sara Nason, and Dr. Leigh Whittinghill, participated in a Zoom meeting regarding a potential phytoremediation project in Bridgeport, CT (*March 25*).
- With multiple CAES staff members, participated in a Zoom call with New Haven Public School staff regarding a

CAES Mentoring Girls in Science program (*March 28*).

- Gave a presentation by Zoom to the University of California Riverside Department of Botany and Plant Sciences titled "Nanotechnology in Agriculture: A Path to Sustainably Achieve Food Security?" (*March 30*).
- Co-hosted a USDA-funded workshop titled "Toxic Metals in Food: Identification of Critical Knowledge Gaps to Ensure a Safe Food Supply" on Zoom (*April 4-5*).
- Gave a presentation titled "Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition, and Yield" at the US-NA Nanotechnology Convergence for Energy, Environment, and Health (remote) (*April 6*).
- Participated in the NSF Center for Sustainable Nanotechnology (CSN) weekly All-Hands call (*April 6 and 27*).
- With Dr. Sara Nason and Dr. Nubia Zuverza-Mena, participated in a NIEHS sponsored Zoom call to establish a PFAS Analysis Working Group (*April 8*).
- Traveled to Atlanta, GA, to participate in the annual CSN All-Hands in-person meeting (*April 11-12*).
- Participated in an FDA-sponsored call of the FDA LFFM to discuss an upcoming presentation on violative food samples in Connecticut (*April 13*).
- With Dr. Sara Nason and Dr. Nubia Zuverza-Mena, spoke by Zoom with staff of Senator Christine Cohen to discuss PFAS (*April 14*).
- Spoke by Zoom with Wilanyi Alvarez of the University of Minnesota about her Ph.D. research project (*April 14*).
- Spoke by Zoom with USDA NIFA staff regarding a presentation at an upcoming USDA Public Meeting (*April 15*).
- Participated by Zoom in an NIEHS-sponsored webinar "Approaches to Enhance Bioremediation" (*April 15 and 29*).
- With Department of Analytical Chemistry staff, participated in a Zoom call with CT Department of Agriculture staff to discuss sampling for the next year (*April 18*).
- Hosted the quarterly meeting of the CAES Board of Control (*April 20*).
- Participated in an FDA Webinar on "Interesting Year 2 Samples" (*April 20*).
- Gave a Director's Report at the annual meeting of the Experiment Station Associates in Jones Auditorium (*April 20*).
- Participated in the monthly CSN faculty meeting (*April 21*).
- Gave a presentation by Zoom to the University of Massachusetts Stockbridge School of Agriculture titled "Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition and Yield" (*April 26*).
- Gave a presentation titled "Toxic Elements in Food: Identification of Critical Knowledge Gaps to Ensure a Safe Food Supply" at a USDA Public Meeting (*April 27*).
- With Department of Agriculture staff, participated in a Teams call with DCP Drug Control staff about adult use cannabis testing (*April 28*).
- Hosted the monthly CAES J-1 Visa recipients meeting (*April 29*).
- Dr. Jason C. White participated in the monthly Laboratory Preparedness meeting at the CT Department of Public Health Laboratory in Rocky Hill (*May 2*).
- Participated in the APHL sponsored kick-off planning meeting for the annual FDA LFFM face to face meeting scheduled to occur in November 2022 (*May 3*).
- Participated in the Ph.D. Dissertation defense of Dr. Becky Curtis of the University of Wisconsin Milwaukee (*May 4*).
- Spoke by Zoom with Dr. Miriam Krause of the NSF Center for Sustainable Nanotechnology (CSN) to plan a blog post on nano-enabled agriculture (*May 5*).
- With Dr. Sara Nason and Dr. Nubia Zuverza-Mena, participated in the monthly call of the PFAS Testing Laboratory Working Group (*May 6*).
- Participated by Zoom in a PI review for the NSF CSN (*May 9*).
- Hosted CT DPH Commissioner Dr. Manisha Juthani and gave the opening remarks for the CAES Vector-borne Diseases Workshop (*May 10*).
- With Mr. Michael Last, participated in the Valley Laboratory design meeting in Windsor (*May 10*).
- Gave a presentation by Zoom titled "Nanotechnology-enabled Agriculture: A Path to Global Food Security?" to the International Environmental Institute based in Ontario, Canada (*May 11*).
- With the CT Department of Consumer Protection Food Division, participated in the annual FDA audit of the MFRPS (*May 11*).

- With Dr. Shital Vaidya and Dr. Nubia Zuverza-Mena, hosted a Zoom call with a prospective visiting Ph.D. student from the University of Lahore in Pakistan (*May 11*).
- Participated in the weekly all-hands Zoom call for the NSF CSN (*May 11 and 17*).
- Participated in a Zoom call with Prof. Soledad Peresin of Auburn University to discuss a joint grant submission to USDA (*May 12*).
- With Dr. Leigh Whittinghill, participated in a Zoom call with an EPA staff intern to discuss their project on evaluating plant uptake pathways of chemical contaminants in state models for risk assessments of contaminated sites (*May 13*).
- Participated in the NIEHS Superfund Research Program Progress in Research Zoom call (*May 13*).
- Gave a presentation by Zoom titled "Nanotechnology-enabled agriculture: A path to global food security?" for the Novo Nordisk Foundation Challenge program "Biocompatible Nanofertilizers for Targeted Delivery and Programmed Release of Essential Mineral Ions in Crops" at the University of Copenhagen (*May 16*).
- Hosted the monthly NSF CSN Nanochemistry-Plant call (*May 17*).
- Participated in a Zoom call as part of the 2022 Farmland Restoration Program review panel (*May 17*).
- Participated in a Zoom call with UConn CAHNR faculty and CT DEEP staff to discuss an invasive aquatic species coordinator position (*May 18*).
- Participated in the Farmland Preservation Advisory Board Meeting (*May 19*).
- Participated in the monthly NSF CSN Faculty meeting (*May 19*).
- Met by Zoom with USDA APHIS staff to discuss the response to the spotted lanternfly (*May 19*).
- With Dr. Sara Nason and Dr. Nubia Zuverza-Mena, participated in a Zoom call with Dr. Sara Thomas who will be joining the CAES NIEHS grant on PFAS phytoremediation (*May 20*).
- Gave a presentation at Duke University titled "Nanotechnology-enabled Agriculture: Crop Nutrition and Food Security?" for the International Network for Researching, Advancing, and Assessing Materials for Environmental Sustainability (INFRAMES) (*May 26*).
- Hosted the monthly CAES J-1 Visa Recipients meeting (*May 31*).
- Attended a Connecticut Farm Bureau Association Farm-to-Table Dinner at Jones Family Farm to honor American Farm Bureau Federation president Zippy Duvall (*May 31*).
- Participated in the weekly all-hands Zoom call for the NSF Center for Sustainable Nanotechnology (June 1 and 29).
- Along with Department of Analytical Chemistry staff, met with Green Empire Therapeutics to discuss the CT Adult Use Cannabis program (*June 2*).
- Gave a remote presentation titled "Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition, and Yield" to the University of Vienna Centre for Microbiology and Environmental Systems Science (*June 2*).
- Along with Dr. Sara Nason, participated in the monthly call of the PFAS Testing Laboratory work group (*June 3*).
- Hosted the CAES Retiree luncheon at Lockwood Farm (*June 3*).
- Participated in a Ph.D. committee meeting by Zoom with a graduate student at the University of Wisconsin (*June 3*).
- Participated in the monthly Laboratory Preparedness meeting at the CT Department of Public Health Laboratory in Rocky Hill CT (*June 6*).
- Attended the 26th Annual Green Chemistry & Engineering Conference in Reston, VA and presented a lecture titled "Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition, and Yield" (*June 6-8*).
- Along with Dr. Christian Dimkpa participated in a US TAG to ISO/ TC 229 Zoom meeting and discussed the new project - Toxicity assessment of manufactured nanomaterials in soils using plant *Arabidopsis thaliana* (*June 9*).
- Hosted a Zoom call with Dr. Nathan Bossa of Duke University to discuss available CAES post-doctoral positions (*June 10*).
- Along with Dr. Quan Zeng and Dr. Susanna Keriö participated in a Zoom call with Dr. Tariq Sofi and colleagues of Skuast-Kashmir to discuss an upcoming research stay at CAES (*June 13*).
- Participated in the monthly FDA LFFM Zoom calls for the Human and Animal Food and the Food Defense programs (*June 13*).
- Attended the TechConnect World Innovation Conference and Expo in Washington DC and presented a lecture titled "Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition, and Yield" (*June 13-15*).

- Participated in an organizational call for the 2023 Annual International Phytotechnologies Society meeting (*June 16*).
- Participated in a Teams call with Connecticut Department of Consumer Protection staff to discuss sample collection for the FDA LFFM Human Food Program (*June 17*).
- Attended the 2022 Nanoscale Science and Engineering for Agriculture and Good Systems Gordon Research Conference at Southern New Hampshire University Manchester NH and gave a presentation titled "Convergence of Nanotechnology with Food and Agriculture"; also served as a Discussion Leader and co-presented two posters titled "AFRI 2021-67021-34001: Biodegradable polymer nanocomposites for controlled release and targeted delivery of phosphorus during plant growth" and "AFRI 2020 67022 32416 Nanoscale sulfur for plant nutrition, disease suppression, and food safety" as part of the USDA NIFA Nanotechnology Program annual review (*June 19-24*).
- Hosted a tour of CAES programs and facilities as part of the 2022 International Festival of Arts and Ideas (*June 23*).
- Hosted the monthly CAES J-Visa recipient meeting (*June 27*).
- Spoke to reporter Brian Scott Smith as part of a new CAES podcast on nanotechnology and agriculture (*June 28*).
- Gave a presentation for the CT Department of Public Health Toxi-Rounds meeting titled "Hemp and Adult Use Cannabis Testing at The CAES" (*June 30*).

WHITTINGHILL, LEIGH

- Held a virtual meeting with Brent Peterkin, Director of Gather New Haven, and discussed their current projects, issues, and potential future collaboration (*October 22, 2021*).
- Went on a farm visit with Deborah Greig at Common Ground, toured the farm and discussed what they do, issues they have been having, and possible future collaborations (*October 22*).
- Held a virtual meeting with Baikun Li from UConn's Department of Civil and Environmental Engineering to discuss her projects developing soil monitoring probes, Dr. Whittinghill's research directions, and potential collaborations with the UConn team (*November 1*).
- Met with Domingo Medina from Peels on Wheels to discuss local urban agriculture issues, what they do, Dr. Whittinghill's research, and potential future collaborations (*November 3*).
- Gave an invited talk titled "Urban Vegetable Production and Green Roofs" for the UConn Plant Science and Landscape Architecture Friday Seminar series, Storrs (20 attendees) (*November 12*).
- Gave an invited talk titled "Increasing Urban Agricultural Productivity Through Innovative Production Practices" for the Sussex Plant Biology Symposium hosted by Yale University (55 attendees) (*November 12*).
- Held a virtual meeting with Patrick Doyle from the Knox Foundation in Hartford, to discuss what they do, projects Dr. Whittinghill has planned, and possible future collaboration (*November 29*).
- Held a virtual meeting with Eliza Caldwell, Community Garden manager, and Jonathan Savage, Farm manager; with Gather New Haven to discuss their farms and gardens, issues they were having, Dr. Whittinghill's research, and possible future collaborations (*December 1*).
- Had a virtual meeting with Abbie Winer with the Andover Community Garden to discuss their garden, Dr. Whittinghill's research, and possible future collaborations (*December 1*).
- Had a virtual meeting with Micro2Life to discuss their farm, Dr. Whittinghill's research, and possible future collaborations (*December 2*).
- Spoke with Diann Litwin at Common Ground to discuss their participation in farm monitoring research (*December 2*).
- Met virtually with the Connecticut Department of Agriculture and other stakeholders on a CT Urban Agricultural webinar series (10 attendees) *(December 13*).
- Gave a CAES Seminar titled, "The Influence of Production Practices on Urban Agriculture Outcomes" in Jones Auditorium (70 attendees) (*December 15*).
- Attended the Connecticut Soil and Water Conservation Council quarterly meeting as the CAES representative (*December 16*).
- Met with Ivette Ruiz of Onward Horizons Leadership Development Associates to talk about her programs, Dr. Whittinghill's research, and possible future collaborations (*January 11, 2022*).
- Introduced herself and The CAES during the January webinar for the State of Connecticut Support for Urban Agriculture Webinar series (69 attendees) (*January 19*).

- Met with Jane Philbrick and Christopher Bergstrom of NE Wool BX and CAES staff to discuss two brownfield regeneration sites in Bridgeport (*January 28*).
- Met with Christ Sullivan of the Southwest Conservation District and two others virtually to discuss their roles and possible collaborations (*February 3*).
- Participated in a listening session hosted by Jiff Martin at UConn Extension for an urban farmer tool share program they are starting (15 attendees) (*February 17*).
- Introduced herself to the I Got Next urban farming group and others who run a series of urban farmer training sessions with assistance from Jiff Martin and UConn Extension at a virtual planning meeting (17 attendees) (*February 25*).
- Met virtually with Jacqueline Kowalski, UConn Extension Educator in Urban Agriculture, to discuss potential collaboration on her Specialty Crop Block Grant application and other issues (*March 3*).
- Met virtually with farm managers for Yale Farm, Gather New Haven, and Common Ground to discuss the record-keeping system for the upcoming monitoring project (*March 10*).
- Met with Alyssa Grant from City Seed to discuss how they can assist with farmer recruitment for her Specialty Crop Block Grant project should it get funded (*March 14*).
- Attended the quarterly meeting for the Connecticut Council for Soil and Water Conservation and gave them an update on CAES activities (*March 17*).
- Met virtually with Patrick Doyle of Knox, Inc. to discuss the Specialty Crop Block Grant Project and other updates (*March 18*).
- Attended a virtual meeting with CAES representatives and Ivalise Velazquez and Kimberly Barrington at Wilbur Cross to discuss the Mentoring Girls in STEM partnership (*March 28*).
- Helped to organize and host the second Connecticut Department of Agriculture's Urban Agriculture Webinar on the topic of grant writing (*March 30*).
- Met with Jeremy Oldham at Yale Farm during the first farm visit of Dr. Whittinghill's farm monitoring pilot project (*March 31*).
- Attended a planning meeting for the 2023 Connecticut Vegetable and Fruit Conference (*April 1*).
- Met with Doreen Abubakar to discuss her projects at the Newhallville Learning Corridor and potential partnerships with CAES (*April 1*).
- Reviewed Connecticut Department of Agriculture Transition Grant proposals with the review panel for New Farmer Micro Grants, and Research and Development Grants (*April 5*).
- As part of her on-farm monitoring pilot project, met with Diane Litwin at Common Ground for the first farm visit, and met with Jonathon Savage at Gather New Haven at the 613 Ferry Street location for the first farm visit (*April 8*).
- Participated in a thesis defense for Turquoise Brown-Patterson, a Masters of Environmental Science student at Kentucky State University (*April 14*).
- Participated in a thesis defense for Jacob Brown, a Masters of Environmental Science student at Kentucky State University (*April 19*).
- Judged student posters/presentations for the Quinnipiac Chapter of the Sigma Xi Student Research Symposium (25 posters) (*April 25*).
- Participated in a meeting of the Soil Health Committee of the Connecticut Council on Soil and Water Conservation; the committee is currently formulating a Soil Health Plan for the state (*April 27*).
- With Dr. Jason White, met virtually with Ashley DeJuliannie, a VSFS EPA intern, to discuss her report on heavy metals uptake by food crops in urban agriculture (*May 13*).
- Presented a two-hour workshop titled "Green Roofs: Benefits and Possibilities" to Master Gardeners through the UConn Extension (*May 14*).
- Participated in a meeting of the Soil Health Committee of the Connecticut Council on Soil and Water Conservation regarding finalization of the Soil Health Plan (*May 31*).
- Met virtually with a group from the University of New Haven to discuss their ideas for an NSF Engine and possible collaboration on the project (*June 16*).
- Spoke as part of the Urban Food Production: Practical Realities Exposed Urban Agriculture Environments panel discussion at the Green Roofs for Healthy Cities, Grey to Green Virtual Conference (*June 22*).

WILLIAMS, SCOTT C.

- Presented an invited Zoom lecture titled "Tick Talk" for the lecture series hosted by the Town of Guilford's Conservation Commission (51 attendees) (*July 7, 2021*).
- As a sitting advisory member, participated in a biweekly meeting of the National Wildlife Tick-Borne Disease Program (*July 8*).
- Presented an invited Zoom lecture titled "Use of Repellents in Deterring Deer and Rabbit Damage" at the Summer Meeting of the Connecticut Nursery & Landscape Association (39 attendees) (*July 28*).
- Participated in a conference call for the Editorial Advisory Board for The Wildlife Society's publication, The Wildlife Professional (*August 10*).
- Participated in a conference call advising staff at the Norcross Wildlife Sanctuary (Wales, MA) on deer management options (*August 23*).
- With Dr. Megan Linske and Mr. Michael Short, conducted a small mammal trapping demonstration to students in the Wildlife Management Techniques class in the Department of Natural Resources and the Environment at the University of Connecticut, Storrs (24 students, 1 professor) (*September 13*).
- Met with Yale University researcher Dr. Sajjad Hassan to discuss tick ecology and integrated tick management (*October 6*).
- Participated in a conference call for the Editorial Advisory Board for The Wildlife Society's publication The Wildlife Professional (*October 7*).
- Gave a research update to members of the Conservation Land Committee for Centennial Watershed State Forest, which includes staff from the CT DEEP Forestry Division, Aquarion Water Company, and The Nature Conservancy (9 attendees) (*October 15*).
- Attended a Zoom graduate committee meeting for Cornell Master's student Joseph Poggi (*October 15*).
- Participated in a Zoom meeting with collaborators on the Department of Defense-funded research project titled "Novel Evaluation of Control and Prevention Strategies for Ticks and Tick-Borne Diseases" (*October 27*).
- Participated in a Zoom call with Drs. Danielle Smith, Jean Tsao, and Susan Paskewitz of the Midwest Center for Excellence in Vector Borne Diseases on the acaricidal treatment of deer for tick control (*December 13*).
- Participated in a Zoom call with members of the leadership team for the Northeast Center for Excellence in Vector-Borne Diseases grant proposal to CDC (*January 5, 2022*).
- Participated in the Centers for Disease Control and Prevention's "Vector Week" for CDC grantees (*January 25-27*).
- Gave an invited lecture over Zoom on the relationship between blacklegged ticks, tick-borne pathogens, and invasive exotic plant species to members of the Harwinton Garden Club (*February 10*).
- Attended The CAES Post-Doctoral Association meeting on grant writing and presented about making your proposal relevant (*March 4*).
- Participated in the 2022 virtual annual meeting of the Northeast Center for Excellence in Vector-Borne Diseases (*March 7-8*).
- Attended the virtual meeting of The CAES Annual Forest Health Monitoring Workshop (*March 8*).
- Attended the virtual spring graduate committee meeting for Cornell University Master's student Joseph Poggi (*March 9*).
- Attended the virtual research and training seminar of the Northeast Center for Excellence in Vector-Borne Diseases (*March 21*).
- Virtually attended the 77th Annual Northeast Fish and Wildlife Conference (*April 4-5*).
- As a graduate committee member, attended the successful virtual thesis defense of Cornell University master's student Joseph Poggi (*April 6*).
- As Executive Treasurer, attended the virtual members meeting of the Northeast Section of The Wildlife Society (*April 13*).
- With Dr. Megan Linske, hosted collaborator David Poche of Genesis Laboratories, Inc.'s visit to The CAES to showcase joint research endeavors (*April 21-22*).

ZARRILLO, TRACY

- Visited the UConn insect collection to update the taxonomy of certain bee species in the genus *Lasioglossum* (*September 9, 2021*).
- Gave a workshop about cavity nesting bee biology and the use of bee hotels for the HuneeBee Project in New Haven, CT (5 participants) (*September 18*).
- Participated in the US National Native Bee Monitoring Workshop (*October 22*).
- Hosted a visit from Mr. James Dorey and Ms. Maisha Lucas, post graduate associates at Yale University, provided a tour of the pollinator laboratory and discussed plans for collaborating on a future regional New England data publication (*December 9*).
- Attended a Pollinator Advisory Committee meeting to discuss recommendations for the Environment Committee of the Connecticut State Legislature on potential changes in policy or legislation to protect pollinator health (*January 14, 2022*).
- Participated in a virtual meeting with Dr. John Ascher of the University of Singapore and Dr. Kimberly Stoner to discuss the Checklist of the Bees of Connecticut project (*February 1*).
- Participated in a virtual meeting with the New England Bee Taxa Team, a subcommittee of the Northeast Fish and Wildlife Diversity Technical Committee, to discuss and finalize regional species of greatest conservation need and regional responsibility levels (*February 9*).
- Participated in a virtual meeting with Bruce Young of NatureServe and Laura Saucier of CT-DEEP to discuss collaboration on an upcoming grant called "Support for Pollinator Conservation in the Northeast" in preparation for the State Wildlife Action Plan update in 2025 (*February 23*).
- Participated in a virtual meeting with James Dorey and Marta Wells of Yale University, Katherine Urban-Mead of Xerces Society, Michael Ulyshen of US Forest Service Southern Research Station, James Hung Keng-Lou of University of Ohio, and James Rivers of Oregon State University to discuss a collaboration on a project that will examine wild bee populations in forest canopies (*March 2*).
- Participated in a virtual meeting with the New England Bee Taxa Team, a subcommittee of the Northeast Fish and Wildlife Diversity Technical Committee, to discuss and finalize regional species of greatest conservation need and regional responsibility levels (*March 3*).
- Loaned bee specimens to Jason Gibbs at the University of Manitoba to be used in a revision of the bee genus *Pseudopanurgus* (*March 4*).
- Participated in a virtual meeting with Bruce Young of NatureServe and Laura Saucier of CT DEEP to discuss collaboration on an upcoming grant titled "Support for Pollinator Conservation in the Northeast" in preparation for the State Wildlife Action Plan update in 2025 (*March 9*).
- Attended a meeting titled "Virtual Workshop on Native Bee Inventories and Monitoring" sponsored by the Commission for Environmental Cooperation to discuss the upcoming project called "Advancing Pollinator Conservation throughout North America" (*May 3*).
- Attended a virtual meeting with Bruce Young of NatureServe and Laura Saucier of CT DEEP to discuss methods for assessing and ranking Connecticut's bee fauna (*May 17*).
- Presented a virtual talk titled "A Checklist of the Bees of Connecticut, Then and Now" to the Granby Senior Center (*May 18*).
- Was invited to participate in a project called "Tropics to Tundra" by Dr. Neil Cobb of Northern Arizona University (*May 23*).
- Presented a virtual talk titled "Bumble Bees of Connecticut: Rare, Common, and Declining Species" sponsored by the Hamden Land Conservation Trust and The Norfolk Hub (*May 26*).
- Led a tour of the "Garden in the Park" in New Haven focusing on bee species encountered and plant/pollinator relationships for The Hunneebee Project (*June 4*).
- Presented a virtual talk titled "Bumble Bees of Connecticut: Rare, Common, and Declining Species" sponsored by the Glastonbury Pollinator Pathway (*June 9*).

ZENG, QUAN

- Participated in the Bacteriology Committee meeting at the online conference Plant Health 2021 (*July 26, 2021*).
- Participated in the Soil Microbiology Committee meeting at the online conference Plant Health 2021 (*July 27*).

- Had a conference call with Dr. Alejandro Rojas (University of Arkansas) and Ms. Elaine de Gutzman (Frontiers in Plant Science) to discuss initiating a research topic article collection with the journal Frontiers in Plant Science (*July 30*).
- Gave an invited seminar via Zoom titled "Microbiome on Apple Flowers and Its Impact to Fire Blight Disease" for the Department of Plant Pathology at the University of Minnesota (40 adults) (*September 13*).
- Visited the Department of Plant Science and Landscape Architecture at the University of Connecticut, and gave a seminar titled "Microbiome on Apple Flowers and Its Impact to Fire Blight Disease" (30 adults); met with Dr. Sydney Everhart, Dr. Nick Goltz, and Dr. John Inguagiato from the same department (*September 24*).
- Served as a Panelist for the USDA NIFA Foundational Program (*September 28-30*).
- Participated in the 83rd Annual Meeting of Northeastern Tree Fruit Pest Management Workshop (*October 15*).
- Gave an invited seminar titled "Apple Flower Microbiome and Its Role in Plant Disease Infection" for the Department of Plant Pathology at University of California-Riverside (40 adults) (*October 28*).
- Attended the faculty meeting of the Department of Plant Science and Landscape Architecture at the University of Connecticut (*November 11*)
- Attended the Northeast Tree Fruit Working Group winter seminar planning meeting (*November 12*).
- Participated in the Zoom planning sessions for the New England and New York Fruit Consortium webinar (*December 17*).
- Organized and modulated a webinar titled "Antibiotic and Fungicide Resistance in Tree Fruit Pathogens" for the Northeast Tree Fruit Consortium winter webinar series (54 adults) (*February 1, 2022*).
- Visited the Department of Plant Pathology at the University of Georgia where he met faculty members and graduate students and presented a seminar titled "Apple Flower Microbiome and Its Impact to Fire Blight Infection" (75 adults) (*February 6-8*).
- With Dr. Salma Mukhtar, organized and presented in a virtual workshop titled "Visualizing Effectors During Plant-Pathogen Interactions" for the American Phytopathological Society (29 adults) (*February 21*).
- Presented "Entry Points of Fire Blight Pathogen *Erwinia amylovora* on Apple Shoots" at the Northeastern IPM center seminar (34 adults) (*March 24*).
- Gave a guest lecture titled "Apple Production, Diseases and Pests" to graduate and undergraduate students at the China Agricultural University via Zoom (24 adults) (*March 25*).
- Gave a lecture titled "Fire Blight, Disease Biology, Epidemiology, and Control" to plant pathology majored undergraduate and graduate students at the China Agricultural University (75 students) (*May 20*).
- Participated in a virtual graduate committee progress meeting for Ms. Shreyashi Mitra, University of Wisconsin-Milwaukee (5 adults) (*June 23*).

ZUVERZA-MENA, NUBIA

- With Dr. Sara Nason, presented "Plant Uptake Mechanisms" at the monthly group meeting with Dr. Jason White and collaborators from Yale and the University of Minnesota (*September 1, 2021*).
- Met one-on-one and accompanied for lunch or dinner the Department of Environmental Sciences Assistant Scientist candidates Dr. Ahmed A. Hashem (*September 7*), Dr. Sanjai J. Parikh (*September 9*), and Dr. Itamar Shabtai (*September 20*).
- With Dr. Susanna Keriö, hosted a "Lunch with the Director" potluck organized by Dr. Rebecca Johnson for The CAES Postdoctoral Organization (*September 15*).
- Attended the Department of Analytical Chemistry's monthly quality meeting via Teams (*September 16*).
- With Dr. Gale Ridge, Ms. Jamie Cantoni, Ms. Katherine Dugas, Dr. Jaya Borgatta, and Ms. Meghan Cahill, staffed the CAES booth at the Big E in West Springfield, MA (37,600 overall attendance) (*September 23*).
- Attended the CAES J-1 Visa recipient meeting (*September 30*).
- Participated in the US FDA program Human and Animal Feed (HAF) subcommittee monthly meeting (*September 30*).
- Presented a virtual seminar titled "Nanotechnology Strategies Towards a Sustainable Agriculture" for the University of New Haven Biomedical Engineering FBMI 2021 Seminar (*September 30*).
- With Dr. Sara Nason, interviewed four candidates from over fifty Post-Doctoral Scientist applicants for a project to assess the effects on contaminants from stormwater infiltration in treated wastewater (*November 8-12*).
- Trained visiting staff and CAES personnel on various inorganic analyses (*November 9*).

- Attended the virtual Department of Analytical Chemistry's monthly quality meeting (*November 18*).
- Presented "Estrategias de Nanotecnología hacia una Agricultura Sustentable" at the agronomy applied sciences and biotechnology multidisciplinary society (SOMUCAAB), a Mexican National virtual conference (*November 24*).
- Attended the monthly meeting for J-1 Visa recipients (*November 29*).
- Held a "meet and greet" conversation with an undergraduate to advise on a career in science (*November 29*).
- Got funding for the proposal, "Early detection of urban maple decline syndrome based on non-structural carbohydrate (NSC) levels in association with site and tree growth metrics in urban environments" as a Co-PI along with Dr. Susanna Keriö and Dr. Leigh Whittinghill by the L. Magnarelli Program (*December 9*).
- Attended the NSF R01 grantees call (*December 14*).
- With Drs. Sara Nason and Jason White, held interviews for a Post-Doctoral position (*December 17 and 21*).
- Met with Drs. Jason White, Wade Elmer, and Christian Dimkpa to discuss details on a new study with Zinkicide, a commercial product in the process of registration (*April 1, 2022*).
- Met with Drs. Susanna Keriö, Leigh Whittinghill, and Jeffrey Ward on the recruitment of a Post-Doctoral researcher to work on the early detection of urban maple trees decline syndrome (*April 7, 4, 19, 22, and 28*).
- With Dr. Sara Nason, attended a virtual NIEHS meeting that had the purpose of assembling an analytical networking group (*April 8*).
- With Dr. Sara Nason and Dr. Jason White, attended an online meeting with Ms. Alice Kwak to discuss per- and polyfluoroalkyl substances (PFAS) research at CAES, envisioning possible policy solutions that address PFAS (*April 14*).
- Attended the NIEHS "Progress in Research" virtual webinar (*April 15 and 29*).
- Attended the Association of Public Health Labs – Human and Animal Food subcommittee virtual meeting (*April 19-21*).
- Met virtually with upcoming visiting researcher Dr. Ileana Vera-Reyes (*April 21*).
- Presented "Nanotechnology Strategies Towards a Sustainable Agriculture" at the Materials Research Society in Hawaii (~20 in-person attendees) (*May 10*).
- With Dr. Jason White and Dr. Shital Vaidya, interviewed Sanyia Sattar for a possible six-month stay to research biosynthesized nanoparticles against Erwinia carotovora (*May 11*).
- Attended the NIEHS "Progress in Research" virtual webinar in which the department's work on nano-enhanced phytoremediation was presented (*May 13*).
- Attended the monthly CAES J-1 Visa Recipients meeting (*May 31*).

Service, research, and outreach activities in the Department are conducted within the focus areas of **Food Safety** and **Environmental Monitoring/Remediation**. Activities within each area are often complimentary. A breakdown of samples based on submitting agency is shown below for the period July 1, 2021 – June 30, 2022.

Source of Sample	Numbers of samples analyzed
Department of Agriculture	530
Department of Consumer Protection	523
Department of Energy and Environmental Protection	73
FDA, Health Depts., Cities/Towns, Misc. Foundations	40
Proficiency Test Samples	57
University Research Collaborators	1,200
CAES Departments	28
Grand Total	2,451

I. SERVICE ACTIVITIES

Analyses in the Department of Analytical Chemistry are conducted on a wide range of sample types submitted by other state and federal agencies, municipalities, law enforcement, non-profit groups, businesses, university collaborators, and other Departments at The Connecticut Agricultural Experiment Station (CAES). This list is not intended to be all-inclusive.

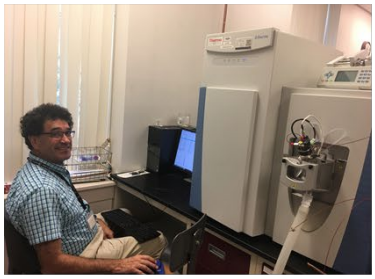
1. ANALYSES ON BEHALF OF CONNECTICUT DEPARTMENT OF AGRICULTURE

The Department of Analytical Chemistry has three long-standing programs with the CT Department of Agriculture (DoAg) involving the chemical analysis of commercial feed and fertilizer products.

a. Animal Feeds:

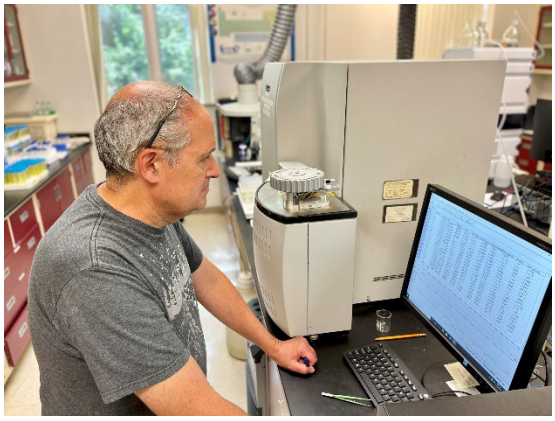
- Analysts: John Ranciato, Terri Arsenault, Kitty Prapayotin-Riveros, Meghan Cahill, Craig Musante, Carlos Tamez, Walter Krol, and Brian Eitzer
- Goal: To assure products comply with stated label guarantees and that levels of aflatoxins and pesticides, if present, are below regulatory limits.
- Summary: This was one of the primary analyses of the Station in the late 1890s. Products for household pets and commercial agricultural operations are collected by inspectors from DoAg. Analytical results are reported to DoAg, who in turn report findings to the product dealer and/or manufacturer and conduct regulatory response as required. In addition, data are reported to the FDA through an online data exchange platform called the NSFDX data exchange portal.

Results: From July 1, 2021, to June 30, 2022, we received 84 feed and associated grain samples for analysis of aflatoxins, 101 feed samples for macro minerals (Ca, K, Mg, Na, P, S) and moisture, 100 dog food samples for copper and moisture analysis, 50 samples for proximate (protein, fat, and fiber) analysis. Joint funding with the DoAg has been acquired from the FDA to facilitate inclusion in the Animal Feed Regulatory Program Standards (AFRPS) and the Laboratory Flexible Funding Model (LFFM); this 5-year cooperative agreement has enabled the Department to bring aflatoxin analysis in animal feeds by liquid chromatography high resolution mass spectroscopy (LC-HRMS) under the scope of ISO accreditation, effective February 2018. In addition, protein by combustion, and fat by gravimetric extraction, were brought under scope in January of 2021. Pesticide testing of food was accredited to the ISO standard under the MFRPS program in 2016. All samples were analyzed by the methods for aflatoxin extraction and quantitation (by LC-HRMS) in feed as part of the AFRPS. All samples were officially logged out with no aflatoxins detected. The reporting limit for each aflatoxin component (B1, B2, G1, and G2) is 1 ug/kg. These samples were also analyzed for protein, fat, and fiber. One sample failed to meet the protein label guarantee – 13.9% found - minimum for sample to pass was 17.4%. Five samples failed to meet the fat label guarantee – 2.4%, 3.0%, 13.2%, 11.1% and 1.6% found – minimum for samples to pass were 3.2%, 3.6%, 14.4%, 12.6% and 1.8% respectively. Five samples failed to meet the fiber label guarantee – 5.2%, 1.6%, 2.9%, 3.8%, 2.2% found – maximum for samples to pass 5.1%, 1.4%, 1.1%, 3.0%, and 1.9% respectively. From July 1, 2021, through June 30, 2022, a total of 20 animal feed samples were analyzed for pesticide residues. Of the 20 samples analyzed, 12 (60%) contained a total of 15 residues. There were 6 different pesticide active ingredients found at an average concentration of 0.111 µg/kg. No residues were found over tolerance guidelines. Of the 101 animal feed samples for macro minerals there were 11 samples of pig feed, 6 samples of bovine feed, 25 samples of poultry feed, 2 sample was equine feed, 4 samples of sheep feed, 1 sample of cat feed, 1 sample of other ruminant feed, and 51 samples of dog feed. This program has continued to allow for providing safer feed products for pets and other domesticated animals in the state.



b. Fertilizers:

- Analyst: John Ranciato
- Goal: To assure products are in compliance with stated label guarantees.
- Summary: This was one of the primary analyses of the Station in 1875. Products from residential and commercial agricultural operations are collected by DoAg inspectors. Analytical results are reported to DoAg, who in turn reports findings to the product dealer and product manufacturer and takes regulatory response as needed.



- Results: From July 1, 2021, to June 30, 2022, we received and completed analysis of 69 samples for macronutrients, including nitrogen, phosphorus, and potassium,. Six (18%) of the 34 samples received in 06/04/21 were found to be deficient in one or more analytes (determined according to the investigational allowances outlined in the Official Publication of the Association of American Plant Food Control Officials). Analytical findings are turned over to the CT Department of Agriculture for regulatory action. This program ensures that farmers are provided with appropriately labeled and guaranteed nutrient-fertilizer inputs.

c. Analysis of seaweed samples:

- Analysts: Terri Arsenault, Craig Musante, Meghan Cahill, Michael Ammirata, Walter Krol, Carlos Tamez, and Brian Eitzer
- Goal: To assess potential contamination of seaweed prior to release for sale.
- Summary: A newer program with the CT DoAg Bureau of Aquaculture involves the chemical and microbial analysis of seaweed grown commercially in CT for sale to restaurants. The CAES Department of Analytical Chemistry conducts the chemical analysis; the microbial analysis happens at the Department of Public Health (DPH) Laboratory Environmental Microbiology Section. During the current reporting period, 2 samples were received for analysis of moisture content, pesticides by both liquid and gas chromatography with mass spectrometry (LC-MS; GC-MS), and select heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Se) by inductively coupled plasma mass spectrometry (ICP-MS). Results are reported to DoAg Aquaculture staff for a decision on regulatory action. All pesticides, and heavy metals were within acceptable limits for sales of the product.

d. Analysis of hemp samples:

- Analysts: Terri Arsenault and Kitty Prapayotin-Riveros
- Goal: To determine the tetrahydrocannabinol (THC) content of hemp grown by state farmers prior to the sale of the product
- Summary: This new program was initiated by the 2018 Farm Bill which allowed hemp to be grown in the state. In this bill, hemp was defined as *Cannabis sativa L* with less than 0.3% total delta-9 THC. The state plan requires that each hemp variety is tested two weeks prior to harvest. From July 1, 2021, to June 30, 2022, a total of 104 preharvest samples were submitted for analysis. These samples were analyzed by gas chromatography with flame ionization detection. 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. Twelve of the submitted samples (12%) exceeded the allowable amount of THC. These data are reported back to the Department of Agriculture which has regulatory authority over the disposition of the crop.

2. ANALYSES ON BEHALF OF CONNECTICUT DEPARTMENT OF CONSUMER PROTECTION, FOOD AND STANDARDS DIVISION

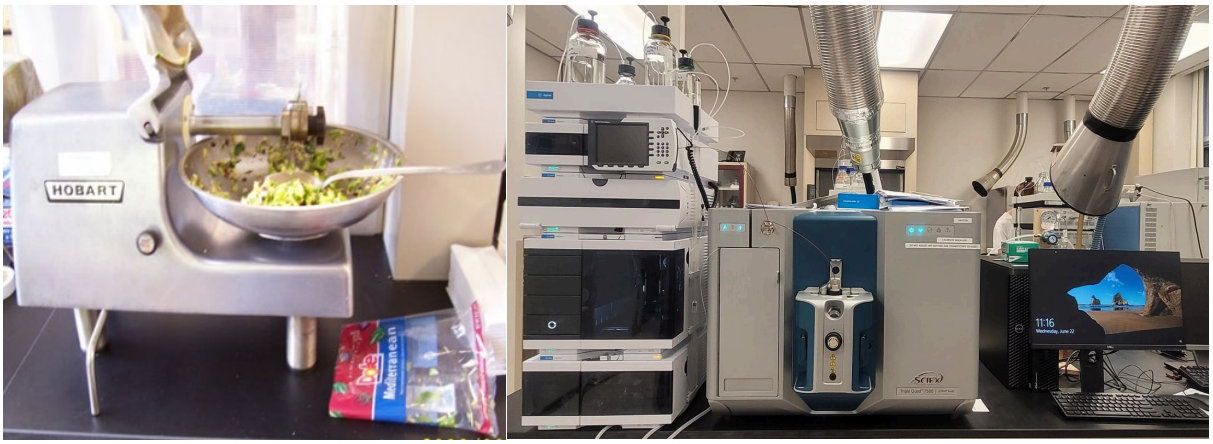
Analyses conducted on food and consumer product samples submitted by the CT Department of Consumer Protection (DCP) are important to public safety. The results of these analyses are reported quickly and can lead to the recall of products that have levels of chemical residues, heavy metals, fungi/mold, or fecal contamination that are deemed unacceptable by DCP. If products are imported into CT from other states or countries, the US Food and Drug Administration leads the regulatory response.

a. Pesticide residues and heavy metals in human food:

- Analysts: Walter Krol, Carlos Tamez, Brian Eitzer, Michael Ammirata, Terri Arsenault, Kitty Prapayotin-Riveros, Meghan Cahill, and Craig Musante

- Summary: As part of the Manufactured Food Regulatory Program Standards (MFRPS) and Laboratory Flexible Funding Models (LFFM), we determine concentrations of pesticides and total arsenic in fresh and processed foods from local, domestic, and imported sources offered for sale in CT and assure compliance with established tolerances. MFRPS surveillance samples are collected by DCP Inspectors and results are published in periodic Station Bulletins available by mail and at https://portal.ct.gov/CAES. From July 1, 2021, through June 30, 2022, a total of 105 samples of human food were analyzed for pesticide residues. Of these samples, 46 (44.0%) contained a total of 80 residues. Of these 46 samples, there were 8 samples that contained illegal residues. A sample of asparagus imported from Peru was found to contain carbofuran, a no tolerance violation. A sample of green grapes from Peru was found to contain diphenylamine, which was also a no tolerance violation. A sample of ginger from the US was found to contain chlorpropham, which has no registered tolerance level. A no tolerance violation for dicloran was found in a sample of yam from the US. Chlorpropham was found in US grown parsley, a no tolerance violation. A sample of dragon fruit imported from Ecuador contained thiabendazole, a no tolerance violation. Ginger importer from Honduras was found to contain phosmet, a no tolerance violation. Finally, a sample of garlic imported from Argentina was found to contain 0.101 mg/kg of phenothrin, which has an allowed tolerance of 0.01 mg/kg—an over tolerance violation. There were 42 different pesticide active ingredients found at an average concentration of 0.634 mg/kg. From July 1, 2021, through June 30, 2022, a total of 285 samples of human food (including infant rice cereals, rice, root vegetables, baby food retail products, vinegar, spices, and boxed cereals) were analyzed for heavy metals. Of the infant rice cereal samples, 4 (10.5%) contained inorganic arsenic above the FDA action level of 100 ppb.

- With US FDA funding and support, the Department has received and expanded ISO/IEC 17025 Accreditation from the American Association for Laboratory Accreditation (A2LA) for this program.



Impact: The Department's MFRPS serves as the sole surveillance and monitoring effort in the state, assuring that the food supply within CT is safe and free from chemical and toxic elements contamination. An important highlight of our work with DCP during the year under review is the revelation of the presence of an insecticide, carbofuran in imported fresh asparagus produce. Carbofuran is banned for use in the United States. This work resulted in the foreign processor of the produce being added to the "red list" attachment of FDA's Import Alert 99-05, *Detention Without Physical Examination Of Raw Agricultural Products for Pesticides*. This is a significant accomplishment requiring sample analytical package from DAC to be reviewed by multiple regulators within the FDA.

b. Miscellaneous samples:

- Analysts: John Ranciato, Carlos Tamez, Meghan Cahill, Craig Musante, Walter Krol, and Brian Eitzer
- Summary: From July 1, 2021, to June 30, 2022, 44 consumer complaint samples were submitted by CT DCP for analysis, including foreign material identification, fecal content determination, product adulteration or tampering, and off taste/smell. For some samples, we rely on the expertise in other CAES Departments, including Plant Pathology & Ecology, Entomology, and Forestry & Horticulture. Samples during the current period included apple cider, baby formula, eggplant cutlets, steak, muffins, grapes, pumpkin pie, sea salt, soda, bottled water, calzones, spices, beer, peanut butter, ginger ale, salad kits, and juice.

3. Analyses on behalf of Department of Consumer Protection, Liquor Control Division

Alcoholic beverages sold must be registered and labeled correctly. This requires knowledge of the ethanol content of products.

- Analyst: Terri Arsenault
- Goal: To provide percent ethanol content for label registration and taxation purposes.
- Summary: We analyzed 2 products (wines) for ethanol content. Results were submitted to DCP in support of product label registration.

4. Analyses on behalf of Department of Consumer Protection, Drug Control Division

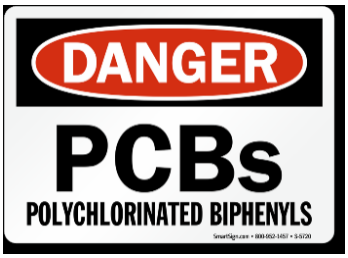
a. Analysis of marijuana products:

- Analyst: Anuja Bharadwaj and Terri Arsenault
- Goal: To develop and validate methods for analyzing marijuana products for various cannabinoids.
- Summary: Since the legalization of adult use of marijuana in July 2021, there has been a need to develop a program for the analysis of marijuana products to assess them for their cannabinoid contents, as per label claims. The legislation imposes strong requirements for product safety. Products will have to be lab tested and for strict packaging and labeling standards. To begin with, the cannabinoids analyzed are Cannabidiolic acid (CBDA), Cannabidiol (CBD), Cannabinol (CBN), delta-9 Tetrahydrocannabinol (THC) - the primary psychoactive constituent of *Cannabis sativa*, and Tetrahydrocannabinolic acid (THCA), among others. The program will in addition test the products for pesticides, mycotoxins, terpenoids, and heavy metals. The Dept of Consumer Protection (DCP) will submit the samples to DAC, and the data will be reported back to the DCP.
  This new program is work in progress. The initial plan is to develop a method using High-Performance Liquid Chromatography-UV for the analysis of cannabinoids such as CBDA, CBD, THC, and THCA. The Agilent 1200 HPLC system is used for this purpose. Simultaneously, a method is being developed for cannabinoid testing using a different technique, namely Gas-Chromatography Mass Spectrometry (GCMS).
- This program will ensure that products comply with the stated labels for the different cannabinoids. To date, 16 samples of marijuana products have been submitted by DCP and the analysis is in progress.



5. ANALYSES ON BEHALF OF DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION (DEEP), WASTE MANAGEMENT BUREAU

a. Analysis of PCBs (polychlorinated biphenyls):

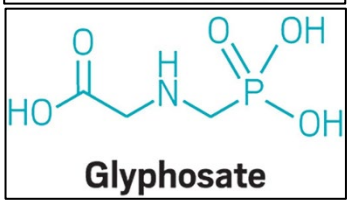


- Analysts: Michael Ammirata and Terri Arsenault
- Goals: To determine the extent of polychlorinated biphenyl (PCB) contamination in submitted samples, with matrices including soil, water, oil, sediments, and surface wipes.
- Summary: From July 1, 2021, to June 30, 2022, 55 samples were analyzed from pre-existing sites or new locations in CT. Sample collection is performed by the DEEP PCB Enforcement Unit as part of mandatory long-term monitoring of these areas. The findings are reported to DEEP for assessment of continued regulatory compliance or to establish remediation criteria. In addition, a proficiency test was completed as part of this program.

b. Analysis of pesticides:

- Analysts: Brian Eitzer, Carlos Tamez, Terri Arsenault, Walter Krol, and Christina Robb
- Goals: To ascertain pesticide concentration associated with misapplication or drift in support of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Additional samples are analyzed in support of DEEP surface and groundwater monitoring programs. We also analyzed a set of samples of sediment contaminated after a truck containing pesticides caught on fire. Submitted sample matrices include soil, water, oil, sediments, tank mixes and surface wipes.
- Summary: From July 1, 2021, to June 30, 2022, 18 samples were analyzed under this program.

Impact: The analysis of samples collected from surveillance programs for soil, surface/groundwater and sediments, as well as those that are part of active misapplication investigations, enable DEEP to enforce current state and federal regulations on pesticides and to promote overall environmental and public health.



6. ANALYSES ON BEHALF OF MUNICIPAL AND FEDERAL AGENCIES

a. Analysis of samples for FDA Food Emergency Response Network (FERN):

- Analysts: Craig Musante, Terri Arsenault, Brian Eitzer, Christina Robb, Walter Krol, Kitty Prapayotin-Riveros, John Ranciato, Carlos Tamez, Meghan Cahill, Christian Dimkpa, and Jason C. White.
- Summary: The Department of Analytical Chemistry continued its work with the FDA as part of the Food Emergency Response Network Chemistry Cooperative Agreement Program (FERN cCAP). This program enables research and analyses on contaminants in food such as pesticides, poisons, toxins, and heavy metals. During the past year, a pilot test program was initiated by FDA, in which samples were shipped to labs by the FDA inspectors and results of sample analysis were uploaded directly to the FDA ORA Partners Portal (ORAPP). Some of the samples in this actionable import sample. In this initiative, we were among the first state labs to join the ORA Sample Analysis Workgroup. Moreover, we were the first state lab to complete the NFSDX mapping with our LIMS. During the course of the year, we successfully submitted five pilot samples (for pesticides analysis) via the ORAPP option-three Excel uploads. DAC also participated in the analysis of surveillance samples that included hemp infused drinks imported across state line.

- Lastly, Brian Eitzer and Ms. Terri Arsenault have both been instructors for FDA courses on LC-MS and GC-MS FERN methods, respectively; these training courses are open to FDA staff and other state laboratories; however, the courses have not happened in the last two years due to Covid-19.

Impact: The Department's participation in FERN has resulted in the acquisition of highly sensitive analytical equipment and significant funding to support staff, including post-doctoral researchers. In addition to being used for FDA work, these resources are also applied to our state programs in a manner that directly benefits the public health of CT residents.

b. Analysis of samples for municipalities, law enforcement and other groups:

- Analysts: Terri Arsenault, Brian Eitzer, Walter Krol, Craig Musante, Meghan Cahill, and John Ranciato
- Summary: From July 1, 2021, through June 30, 2022, Department staff analyzed 24 samples for municipalities or other groups. Among these, we analyzed foods and other products for heavy metals at the request of the New Haven Health Department, Quinnipiac Valley Health District, and Connecticut State Police, Maple Syrup on behalf of the New Haven City Maple growers, and soils on behalf of a community garden.
- State of CT - Department of Emergency Services & Public Protection to assist with instrumentation set up.
- Impact: Analyses in support of these organizations can allow them to make decisions that will impact human health.

7. ANALYSES ON BEHALF OF OTHER STATION DEPARTMENTS

a. Elemental and Molecular Analysis - Department of Plant Pathology and Ecology:

- Analyst: Craig Musante, Nubia Zuverza-Mena, Yi Wang, Jason C. White
- Summary: In conjunction with scientists in the Department of Plant Pathology and Ecology, elemental and molecular analysis of several hundred samples of various crops grown in the presence or absence of nanoscale micronutrient amendments was again conducted. This work is being done under a USDA AFRI NIFA grant on nanoscale sulfur for plant nutrition, disease suppression and food safety**.** This 3-year, $500,000 grant began September 1, 2020, and includes co-investigators at the University of Massachusetts, Amherst This ongoing work continues to evaluate effects of nanoscale S on fungal interaction with food crops. More update on this efforts is presented under Project 3 of the Research Activity Section, and in the Department of Plant Pathology and Ecology section of this document. A related project on nano-enabled phosphorus which started around August of 2021 seeks to understand the role of biopolymers on phosphorus use efficiency. This project is undertaken in conjunction with scientists in the Department of Plant Pathology and Ecology and John Hopkins University, Baltimore.

8. ANALYSIS OF CHECK SAMPLES

- Analysts: Walter Krol, Terri Arsenault, Brian Eitzer, Craig Musante, Meghan Cahill, Michael Ammirata, and Kitty Prapayotin-Riveros
- Summary: Seventy-five samples were analyzed during the reporting period as part of annual proficiency testing related to our FDA FERN work, FDA ISO Accreditation program (MFRPs), Animal Feed Regulatory Program (AFRPs), as well as performance evaluation samples for our polychlorinated biphenyl (PCB) regulatory program. All of these testing regimes serve to ensure accurate and reliable laboratory results.

II. RESEARCH ACTIVITIES

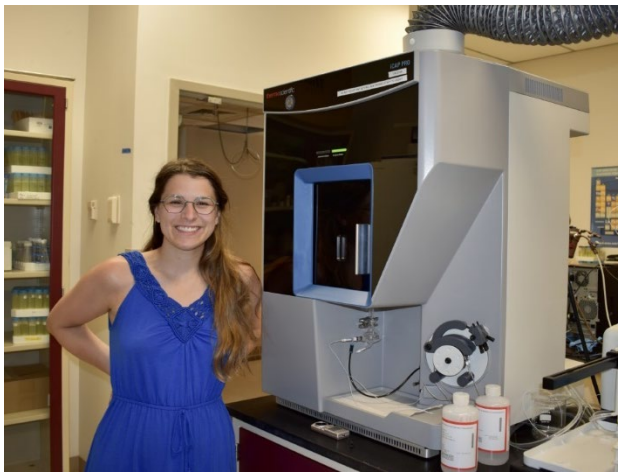
Research projects in the Department of Analytical Chemistry include applied and fundamental investigation search. Research is often stimulated by our service work and in turn, research results often impact service activities.

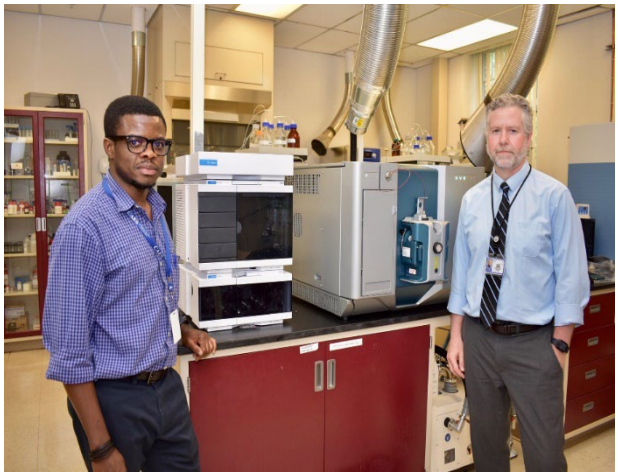
1. FOOD SAFETY

Project 1: *Improvement of analytical methods for determination of pesticide residues and heavy metals in food:*

- Investigators: Brian Eitzer, Terri Arsenault, Carlos Tamez, Walter Krol, Christina Robb, Michael Ammirata, Craig Musante, Meghan Cahill, John Ranciato, Christian Dimkpa, and Jason C. White
- Summary: We continue to participate in or lead several FDA coordinated research projects. This includes the use of high-resolution LC-MS and LC-MS/MS platforms for the screening of pesticides, toxins (fungal, plant) and poisons. During the past year, our ISO Accreditation for two the now consolidated FDA LFFM program has been maintained and would be up for reassessment in early 2023 by the accreditation body, During the year new ICP-OES and LC-MS instruments were purchased, to beef up our analytical capability for inorganic and organic contaminants, respectively.

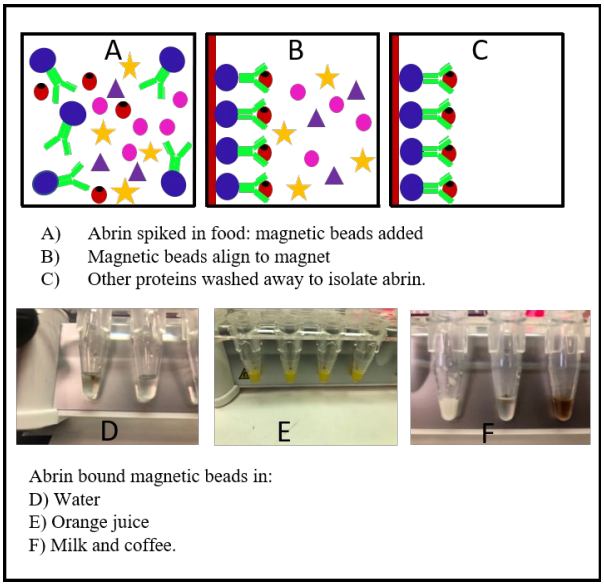
- Impact: The development and validation of new, more sensitive equipment and analytical techniques will enhance food safety surveillance activities in the state and serve to better protect the public against incidental or intentional adulteration.





Project 2: *Select Agent Detection in foods: abrin and abrine*

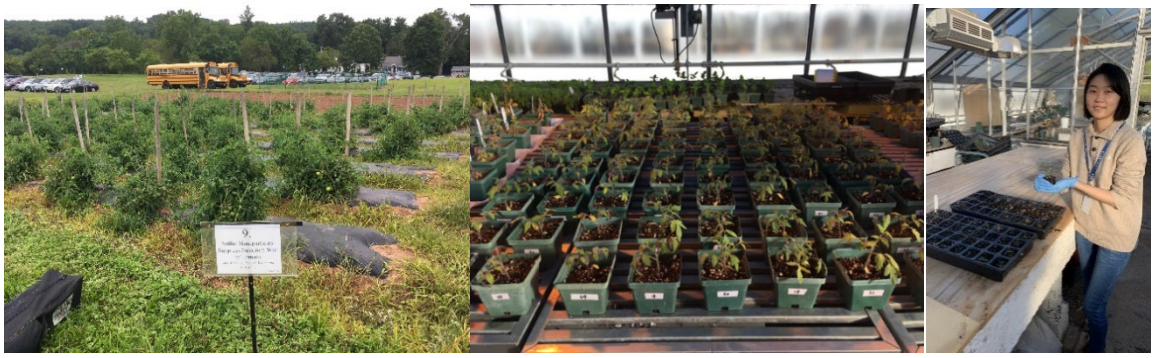
- Investigators: Christina S. Robb, Walter Krol, and Brian Eitzer
- Summary: *Abrus precatorius* seeds contain the ribosome inactivating protein abrin. Abrin is the most toxic molecule that we investigate for the FERN program. Detection methods for abrin are of importance to homeland security, toxicology and public health. The method development for abrin protein is highly challenging as no purified standard or high-quality antibody are commercially available at this time. Dr. Christina Robb has worked with the CDC and the FDA Forensic Chemistry Center to gain the skills to develop abrin analysis by LC-MS. The extraction of abrin from food samples by antibody coated magnetic beads, on-bead digestion by multiple proteases, and analysis of the peptides by LC-MS have been achieved. The peptides determined so far represent universal, combination and single protein isoform indicators for the abrins a, b, c, d and agglutinin. The refinement of these method conditions is ongoing with input from the FDA and CDC. Dr Robb will be applying the same technological approach and knowledge to ricin analysis.
- Impact: The new LC-MS approach to analysis presents several advantages; it is a greener with an improved safety impact for the analytical chemist, it removes the requirement for commercial kits therefore enabling analysis at any time whilst lowering the cost and it provides more detailed molecular information on the abrin proteins.



Project 3: *Nanoparticles in agricultural systems*:

- Investigators: Nubia Zuverza-Mena, Craig Musante, Ishaq Adisa, Carlos Tamez, Yi Wang, Chaoyi Deng, Ayesha Nisar, Jason C. White, Jaya Borgata, Meghan Cahill, Shital Vaidya, and Christian Dimkpa
- Summary: Nanomaterials (NM) have at least one dimension less than 100 nm (one billionth of a meter) and possess unique physical and chemical properties not observed at the bulk scale. Nanotechnology, which takes advantage of these useful nanoscale properties, has become widely used in numerous sectors, including electronics, healthcare, cosmetics, pharmaceuticals, food processing, and agriculture. Our general work in this area is focused on two separate but related topics; initially on the implications of nanomaterial presence (by accident or design) in agricultural systems and, more recently, on the design and use of nanoscale nutrients as agricultural amendments to suppress plant disease, improve nutrient use efficiency, and, ultimately, increase yield. The presence of state-of-the-art analytical instrumentation has allowed us to continue to measure the uptake and translocation of these nanoparticles into plants. Studies on nanoparticle interactions in agricultural systems at the Department of Analytical Chemistry are conducted in collaboration with several partners, including John Hopkins University, University of Central Florida, North Dakota State University, University of Parma, Italy, Harvard University TH Chan School of Public Health, University of Massachusetts, the University of Texas El Paso, the US National Institute of Standards and Technology, The Center for Sustainable Nanotechnology at the University of Wisconsin-Madison, Hasselt University in Belgium, Peking University in China, The Ocean University of China, Zhejiang University, China Agricultural University, Jiangnan University, Nanjing Agricultural University, and the Chinese Academy of Sciences, among others.

One such project involves use nanoscale sulfur as a novel multifunctional agricultural amendment to sustainably increase yield and suppress crop disease. Collaborators on this project are colleagues at the University of Massachusetts. In this study, Pristine (nS) and stearic acid coated (cS) sulfur nanoparticles were added to soil planted with tomato (*Solanum lycopersicum*) at 200 ppm and infested with Fusarium oxysporum. Bulk sulfur (bS), ionic sulfate (iS), and healthy controls were included. Orthogonal endpoints were measured in two greenhouse experiments, including agronomic and photosynthetic parameters, disease severity/suppression, mechanistic biochemical and molecular endpoints including the time-dependent expression of 13 genes related to two S bioassimilation and pathogenesis-response, and metabolomic profiles. Disease reduced plant biomass by up to 87%, but nS and cS amendment significantly reduced disease measured by AUDPC by 54 and 56%, respectively. An increase in planta S accumulation was evident, with size-specific translocation ratios suggesting different uptake mechanisms. In vivo two-photon microscopy and time-dependent gene expression revealed a nanoscale-specific elemental S bioassimilation pathway within the plant that is separate from traditional sulfate accumulation. These findings correlate well with time-dependent metabolomic profiling, which exhibited increased disease resistance and plant immunity related metabolites only with nanoscale treatment. The linked gene expression and metabolomics data demonstrate a time-sensitive physiological window where nanoscale stimulation of plant immunity will be effective. These findings provide mechanistic understandings of non-metal nanomaterial-based suppression of plant disease, and significantly advance sustainable nano-enabled agricultural strategies to increase food production.



A related work spearheaded by a visiting scientist from the University of the Punjab, Lahore, Pakistan involves the synthesis and characterization of several metallic nanoparticles using bacterial cell-free growth cultures and the evaluation of these nanoparticles for application in crop disease control, especially fungal. The student returned to their country during the year to continue working on the project.

Another project is aimed at developing and evaluating tripolyphosphate (TPP) as nanofertilizer enhanced in value and plant use efficiency by formulation with chitosan and zinc oxide nanoparticles. Phosphorus (P) is the second most important crop nutrient. Despite its critical importance in plant development and productivity, P use by crops is characterized by very low efficiency. Over 70% of applied P is lost due to fixation in the soil, or runoff into surface or underground waters. TPP is an inorganic P-containing material and is a component of numerous domestic and industrial products. This project aims to repurpose TPP as a source of crop fertilizers to supply P. We are working on the hypothesis that functionalization of TPP with chitosan and zinc oxide nanoparticles (ZnO NPs) will regulate TPP solubility, and therefore, its bioavailability to plants. As shown below, several formulations of TPP and Chitosan without and with ZnO NPs have been developed, and evaluation in plants is ongoing. Preliminary data indicates that formulating nano-P without and with ZnO NPs generated amorphous materials with high polydispersity (particles with both nano and submicron dimensions), and a positive zeta potential of between 15.1 and 3.3 mV, respectively. Compared to the conventional P fertilizer used by growers, MAP, nano-P reduced P release by 73% in water after 2.5 hr; ZnO NP addition further reduced P release by 84%. In soil, nano-P reduced P leaching by 35% after 72 hr, compared to unformulated TPP. With ZnO NP addition, nano-P further decreased P leaching by between 42 and 84%, depending on Zn concentration. Notably, reduced P leaching in soil by nano-P (without and with lower Zn%) was intermediate between that of MAP and highly insoluble rock phosphate, suggesting a favorable modulation of P for potential plant availability. Plant studies are underway to evaluate the effects of nano-P on growth, P uptake and retention in postharvest soil.

A related ongoing project in partnership with John Hopkins University scientists looks at the use of polyhydroxyalkanoates (PHA) to improve plant bioavailability and reduce environmental P loss in plant-soil systems. Biodegradable polymer nanocomposites containing PHA and calcium phosphate nanoparticles were synthesized and evaluated on tomato plants. This product supported plant performance comparable to conventional P fertilizers, while reducing the P content of runoff by over 80%. Given the negative consequences of eutrophication driven by P-rich agricultural runoff, significant reduction in leached P has broad implications. This finding demonstrates the significant potential of biodegradable PHA formulated with calcium phosphate nanoparticles as a platform to reduce the negative impacts of agriculture on the environment.

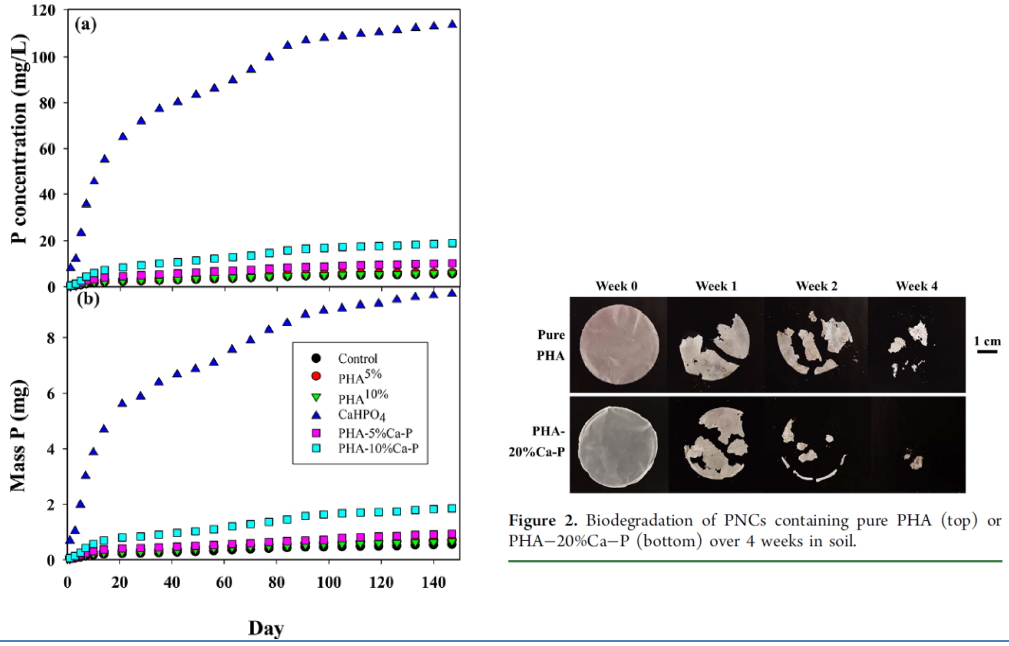
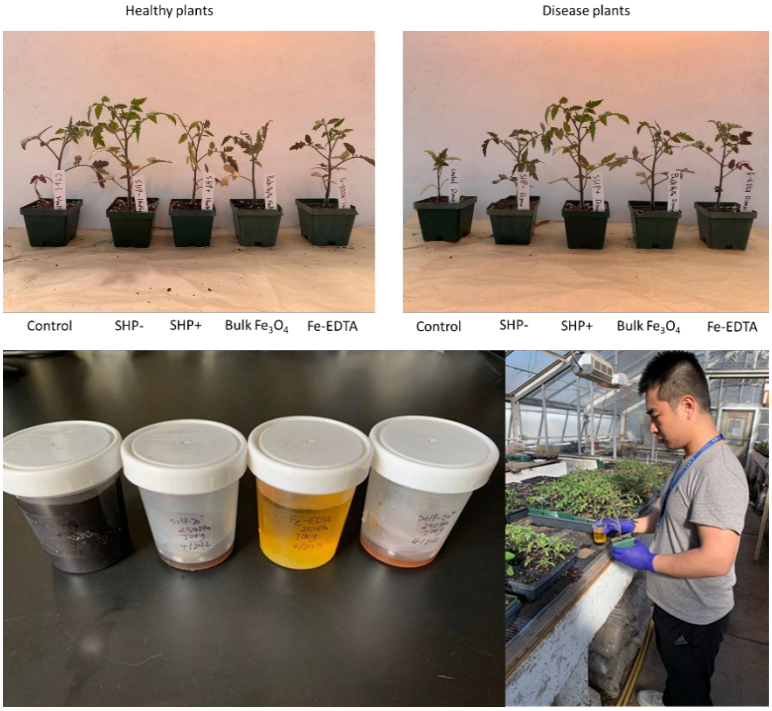


Figure 2. Biodegradation of PNCs containing pure PHA (top) or PHA−20%Ca−P (bottom) over 4 weeks in soil.

A separate nano project under the auspices of the Center for Sustainable Nanotechnology seeks to understand the underlying chemistry governing the interaction between nanomaterials and a unique hydrophobic biological surface (i.e., the plant leaf). Here ferric oxide (Fe_3O_4) nanoparticles of variable surface charges are used to treat tomato plants that are either healthy or infected with *Fusarium oxysporum*, a fungal pathogen. The goal of the study is to determine if nano-sized ferric oxide could increase the tomato plant's disease resistance ability. Preliminary data collection is ongoing.



Several other nanoscale efforts are ongoing in the department, in collaboration with colleagues in other CAES departments. These include:

(i) ***Enhancement of drought tolerance in chestnut seedlings treated with CuO NPs***. CuO NPs have shown applications in agriculture not only as an efficient source of Cu nutrient. Previous studies have also shown that CuO NPs can increase the water content in plant tissues such as certain wheat species or express drought tolerance genes such in soybean. Drought events are causing an increase in tree mortality globally. In collaboration with Dr. Susanna Keriö from the Dept. of Forestry and Horticulture, we are studying the potential of CuO NPs to mitigate drought impacts in trees by using chestnut hybrid seedlings as a model ***system. Preliminary observations show trends where drought stressed*** seedlings treated with CuO NPs have characteristics comparable or better to non-stressed seedlings, such as height and the number and size of leaves. Results are inconclusive and more studies are underway.

(ii) ***Use of nanocarriers for dsRNA delivery.*** Plants (and other living organisms) have a natural mechanism to prevent viral replication, via RNA interference (RNAi). After infection, plants can later recognize viral RNA regions and code for its destruction instead of replication. Thus, an approach to vaccinate plants is to provide viral double stranded RNA (dsRNA) to trigger the gene silencing mechanism, RNAi. However, dsRNA is easily destroyed and its effect last only a few days. Studies have shown that nanocarries of dsRNA such as Mg-Al double layered hydroxides (LDHs) can provide dsRNA protection, prolonging its effectiveness, although the exact mode of action is not completely understood. Together with Dr. Da Silva from the Dept. of Plant Pathology, we are exploring silica and chitosan besides Mg-Al LDHs as dsRNA carriers to protect plants against potato virus Y (PVY).

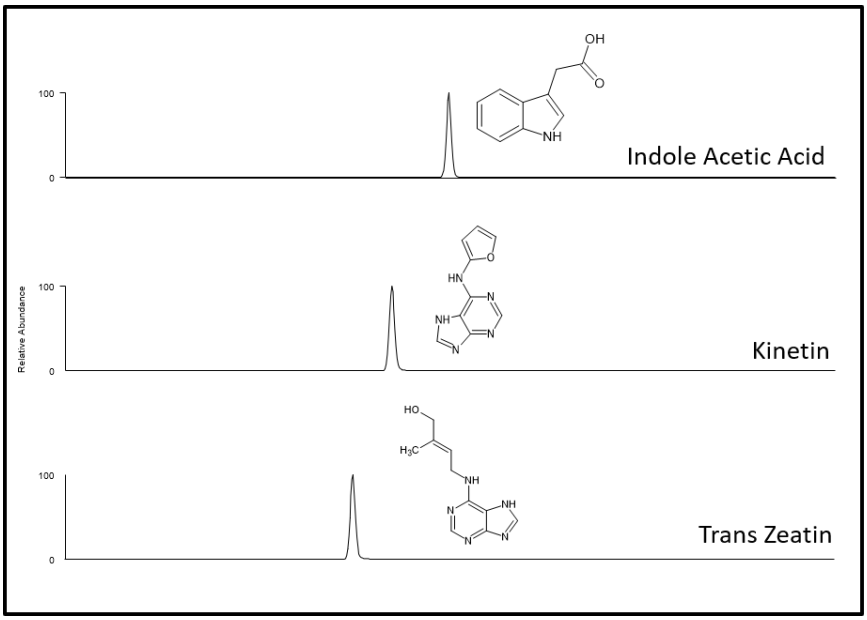
Impact: Our past research has demonstrated that the toxicity of nanomaterials to crops can be significantly different from that of the corresponding bulk material. Current investigations are focused on understanding the interactions and related mechanisms of plant response so as to enable safe design and use of these important materials. For example, when used appropriately, nanoscale versions of select secondary and micronutrients can suppress crop disease and increase yield. Such techniques may be critical to sustainably increasing food production so as to achieve and maintain global food security in the coming decades. Furthermore, the enhancement of P use efficiency by plants via nanotechnology could address the P quagmire in soil and the environment.

2. PLANT HEALTH

Plant hormones: Linking soil microbes and predators to crop health

- Investigators: Christina S. Robb, Lindsay Triplett and Ravi Patel
- Summary: Dr Christina S. Robb and Dr Lindsay Triplett were awarded The Connecticut Agricultural Experiment Station Magnarelli post-doctoral award for their proposal to study the role of protists in the hormonal condition of plants for 2020-2022. The main analytical objectives of this study are to develop and optimize LC-MS methodologies for plant hormone analysis. These methodologies will assist in determining the role of protists in hormone-producing soil bacteria and to determine the effect of protists on the plant hormonal status. Dr Christina Robb and Dr Ravi Patel have developed a reverse-phase screening method for compounds representative of multiple, main compound classes of phytohormones. This general screen will be used to analyze sample sets and when specific phytohormones are determined to be of interest, the methodology may be further enhanced for those phytohormones. An example separation of three of the compounds is shown here. This screen has been tentatively tested for plant, protists and bacterial extracts and is being expanded. This chromatographic methodology was developed on a low-resolution LC-MS and is being transferred to a high-resolution LC-MS to increase sensitivity and improve the detection of individual plant hormones not included as standard compounds in the phytohormone screen.

Impact: This project will provide meaningful improvement to the field of plant pathology and understanding crop health.



3. Hemp Research

- Investigators: Terri Arsenault and Christian Dimkpa
- Summary: This project aims to (i) Test various varieties of hemp to assess compliance with THC levels throughout the growing season and maximum potential yield of CBD (ii) measure the effect of Zn-micronutrient application on the levels of CBD and THC in hemp plants grown under field conditions. Research on the first objective was initiated in 2019 and continues today to assess sampling strategies and ensure conformance to the THC limit in hemp plants grown in CT. Research at CAES and elsewhere shows that many Cannabis sativa varieties will exceed the legally allowed level of THC (0.3%) if allowed to reach full maturity. In this study, different varieties of hemp were grown in soil and analyzed using gas chromatography with flame ionization detection (GC-FID) for total delta-9 THC and total cannabidiol (CBD) contents. Data showed that the maximum amount of CBD in compliant hemp is about 8% - 10%. In addition, CBD and THC escalate rapidly during maturation, with concentrations doubling over about two weeks, making timing the harvest a risky strategy. At this time, hemp varieties are not well developed and lack overall consistency in physical appearance as well as

CBD/THC content. While hemp for CBD may be a viable crop for local farmers, there is reason for caution in this emerging market. With respect to the second objective, Zn is notably involved in the regulation of secondary metabolite production in plants. Preliminary data to understand the second object indicated that Zn has no effect on the levels of these metabolites under the studied conditions, which included Zn (10 mg/L; as ionic Zn, bulk Zn-oxide and nanoscale Zn-oxide) being foliar-sprayed on the plants at least several weeks before flowering.

Impact: These data indicate that time and plant-dependent factors significantly affect the concentration of THC and CBD. The data will assist states, especially those with lot sizes of 1-2 acres, to develop better performance-based sampling strategies as allowed by the USDA final rule regarding hemp production. In addition, this data is helpful to growers trying to maximize CBD production while maintaining conformance to the legal THC limit of 0.3%.

PUBLIC OUTREACH

Telephone/Internet Inquiries: We receive approximately 100 calls and emails from the public each year requesting information on issues such as pesticides in food and the environment, as well as heavy metals in food, soils, and consumer products. In some instances, we refer the caller to a more appropriate CAES department or state agency.

Station Bulletins: Three Station Technical Bulletins were published by our department in the past year: Technical Bulletin numbers 21, 24 and 27. These bulletins are available in printed form and on the CAES website: https://portal.ct.gov/CAES/Publications/Publications/Technical-Bulletins.

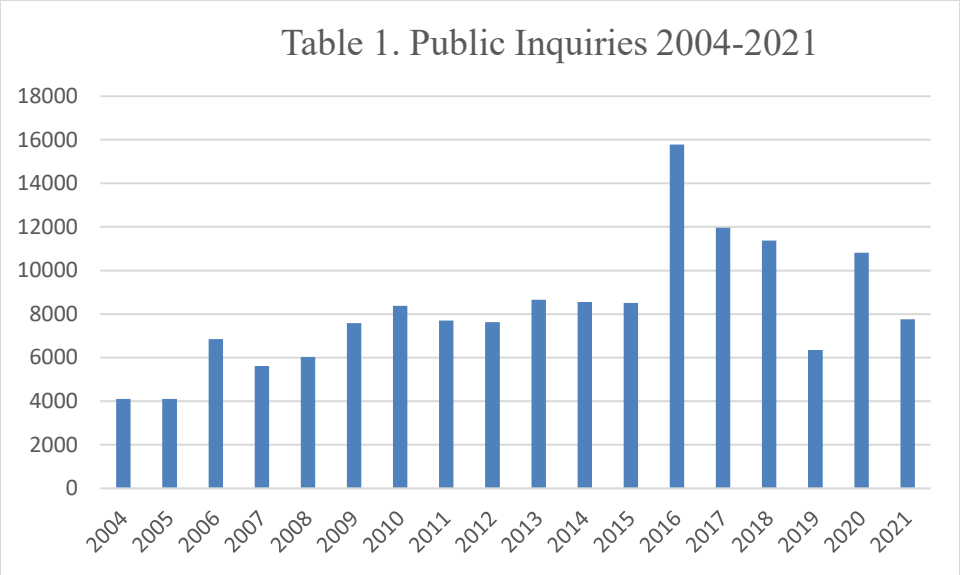
Insect Information Office in the atrium of Jenkins-Waggoner Laboratory showing the wallpaper, part of the artwork installed called Plants & Insects: Excavating the Archives.

The Department of Entomology is involved in a variety of service, research, pest surveillance, and plant regulatory activities. The primary service activities are provided through the Insect Information Office (IIO). Staff in this office answer insect-related questions and identify insects and related arthropods for the public, government agencies, growers, and business organizations. All scientists provide information to citizens of Connecticut by answering telephone inquiries, making farm visits, participating in meetings of growers and other groups, and speaking on their research. Most of the research in the Department has a major applied aspect, addressing the integrated management of ticks, pests of field crops, nurseries, and orchards, wood-boring insects, invasive insects, honey bees, and other bee pollinators.

The Office of the State Entomologist at The Connecticut Agricultural Experiment Station, created by the Connecticut General Assembly in 1901, is part of the Department of Entomology with responsibility, in part, to ensure our nursery industry is free of plant pests and certify their products for shipment to other states and outside the United States. The Connecticut Green Industry (i.e., nursery, greenhouse, floriculture, sod, Christmas trees) is the largest agricultural business in Connecticut. The industry estimates that environmental horticulture generates $1.022 billion gross income supporting 48,000 full- and part-time jobs in Connecticut. In conjunction with regulatory activities, Department staff conducts a surveillance program in Connecticut for a variety of established pests and for exotic plant pests, some of regulatory concern, that represent a threat to our green industry, forests, and urban ornamental trees and shrubs. Surveillance for plant pests is performed in partnership with the United States Department of Agriculture (USDA) through the Cooperative Agricultural Pest Survey (CAPS) program, Plant Protection Act surveys, and the U.S. Forest Service. For plant diseases of regulatory concern, we work closely with the Plant Disease Diagnostic Laboratory in the Department of Plant Pathology and Ecology. We also conduct forest health surveys and a statewide aerial survey for spongy moth defoliation (and any defoliation by other insects) and a spongy moth (formerly known as gypsy moth) egg mass survey. The results of our plant and forest surveys for 2021-2022 may be found later in the Department's research activities along with summaries of our regulatory activities. The Office of the State Entomologist and the Apiary Inspector also oversee registration of beekeepers and inspection of honey bee colonies for pests and disease. The staff of the Department of Entomology also take a lead in providing extensive outreach activities for the Experiment Station by providing information to both children and adults about the Experiment Station's research at public events and at health and agricultural fairs. The Insect Information Office is in the Jenkins-Waggoner Laboratory and has a laboratory, office, public reception, and a climate-controlled collections room.

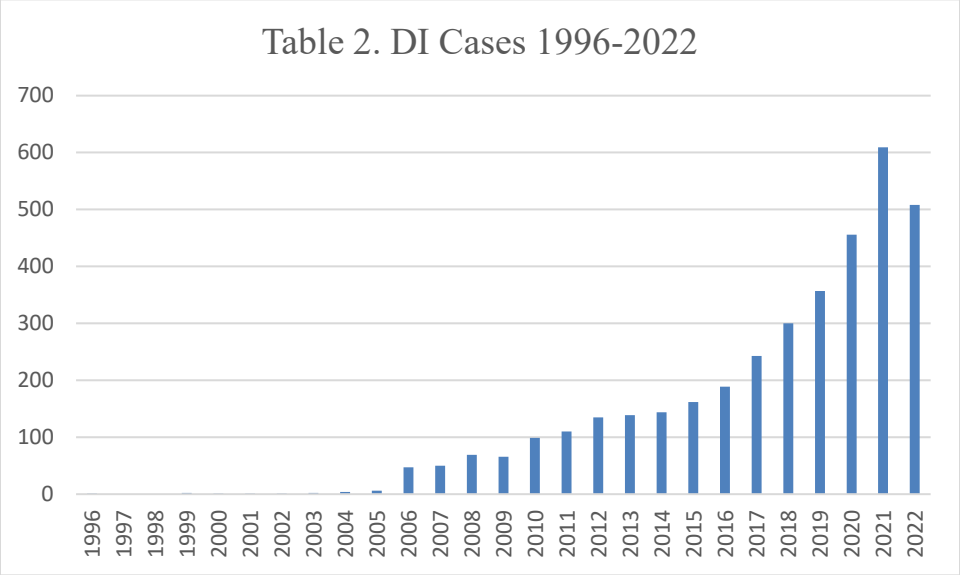
Service Activities

Insect Information Office: Dr. Gale E. Ridge works in the New Haven insect information office (IIO). Insect identification services date back to nearly the inception of the institution (1875) starting with the first Annual Report of The Connecticut Agricultural Experiment Station published in 1877. The station announced that it was offering to "identify useful or injurious insects…..and to give useful information on the various subjects of Agricultural Science for the use and advantage of the citizens of Connecticut."



Since 2000, there has been a trend away from traditional communication such as mail and visitors to cell phone and internet. Emails and iPhones are currently the most common forms of communication used by the public to submit inquiries. Since the onset of the COVID-19 pandemic these two forms of communication have been the principal way citizens have communicated with the IIO.

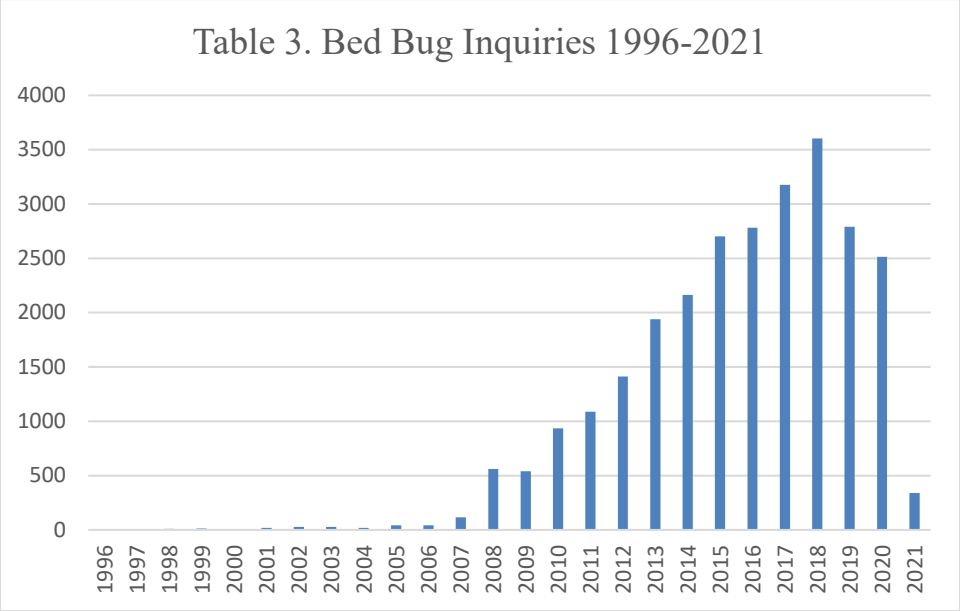
Impact of the IIO is public education to reduce pesticide use and promote non-chemical management of nuisance arthropods, protection of public health, conservation of natural habitats and species, protection of agriculture, and protection of urban structures and buildings. The office directly serves private citizens, pest management professionals, the real estate industry, nurseries, land care businesses, arborists, 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. Between July 1, 2021 and June 30, 2022 the IIO handled 7,761 requests for information (Table 1).



There were 910 categories of inquiries including insects, arachnids, animal, pesticides, insect damage, general entomology, and horticulture. Delusional Infestation (DI) cases dropped from the 2021 peak of 609. Since 2006/2008 DI inquiries steadily climbed (47 (2006), 50 (2007), 69 (2008), 66 (2009), 99 (2010), 110 (2011), 135 (2012), 139 (2013), 144 (2014), 162 (2015), 189 (2016), 243 (2017), 300 (2018), 357 (2019), 456 (2020), 609 (2021), and 508 (2022). These are time consuming

medical and psychiatric cases that encompass multiple phone calls, emails, and visits which often involve collaboration with medical professionals. DI continued to remain high in part due to stress and depression (two leading drivers of DI) likely caused by home confinement and stressful work conditions from the Covid-19 pandemic (Table 2).

Spongy moth *Lymantria dispar* (formerly called the Gypsy moth), activity was quiet across most of Connecticut except for the Sharon area in the north western quadrant of the state where there was a second year of very high populations. The pathogenic fungus *Entomophaga maimaiga* this year attacked these populations, preventing reproduction. This suggests lower populations in 2023. Human feeding bed bug inquiries significantly dropped this year to 341 requests for information from a peak in the 2017-2018 fiscal year of 3178 (Table. 3). This may be an artifact of less public travel due to the Covid-19 pandemic. More people stayed home so were less likely to encounter bed bugs.



Natural resources led the four categories of inquiries followed by man (incl. home, building, and medical issues), food, and undetermined. Current data showed percentage of category division as 46% natural resources, 42% man and medical issues, 9% food, and 3% undetermined.

Towards the latter half of 2021 inquiries about jumping worms exponentially "jumped" from one to two inquiries per year to 143 in two months. Populations were being reported throughout the state. These are highly active invasive worms that homogenize soil structures making it impossible for young plants, particularly those in forest settings to establish. By November 2021 calls included sighting of the Hammerhead worm, *Bipalium adventitium*, a planarian predator of the jumping worms (Fig. 1). During the mid-1900s it was accidentally introduced to the United States from Japan where it had evolved to hunt jumping worms. During the spring of 2022 sawfly inquiries were unusually high, particularly on roses.

Figure 1. Hammerhead worm. Photo: Kerstin Calia

CAPS Survey and Outreach Programs: The Cooperative Agricultural Pest Survey (CAPS) and Plant Protection Act Section 7721 (PPA 7721) (formerly the Farm Bill), supported by the USDA-APHIS-PPQ provides support for pest survey and educational outreach on the identification and risks posed by potential invasive insects and plant diseases. With worldwide trade and travel increasing, we are at an increased risk of foreign plant species, plant diseases, and insect pests being introduced in the U.S. In 2021, the CAPS program conducted a Nursery Pest Survey looking for hardwood tree pests. Additional Vegetable Crops Pest Survey is supported by funding from the Plant Protection act, as well as the funding of the Forest and Agricultural Pest Outreach Program with a focus, in part, on the spotted lanternfly. The program also provides guidance on the management and control of detected invasive pests. By raising awareness of invasive pests, we hope to increase public awareness of pest management options and early reporting of potential new pest sightings to federal or state authorities.

Bird & Butterfly Garden: The Bird & Butterfly Garden is a partnership of the Federated Garden Club of Connecticut, the Spring Glen Garden Club of Hamden, and The Connecticut Agricultural Experiment Station. Most maintenance and improvements to the garden are done by farm manager Richard Cecarelli and his staff. The garden is normally open to the public Monday-Friday 8:30 a.m.-4:00 p.m., closed on the weekends and state holidays. The garden creates several favorable habitats for our native birds, butterflies, and pollinating insects and helps us determine which plants may work best in Southern Connecticut gardens. Plants are labeled for easy identification. The Bird & Butterfly Garden at Lockwood Farm is listed in the *Nature Conservancy Open Days Directory for New England*.

Meetings, Conferences, and Interns:
The Department of Entomology and Center for Vector Biology and Zoonotic Diseases hosted the Vector-Borne Disease Symposium on May 10. The symposium presented content on recent developments in vector-borne diseases, emerging tick and mosquito vectors and their associated pathogens, range expansion of new and emerging tick and mosquito vectors, and anticipated challenges for managing vector-borne disease as a result of climate change and other anthropogenic factors. Proposed mitigation and management strategies were also discussed. The speakers included:

- Dr. Goudarz Molaei, Department of Entomology, The Connecticut Agricultural Experiment Station
- Dr. Philip Armstrong, Department of Entomology, The Connecticut Agricultural Experiment Station
- Mr. John Shepard, Department of Entomology, The Connecticut Agricultural Experiment Station
- Dr. Kirby Stafford, Department of Entomology, The Connecticut Agricultural Experiment Station
- Mr. Roger Wolfe, Wildlife Division, CT Department of Energy and Environmental Protection
- Dr. Scott Williams, Department of Environmental Science and Forestry, The Connecticut Agricultural Experiment Station
- Dr. Rebecca Johnson, Department of Entomology, The Connecticut Agricultural Experiment Station
- Dr. Douglas Brackney, Department of Entomology, The Connecticut Agricultural Experiment Station
- Dr. Andrea Gloria-Soria, Department of Entomology, The Connecticut Agricultural Experiment Station
- Dr. Megan Linske, Department of Entomology, The Connecticut Agricultural Experiment Station
- Dr. Zannatul Ferdous, Department of Entomology, The Connecticut Agricultural Experiment Station

Following an international virtual symposium on Delusional Infestation (DI) held during the annual meeting of the Entomological Society of America in November, 2020 and organized by Dr. Ridge it was agreed the book "Physicians Guide to Delusional Infestation" be written for the medical profession. All the speakers as well as Dr. Lyle Buss of the University of Florida became co-authors. In April 2021, the book was accepted for publication by Springer Nature with a planned for 18,000 volume distribution throughout the world to academic and medical institutions. The book is scheduled to be published in mid-late 2023.

Dr. Victoria Smith sponsored the Forest Health Monitoring Workshop. This annual workshop brings together personnel from CAES, UConn, USDA, US Forest Service, and anyone else with an interest in the health of the forests of CT. There were presentations on forest management, beech leaf disease, emerald ash borer, urban forests, and spongy moth defoliation. Approximately 90 people attended this virtual workshop. A recording of the Workshop may be found at https://portal.ct.gov/CAES/Publications/Publications/Forest-Health-Monitoring-Workshops/Home. The Workshop for 2023 is scheduled for 7 March 2023.

Interns and Students Hosted in Entomology

Dr. Goudarz Molaei Laboratory

- Hosted and advised Alyssa Marini, a graduate student at the University of Maine. She has assisted with passive tick surveillance and research projects on ticks and mosquitoes. She contributed to the writing of a paper, "Spatiotemporal Distribution, Abundance, and Host Interactions of Two Invasive Vectors of Arboviruses, *Aedes albopictus* and *Aedes japonicus*" published in Parasites and Vectors (2022).

- Hosted and advised Julia Ellman of Wellesley College, MA. She assisted with passive tick surveillance and research projects on ticks and mosquitoes (June 2021-May 2022).

- Hosted and advised internship of Morgan Fitch of the University of New Haven. She has been assisting with passive tick surveillance and research projects on ticks and mosquitoes (Started January 23, 2022). She will continue to conduct research on blood feeding and population genetics of *Culex pipiens* mosquitoes for her MS dissertation.

- Hosted and advised internship of Kristy Lok of the University of New Haven. She has been assisting with passive tick surveillance and research projects on ticks and mosquitoes (Started February 09, 2022).

- Hosted and advised Sagar Bhatta, an MS student in the Department of Biology and Environmental Science, University of New Haven. He has been assisting with passive tick surveillance and research projects on ticks and mosquitoes (since May 22, 2022).

Dr. Claire E. Rutledge Laboratory

- Joselyn Clark – Continued work on senior thesis at Eastern Connecticut State University on Emerald Ash Borer resistance in native Connecticut Ash with Joseyln. Helped to interpret data, write thesis. Co-mentor with Dr. Elisabeth Cowles.

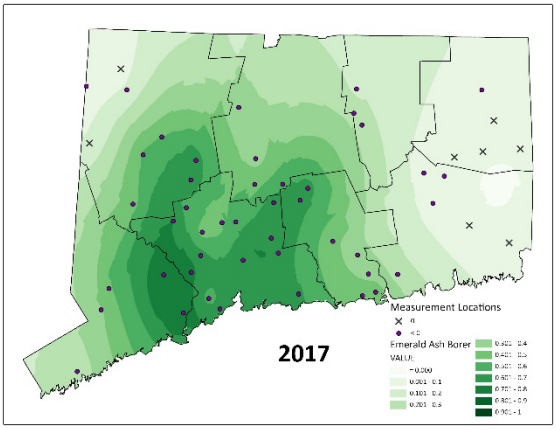
- Priya Sasidharan - Hosted an intern from New Haven Academy high school as part of their annual internship program for juniors. Priya learned some basic insect biology and dissecting scope operation. She assisted me in sample sorting to ascertain attraction of southern pine beetle predators to different pheromones. She also shadowed technicians in the laboratory of Dr. Goudarz Molaei, Dr. Quan Zeng, Tracy Zarillo, and Jacquelyn LaReau. May 16 – June 3, 2022

RESEARCH ACTIVITIES

Biosurveillance for Exotic Buprestidae and the Wasp Watcher Program

(Dr. Claire E. Rutledge and Collaborators – The Wasp Watchers, UConn Master Gardeners)

The wasp watcher program was begun in the spring of 2010. *Cerceris fumipennis* is a native digging wasp that provisions its nest with adult Buprestidae, including emerald ash borer (EAB). It is used as a tool for detecting and monitoring emerald ash borer and other invasive buprestid species by intercepting its prey as female wasps return to their nest. The wasp was responsible for the first detection of EAB in Connecticut and remains as a main tool for detecting and monitoring EAB in the state. We are in the 13th year of our Wasp Watcher program. Over the course of the program, we have trained 214 watchers. In 2021, we had 5 new watchers and 32 veteran watchers returned to cover the state. In 2022, 20 veterans returned and 6 new watchers joined. Since 2010, Watchers have collected over 15,000 beetles and detected EAB in 43 new towns. We have also used this system to examine the native buprestid fauna of Connecticut and have detected over 70 species of beetles with this tool. We have amassed one of the largest collections of buprestids in the country with over 35,000 specimens. Using this depth of information, we can assess the course of the EAB invasion, further understand the reaction of native borers to ecological disturbances, and further explore the abundance and phenology of native buprestid beetles.

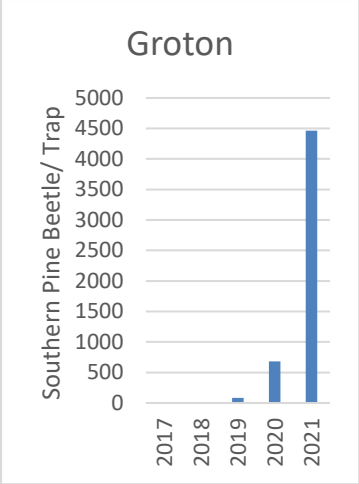


Heat map of emerald ash borer density as shown by *Cerceris fumipennis* prey. In 2017, EAB numbers had begun to drop northern New Haven County where the insect was first detected, while the beetle had not yet been detected in Windham County. Currently EAB is found in all CT towns.

Southern Pine Beetle

(Dr. Claire E. Rutledge and collaborators Dr. Alicia Bray, Central Connecticut State University; Caroline Kanaskie, University of New Hampshire; Dr. Rayda Krell, Western Connecticut State University; DEEP Department of Forestry)

The southern pine beetle (SPB) has been moving north from the southeastern United States for the past 20 years due to climate change. The beetle reached Connecticut in the summer of 2014 and was first detected in 2015. We have been trapping for the beetle every year since then, and after four years with very few captures, we have started to see an increase in the number of beetles. Starting in 2021, we have increased the number of trapping locations to better monitor this alarming rise. We are working to understand the phenology of the beetle in New England, which is quite different to its phenology in the South. Many of the models used to inform SPB management are based on the southern phenology and may be of little use in this new climate. We are also part of study with a doctoral student at the University of New Hampshire to understand the insect fauna associated with pitch pines, and important host of SPB and locally rare species in New England, and how that community changes with the advent of SPB.



Data from the Candlewood Wildlife Management Area in Groton, CT showing increase in numbers of beetles trapped over the past 5 years.

Classical Biological Control of Emerald Ash Borer

(Dr. Claire E. Rutledge with collaborators Dr. Jian Duan, USDA-ARS; Dr. Roy van Driesch, UMass Amherst; Dr. Juli Gould, USDA-APHIS; Dr. Nichole Quinn, UMass Amherst)

Following the detection of emerald ash borer (EAB) in Connecticut, the determination was made to join the USDA APHIS/PPQ biological control program for EAB. In May 2013, releases began of the gregarious endoparasitoid, *Tetrastichus planipennisi* and the egg parasitoid *Oobius agrili* in Middlebury and Prospect, CT. In 2016, we were able to add another species of parasitoid to the releases, *Spathius galinae*. This parasitoid is a gregarious ectoparasitoid of EAB with a much longer ovipositor than *T. planipennisi*. This means that they can parasitize larvae that are feeding in areas of the tree with much thicker bark. The parasitoids are shipped from the USDA APHIS EAB-rearing facility in Brighton, Michigan. Releases have been made in 15 towns and 7 counties in Connecticut.

EAB-killed ash along the Mattabesset River in Middletown, CT. It is too early to say whether our biological control program will be able save the next generation of ash, but early indicators are very promising.

Since those first releases, we have been documenting the progress of the biological control agents. We have confirmed that the wasps have established in the environment, thus displaying the ability to synchronize with their hosts and to tolerate the climate. Both *T. planipennisi* and *S. galinae* have spread at least 14 km from their release sites, an important factor in success of a program. We have documented the phenology of the parasitoids, as well as the host to improve our release schedules and timing of recovery efforts. In 2021, we embarked on a project to examine the factors contributing to the long-term survival of the parasitoids in an area. To do this, we are using sentinel logs to examine the persistence of *T. planipennisi* in the environment at 3 sets of sites of different release ages. We also are examining the ash demographics of these sites as well as peeling trees to determine current levels of emerald ash borer infestation. This work will continue in 2022 and should help us to understand the longer-term dynamics of the system.

The Connecticut Long-Term Wild Bee Monitoring Program

Tracy Zarrillo and Dr. Kimberly Stoner (Retired as of June 1, 2022, with Emeritus status) with assistance from Morgan Lowry, Rose Hiskes of the Valley Laboratory, Robert Durgy of the Griswold Research Center, and in cooperation with Kristina Vagos of the US Fish and Wildlife Service and James Fischer of the White Memorial Conservation Center.

A long-term wild bee monitoring program was initiated in 2010 by Tracy Zarrillo under the supervision of Dr. Kimberly Stoner and has continued through 2021. This program was created in response to growing evidence of decline of certain wild bee fauna locally and globally and seeks to identify wild bee communities that may require conservation action. The project goals were to create a long-term, self-sustaining, easy to implement, low-cost program that surveys wild bees in diverse habitats across Connecticut with the purpose of being able to detect changes in species richness, abundance, and composition over time. The program includes sites at the White Memorial Conservation Center in Litchfield County, the Stewart B. McKinney National Wildlife Refuge in Middlesex County, and the CAES campuses at Windsor, New Haven, Griswold, and Lockwood Farm.

Wild bees are sampled from late March/early April until mid-October, using bee bowl cup traps which run continuously throughout the season. These traps are maintained by CAES staff and our cooperators, and the samples are extracted biweekly and stored until they can be retrieved by CAES staff at the end of the season for processing. The specimens collected are identified by Tracy Zarrillo, and the records are entered into the American Museum of Natural History, Division of Invertebrate Zoology Database. A collaboration with Dr. Lawrence Gall of the Peabody Museum at Yale University and Dr. Neil S. Cobb of the University of Arizona is underway to move the CAES records over to a new platform, SCAN, Symbiota Collections of Arthropods Network https://scanbugs.org/portal/collections/misc/collprofiles.php?collid=276), which will make our data live and available in global biodiversity data portals such as GBIF (the Global Biodiversity Information Facility), BISON (Biodiversity Information Serving our Nation - USGS), and iDigBio.

The Connecticut long-term wild bee monitoring program is one of the few wild bee monitoring programs in the United States that has succeeded in surveying for eleven consecutive years at the same locations in the same exact way, thus being able to detect changes in bee abundance, composition, and diversity over time. A US national program for monitoring native bees is being developed by 13 native bee biologists from across the United States (https://www.usnativebees.com/), and the Connecticut Wild Bee Monitoring Program will be updating survey methods to align with the national program when they become available.

Checklist of the Bees of Connecticut
Ms. Tracy Zarrillo, Dr. Kimberly Stoner, and Dr. John Ascher (National University of Singapore)

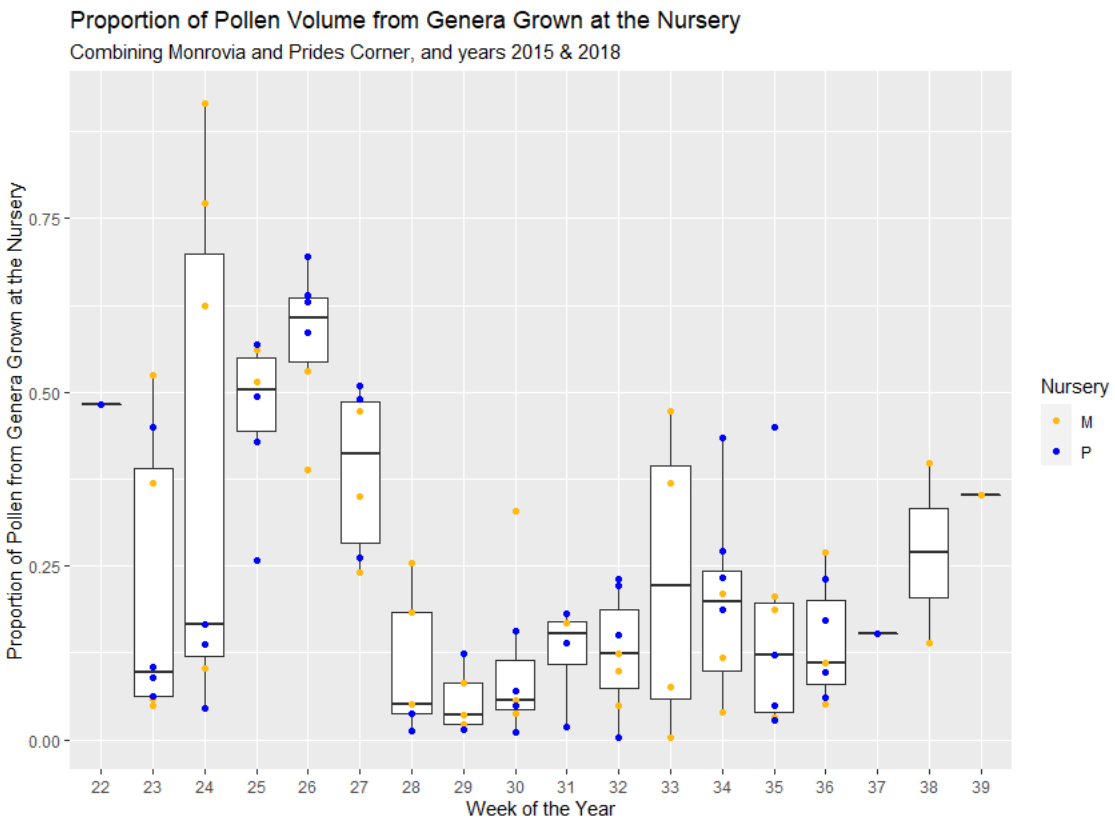
There are 378 species of bees documented for Connecticut. Four species are currently listed as species of conservation concern in Connecticut: *Bombus affinis*, listed as a species of Special Concern in Connecticut and federally listed as an Endangered Species; *Bombus ashtoni*, listed as a species of Special Concern in CT; *Bombus terricola,* listed as Threatened in CT, and *Epeoloides pilosula,* listed as Endangered in CT. The remaining species do not yet have a conservation status, and work is being done by CAES in cooperation with CT-DEEP and NatureServe to give subnational ranks to all bee species in the state. Of note, surveys of native bumble bees in Litchfield County have detected persisting populations of *Bombus terricola* in limited locations. *Bombus terricola* was found in three new locations in 2021, in the towns of Norfolk, Goshen, and Winsted. In 2018 and 2019 it was found in Canaan, and in 2020 it was found in Canaan and Cornwall. Continuing study on its distribution and possible recovery in Connecticut will be a focus of upcoming monitoring work, especially in neighboring counties.

Habitat Enhancement Project at Robbins Swamp Wildlife Management Area
Ms. Tracy Zarrillo and Peter Picone (CT-DEEP)

Ecological restoration is a long-term investment which can increase insect and wildlife diversity in an otherwise degraded habitat, however such restorations often lack information on the responses of target taxa to the improvements. The Connecticut Department of Energy and Environmental Protection is in the process of converting some state land that was previously held in agriculture, specifically corn, to pollinator habitat. One such restoration began in June of 2021 at Robbins Swamp Wildlife Management Area in Falls Village in Canaan in a 14-acre field that had been planted in corn. The field was cleared of invasive non-native plants using spot treatments of herbicide and mechanical pulling and was seeded with native wildflowers and grasses. Surveys of wild bees, monarchs, and vegetation were conducted once per month from April to September to establish a baseline from which to evaluate how plant and insect composition develop over time.

Honey Bees at Ornamental Nurseries Collect Most of their Pollen from Outside the Nurseries

Pollen is the main source of protein, fats, and many micronutrients for honey bees, and it also has the potential to be a major route of exposure to pesticides. The objective of this study was to quantify to what extent honey bee colonies use ornamental nursery plants as sources of pollen over the season. We put honey bee colonies at two large commercial ornamental plant nurseries and used a pollen-trapping device to collect pollen from foraging honey bees as they returned to the hive. Pollen was collected each week from June until September in 2015 and 2018. Samples from the pollen collected were identified to genus by a pollen specialist, and by counting and measuring the pollen cells, we could quantify how much of the pollen came from what plant source. We found that most of the pollen in July and August was collected from plant genera not grown at the nursery, including clover (Trifolium), maize (Zea), buckwheat (Fagopyrum), and jewelweed and related species (Impatiens). Major genera grown in at the nurseries and found in the honey bee-collected pollen in June and early July included roses (Rosa), sumac (Rhus), and hollies (Ilex), but each of these genera also include native or naturalized species that are abundant in the surrounding area, so the pollen probably came from both the nursery and the surroundings.



NURSERY AND PLANT INSPECTION ACTIVITIES

Plant inspection and regulatory services are coordinated and conducted through the Office of the State Entomologist, whose members are State Entomologist Dr. Victoria Smith, Plant Inspectors Jeffrey Fengler, Tia Blevins, Apiary Inspector Mark Creighton, and State Survey Coordinator Gerda Magana.

Nursery Inspection and Certification. One hundred eighty five nurseries were certified to conduct intra- and interstate business. There were 142 nursery inspections during the growing season.

Nursery Insects and Diseases. The most important pests found in nurseries (in order of prevalence) were red headed flea beetle, various aphids, woolly aphids, and thrips. The most important diseases found in nurseries (in order of prevalence) were powdery mildew, cedar apple rust, miscanthus blight, and various fungal leaf spots.

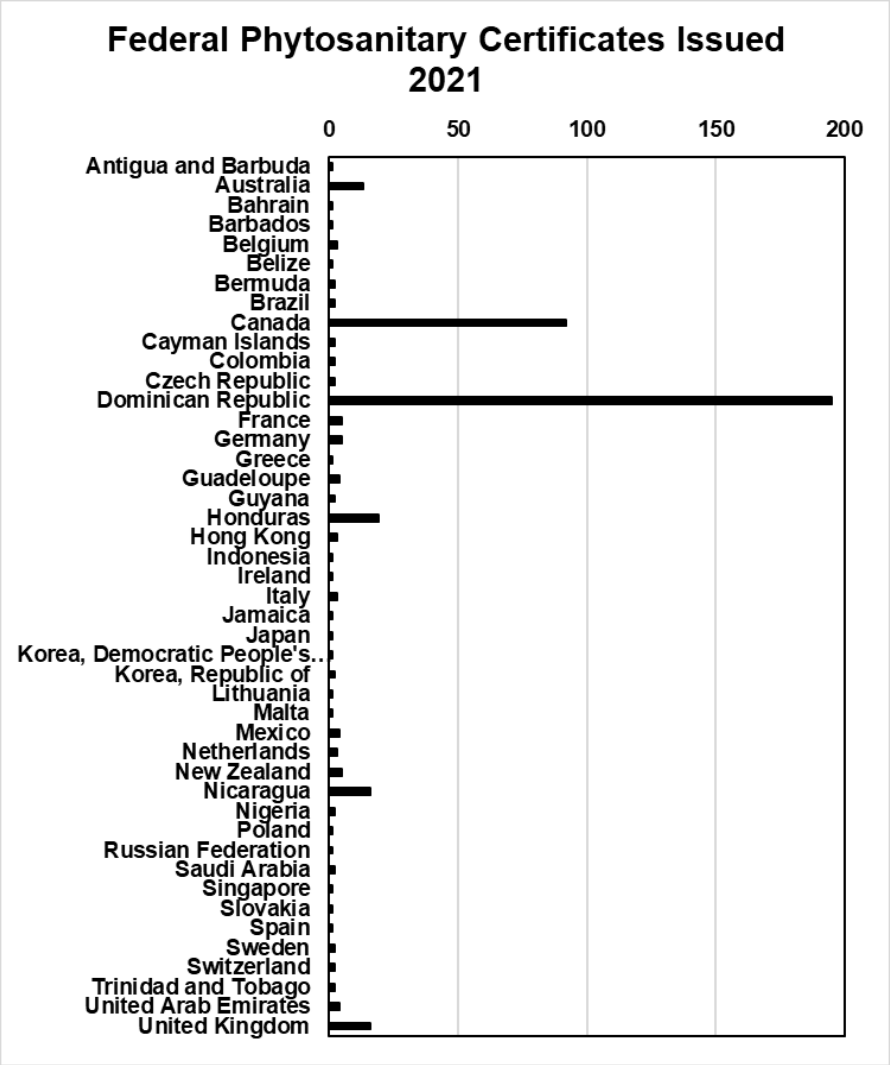
Regulatory Event. A single individual caterpillar of the federally-regulated Box tree moth, *Cydalima perspectalis*, was found during trace forward activity at a garden center in CT. All remaining boxwood nursery stock of the shipment was inspected and destroyed; no more insects were found. USDA conducted follow-up trapping, which will continue in 2022.

Nursery Dealer Permits. Nursery dealer permits were issued to 85 firms.

International Phytosanitary Certificates. Four hundred thirty one phytosanitary inspection certificates were issued covering the shipment of the following plant materials to 45 destinations outside the United States. Of the top three destinations, 195 consignments were bound for the Dominican Republic (tobacco), 92 to Canada (ornamental plants), and 19 to Honduras (tobacco).

Product			Quantity	
Asimina triloba	Pawpaw	seed	0.5	Kg
Arabidopsis	*Arabidopsis*	seed	12	envelopes
Gladiolus/Dahlia	Gladiolus/Dahlia	Tubers/corms	143	bags
Gladiolus/Dahlia	Gladiolus/Dahlia	Tubers/corms	2.5	Kg
Hemerocallis	Day lily	plants	259	plants
Hemerocallis	Day lily	seed	972	packets
Juglans nigra	Walnut	ground shells	34	bags
Juglans nigra	Walnut	ground shells	295	drums
Juglans nigra	Walnut	ground shells	91	Kg
Juglans nigra	Walnut	ground shells	110	pounds
Nicotiana tabacum	Tobacco	leaves	1,100	bags
Nicotiana tabacum	Tobacco	leaves	270	boxes
Nicotiana tabacum	Tobacco	leaves	52,755	bundles
Nicotiana tabacum	Tobacco	leaves	9,376	cartons
Nicotiana tabacum	Tobacco	leaves	1,430	Kg
Nicotiana tabacum	Tobacco	leaves	2,361,954	pounds
nursery stock	various	plants	34,427	plants
Paeonia suffruticosa	Peony	plants	107	plants
Paeonia sp.	Peony	stems	4	bags
Paeonia sp.	Peony	stems	41	each
Phytelephas aequatorialis	Vegetable ivory	ground seed	1,008	boxes
Phytelephas aequatorialis	Vegetable ivory	ground seed	5	drums
Phytelephas aequatorialis	Vegetable ivory	ground seed	2,200	Kg
Prunus armeniaca	Apricot	ground seed	1,200	Kg
Prunus pyrifolia	Asian pear	cuttings	1	box
Succulents	various	plants	74	plants
Tillandsia sp.	Air plant	plants	509	plants
vegetables and herbs	various	seed	407	bags
vegetables and herbs	various	seed	89.3	Kg
Zea mays	corn	ground seed	17	bags

Destinations for out-of-country exports from Connecticut.

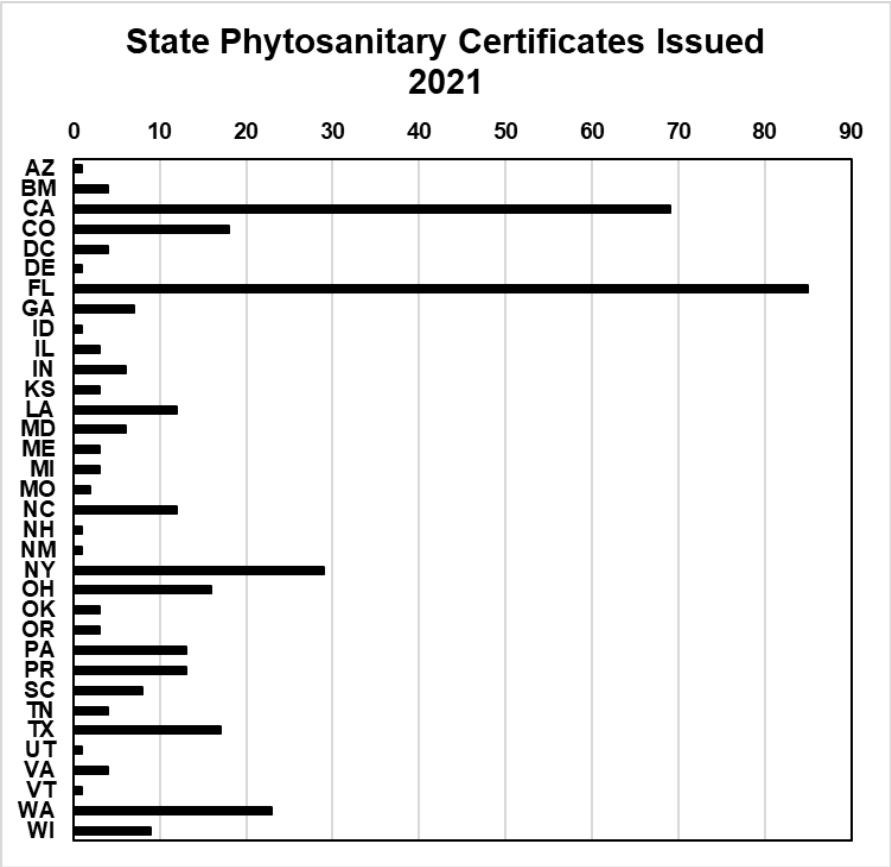


Houseplant Inspections. Nine inspections were conducted for 197 individual plants to assist homeowners moving out of state.

Domestic. A total of 386 State of CT phytosanitary inspection certificates were issued to assist nurseries and other vendors moving the following plants interstate, either to destinations in other states or to US Territories and Puerto Rico (34 listed destinations). Of the top three destinations, 85 consignments were bound for Florida, 69 to California, and 29 to New York.

Product			Quantity	
Greenhouse/indoor plants	various	plants	100	plants
Lycopersicon esculentum	tomato	plants	4	plants
nursery stock	various	bare root plants	6,174	plants
nursery stock	various	plants	23	plants
Orchids	various	In vitro plantlets	17	plantlets
Orchids	various	plants	2,228	plants
Pelargonium sp.	Geranium	plugs	1,374	plants
Perennials	various	plants	44	plants
vegetables and herbs	various	seed	33	bags

Destinations for out-of-state export from CT, including US Territories and Puerto Rico.



Permits to move live plant pests, noxious weeds, and soil. In 2021, there were 138 PPQ 526 Permits (Permit to move live plant pests, noxious weeds, and soil) approved in CT. There were 2 Permits to Receive Soil issued.

Boxwood Blight compliance agreements for shipment to Pennsylvania. Three nurseries met requirements for shipment of boxwood nursery stock to Pennsylvania.

Notification of Shipments of *P. ramorum* hosts and Associated Hosts. There were 15 notifications of shipments of *P. ramorum* hosts and associated hosts, pursuant to 7 CFR 301.92.

FOREST HEALTH

In general, the hardwood forests are suffering from successive years of drought stress and gypsy moth defoliation, and are under threat due to development pressure, and ash mortality due to emerald ash borer infestation is increasing. Most of the ash, especially in urban and suburban areas, is dead due to EAB. We no longer assess damage and mortality of ash.

INSECT AND DISEASE SURVEYS

SPOTTED LANTERNFLY. Populations of spotted lanternfly (egg masses plus adult insects) were found at several locations in Fairfield County, near the New York State line, in September 2020, and populations were found in 2021 in both Fairfield and New Haven counties. A number of single adult insects were also found at various locations throughout the state. USDA plans to conduct survey and delimitation around the known populations, with treatments planned for 2022.

Lymantria dispar dispar. In 2021, we recorded 45,548 acres with significant defoliation caused by LDD, primarily in Litchfield County. In December 2021 through March 2022, a gypsy moth egg mass survey was conducted in 80-95% favorable host sites on a 7-mile grid (102 sites) throughout Connecticut. Egg mass counts were high only in Litchfield County, which indicates the potential for an outbreak there in summer of 2022.

SADDLED PROMINENT. Also in Litchfield County, there was a late-season outbreak of Saddled prominent, *Heterocampa guttivitta*. Defoliation due to larval feeding of this insect totaled over 100 acres.

HEMLOCK WOOLLY ADELGID and ELONGATE HEMLOCK SCALE. These pests have been present in CT for many years, and continue to cause patchy damage and decline among the remaining population of hemlocks.

AGROMYZID FLY, also called the oak shot hole leaf miner, is a relatively new pest causing local damage and defoliation on oaks. We recorded sporadic damage due to this insect.

BEECH LEAF DISEASE, caused by the nematode *Litylenchus crenatae mccannii*, has been detected and confirmed to occur throughout the state. It is causing tree discoloration and some mortality primarily in the shoreline areas. We measured almost 800 acres affected by beech leaf disease in 2021, and expect that number to increase in the coming years.

APIARY INSPECTION

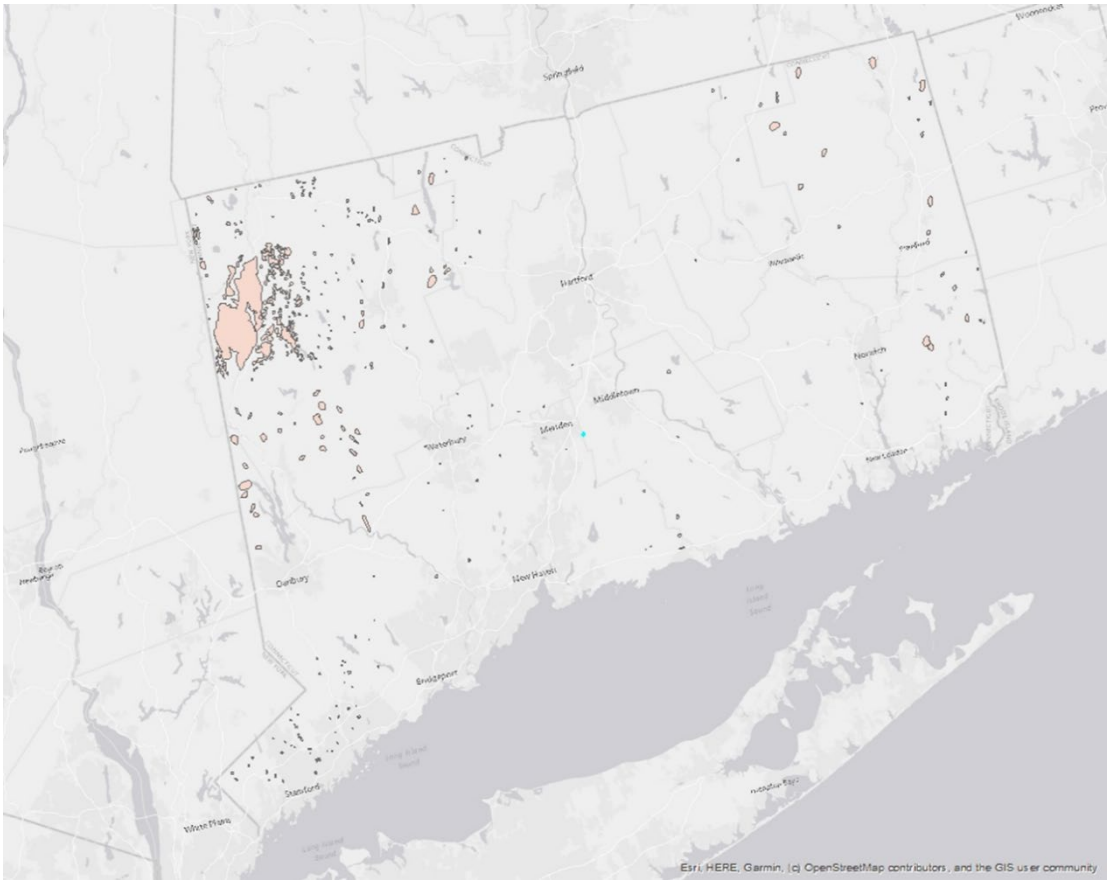
his year was successful despite COVID, the focus was on supporting the larger scale beekeepers (reduced people contact), which resulted in inspecting more hives. Bee Health Certificates were issued for large apiaries to sell approximately 549 colonies to beekeepers in the tri-state area (MA, NJ, and NY), and 4 were issued for travel to South Carolina, Florida, and Maine.

Approximately 1,568 colonies were inspected at 128 apiaries.

Proposed legislative changes recommended by the Pollinator Advisory Board would require notification to CAES for all importation of bees into CT.

Several reported American Foulbrood cases were determined to be Parasitic Mite Syndrome. Varroa mites continue to be a leading cause of colony mortality in Connecticut. The Bee Informed partnership reported the average annual colony loss for Connecticut to be 63 %. Varroa mite testing kits continue to be issued to beekeepers for the 2022 season.

The annual aerial survey of CT forests and natural lands was conducted during June through August of 2021; findings are below.



Special activities:

Email/telephone inquiries concerning emerald ash borer, 1 July 2021 through 30 June 2022: 18
Email/telephone inquiries concerning Asian longhorned beetle, 1 July 2021 through 30 June 2022: 18
Email/telephone inquiries concerning spotted lanternfly, 1 July 2021 through 30 June 2022: 137

CENTER FOR VECTOR BIOLOGY AND ZOONOTIC DISEASE

The CAES Center for Vector Biology & Zoonotic Diseases (CVBZD) and the infectious disease organisms they transmit in Connecticut and the Northeastern US. The mission of the Center is to advance the knowledge of epidemiology and ecology of vector-borne disease organisms and to develop novel methods and more effective strategies for their surveillance and control. The CVBZD is currently engaged in laboratory and field research on the biology and control of mosquitoes, ticks, and bedbugs and is investigating the epidemiology and ecology of mosquito-borne viruses that occur throughout the region including West Nile virus WNV, and eastern equine encephalitis virus (EEEV), and other arboviruses, as well as tick-borne pathogens such as Borrelia spp., Anaplasma phagocytophilum, Babesia microti, Ehrlichia spp., and Powassan virus. The Center is additionally responsible for conducting the state- wide mosquito and arbovirus surveil- lance for EEEV and WNV as well as active and passive tick and tick-borne diseases surveillance.

Vector-borne diseases (VBDs) are parasitic, viral, bacterial, and filarial human illnesses transmitted by mostly arthropod vectors, including mosquitoes, ticks, fleas, and several other groups, and account for more than 17% of all infectious diseases, causing more than 700,000 deaths each year worldwide. Linked, in part, to a warming climate, VBDs are increasingly becoming a major public health concern in the U.S., where a total of 642,602 human disease cases were reported to the Centers for Disease Control and Prevention. Persistently warming temperatures may not only lead to the continued geographic range expansion of some vectors but may also extend their active season, thereby altering host availability and abundance; interactions among vectors, pathogens, and hosts; and the prevalence of infection. A warming climate and other environmental changes will affect abundance, distribution, seasonal activity patterns, and interactions among species differently for various vectors.

In recent years, we have witnessed introduction, range expansion, and changes in the dynamics and frequency of mosquito-borne arboviruses in the Western Hemisphere. WNV has now become firmly established in the continental U.S. since its discovery in the New York City area in 1999, and EEEV with sporadic transmission over the past several decades, has made a comeback in 2019 in the Northeast including Connecticut.
Invasive mosquito species including *Aedes albopictus* and *Aedes japonicus*, with abilities to transmit arboviruses of concern to humans, may soon pose considerable risk to human and animal health in Connecticut. The invasion and spread of *Ae. albopictus* in the U.S. occurred in the past three decades and its range continues to expand. *Ae. albopictus* inhabits a wide range of environments, from urban to rural, and bites a wide variety of hosts including mammals, birds, reptiles, and amphibians.

A. Biology and Behavior of Mosquito Vectors of Arboviruses of Human Health Concern

A.1. Host Associations of *Culex pipiens*: A Two-Year Analysis of Bloodmeal Sources and Implications for Arboviral Transmission.

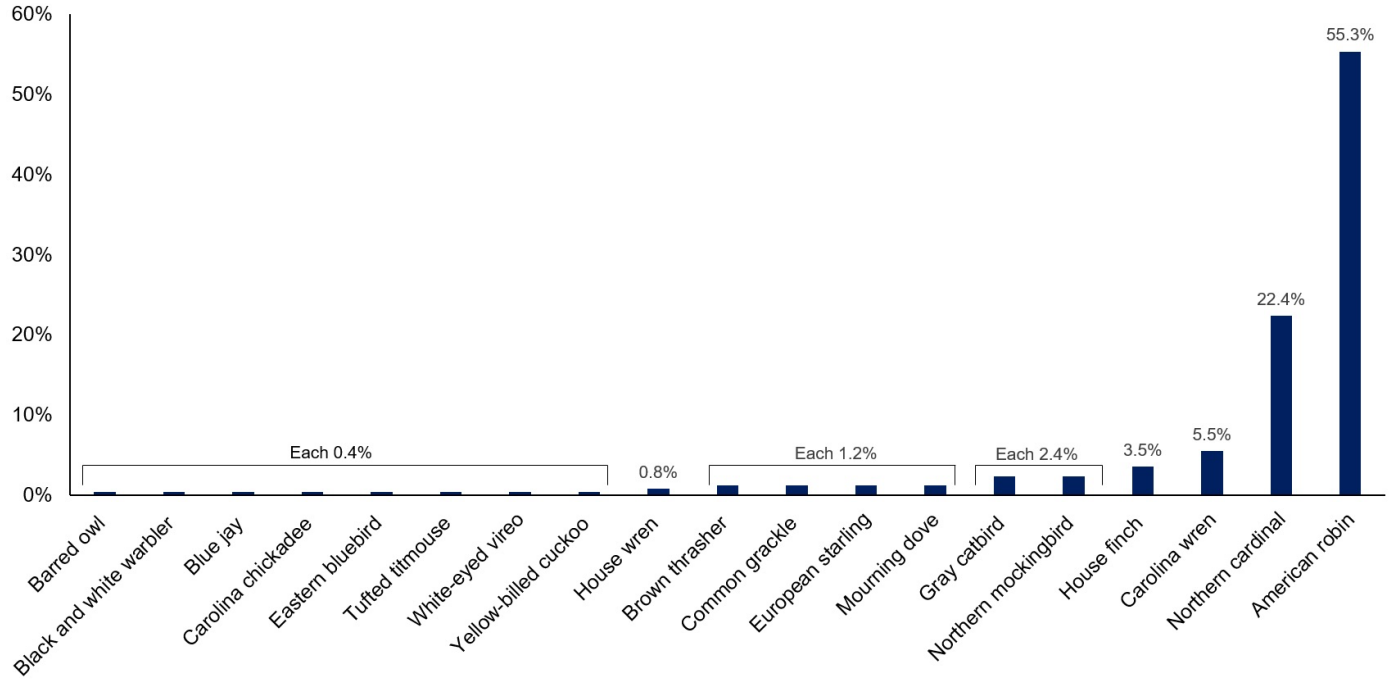
(Noelle Khalil, Eliza A. H. Little, Karen I. Akaratovic, Jay P. Kiser, Charles F. Abadam, Karen J. Yuan, Michael J. Misencik, Philip M. Armstrong, Goudarz Molaei*)

Understanding vector-host interactions is crucial for evaluating the role of mosquito species in enzootic cycling and epidemic/epizootic transmission of arboviruses as well as assessing vertebrate hosts contributions to maintenance and amplification in different virus foci. To investigate blood-feeding pattern of *Culex pipiens*, engorged mosquitoes were collected on a weekly basis at 50 sites throughout Suffolk, Virginia, using Centers for Disease Control and Prevention miniature light traps, BG-Sentinel traps, and modified Reiter gravid traps. Vertebrate hosts of mosquitoes were identified by amplifying and sequencing portions of the mitochondrial cytochrome b gene. Of 281 *Cx. pipiens* bloodmeals successfully identified to species, 255 (90.8%) contained solely avian blood, 13 (4.6%) mammalian, 1 (0.4%) reptilian, and 12 (4.3%) both avian and mammalian blood. Nineteen avian species were identified as hosts for *Cx. pipiens* with American robin (n=141, 55.3% of avian hosts) and northern cardinal (n=57, 22.4%) as the most common hosts. More American robin feedings took place in areas of higher development. Three mammalian species were also identified as hosts for *Cx. pipiens* with Virginia

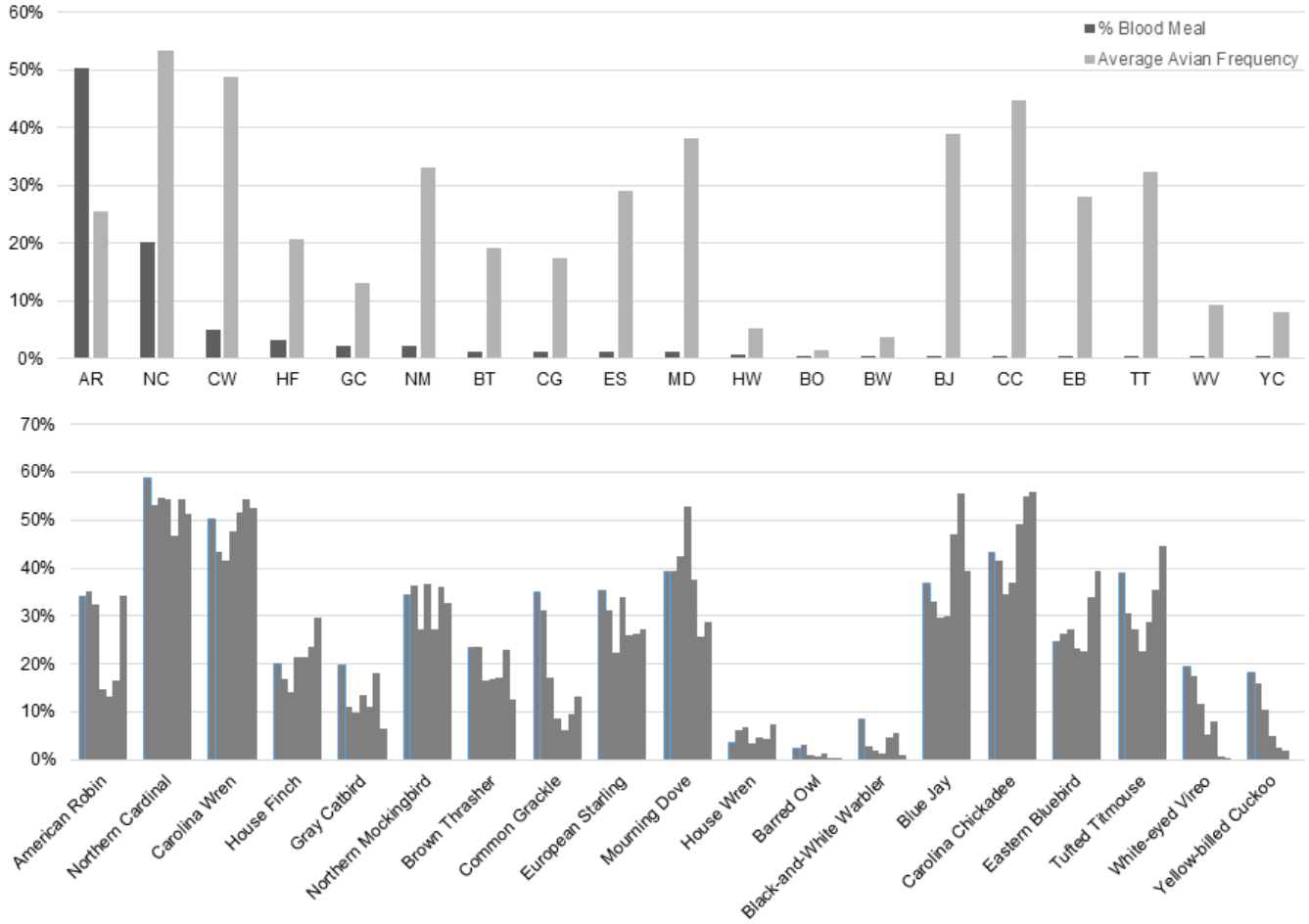
opossum and domestic cat as the most common hosts in this class (each n=6, 46.2% of mammalian hosts). There was no significant seasonal difference in the proportion of bloodmeals obtained from avian hosts, but there was a decrease in the proportion of bloodmeals from mammalian hosts from spring to fall. One engorged specimen of *Cx. pipiens* with Virginia opossum-derived bloodmeal tested positive for West Nile virus (WNV), and another with black-and-white warbler-derived bloodmeal tested positive eastern equine encephalitis virus. Our findings, in conjunction with the results of vector competence studies and virus isolation from field-collected mosquitoes, lend additional support that *Cx. pipiens* serves as the principal enzootic vector and potential epizootic/epidemic vector of WNV in southeastern Virginia.

Number and percentage of avian-, mammalian-, and reptilian-derived bloodmeals from *Culex pipiens* collected in Suffolk, Virginia, 2019-2020.

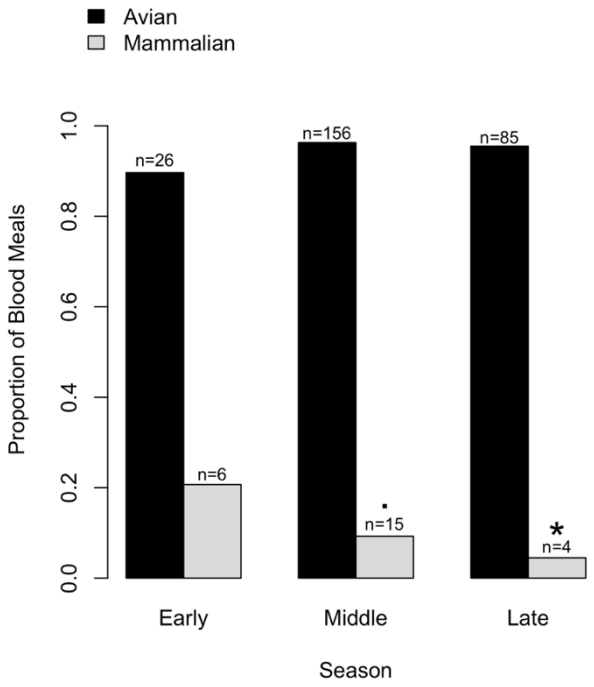
Vertebrate Hosts **Common Name (Species Name)**	**Frequency of Bloodmeals** **No. (%)**
Avian	
American robin (*Turdus migratorius*)	141 (50.18)
Northern cardinal (*Cardinalis cardinalis*)	57 (20.28)
Carolina wren (*Thryothorus ludovicianus*)	14 (4.98)
House finch (*Carpodacus mexicanus*)	9 (3.20)
Gray catbird (*Dumetella carolinensis*)	6 (2.14)
Northern mockingbird (*Mimus polyglottos*)	6 (2.14)
Brown thrasher (*Toxostoma rufum*)	3 (1.07)
Common grackle (*Quiscalus quiscula*)	3 (1.07)
European starling (*Sturnus vulgaris*)	3 (1.07)
Mourning dove (*Zenaida macroura*)	3 (1.07)
House wren (*Troglodytes aedon*)	2 (0.71)
Barred owl (*Strix varia*)	1 (0.36)
Black-and-white warbler (*Mniotilta varia*)	1 (0.36)
Blue jay (*Cyanocitta cristata*)	1 (0.36)
Carolina chickadee (*Poecile carolinensis*)	1 (0.36)
Eastern bluebird (*Sialia sialis*)	1 (0.36)
Tufted titmouse (*Baeolophus bicolor*)	1 (0.36)
White-eyed vireo (*Vireo griseus*)	1 (0.36)
Yellow-billed cuckoo (*Coccyzus americanus*)	1 (0.36)
Mammalian	
Domestic cat (*Felis catus*)	6 (2.14)
Virginia opossum (*Didelphis virginiana*)	6 (2.14)
Dog (*Canis lupus familiaris*)	1 (0.36)
Reptilian	
Brown snake (*Storeria dekayi*)	1 (0.36)
Mixed	
American robin & Virginia opossum (*Turdus migratorius* & *Didelphis virginiana*)	6 (2.14)
Northern cardinal & Virginia opossum *(Cardinalis cardinalis* & *Didelphis virginiana*)	2 (0.71)
American robin & Domestic cat (*Turdus migratorius* & *Felis catus*)	1 (0.36)
Northern cardinal & Domestic cat (*Cardinalis cardinalis* & *Felis catus*)	1 (0.36)
Mourning dove & Virginia opossum (*Zenaida macroura* & *Didelphis virginiana*)	1 (0.36)
Northern mockingbird & Virginia opossum (*Mimus polyglottos* & *Didelphis virginiana*)	1 (0.36)
Total	281 (100)



Percentage of *Culex pipiens* avian-derived bloodmeals Suffolk, Virginia, 2019-2020.



Frequency of avian species and avian-derived bloodmeals of *Culex pipiens* in Suffolk, Virginia, 2019-2020. A. Percentage of avian-derived bloodmeals in *Cx. pipiens* compared with the average avian frequencies in the City of Suffolk, Virginia, and surrounding cities/counties (City of Chesapeake, Isle of Wight County, City of Portsmouth, and Southampton County) May through November 2019-2020. **B.** Monthly frequencies of avian species based on point count data in the City of Suffolk, Virginia, and surrounding cities/counties (City of Chesapeake, Isle of Wight County, City of Portsmouth, and Southampton County) May through November 2019-2020.



Proportion of bloodmeals obtained from avian and mammalian hosts each season in Suffolk, Virginia, 2019-2020. Early season defined as May and June; Middle defined as July and August; Late defined as September, October, and November.

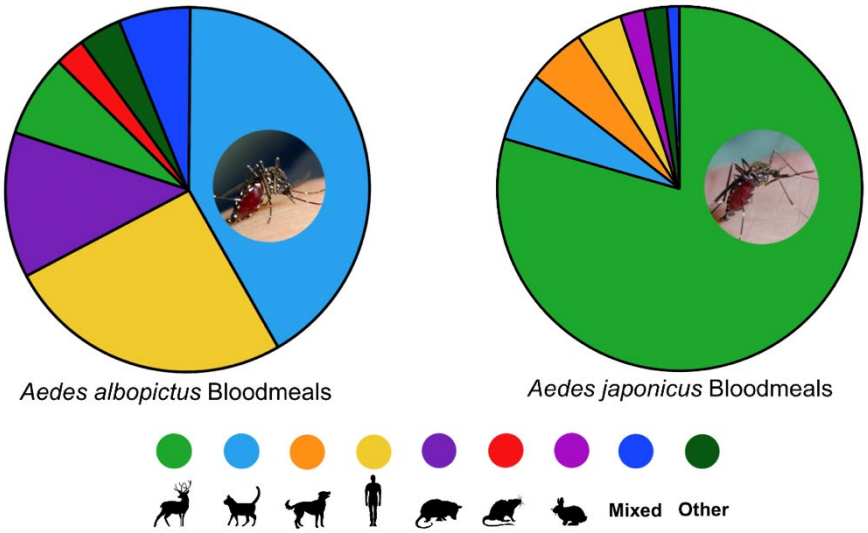
Impact: We find that *Cx. pipiens* mosquitoes in Suffolk, Virginia, feed primarily on passeriformes birds, including American robins and northern cardinals, capable of supporting WNV amplification. *Culex pipiens* also acquires bloodmeals from mammalian hosts, albeit at a much less frequency. Our findings, in concert with vector competence and WNV isolation from field-collected mosquitoes, lend support for *Cx. pipiens* to serve as the principal enzootic vector and potential epizootic/epidemic vector of WNV in southeastern Virginia.

A.2. Spatiotemporal Distribution, Abundance, and Host Interactions of Two Invasive Vectors of Arboviruses, *Aedes albopictus* and *Aedes japonicus*.

(Eliza A. H. Little, Michael L. Hutchinson, Keith J. Price, Alyssa Marini, John J. Shepard, and Goudarz Molaei*)

Aedes albopictus and *Aedes japonicus*, two invasive mosquito species in the United States, are implicated in the transmission of arboviruses. Studies have shown interactions of these two mosquito species with a variety of vertebrate hosts; however, regional differences exist and might influence their contribution to arbovirus transmission. We investigated the distribution, abundance, host interactions, and West Nile virus infection prevalence of *Ae. albopictus* and *Ae. japonicus* by examining Pennsylvania mosquito and arbovirus surveillance data between 2010-2018. Mosquitoes were primarily collected using gravid traps and BG-Sentinel traps, and sources of bloodmeals were determined by analyzing mitochondrial *cytochrome b* gene sequences amplified in PCR assays. A total of 10,878,727 female mosquitoes representing 51 species were collected in Pennsylvania over the nine-year study period, with *Ae. albopictus* and *Ae. japonicus* representing 4.06% and 3.02% of all collected mosquitoes, respectively. *Aedes albopictus* was distributed in 39 counties and *Ae. japonicus* in all 67 counties, and the abundance of these species increased between 2010 and 2018. Models suggested an increase in the spatial extent of *Ae. albopictus* while that of *Ae. japonicus* remained unchanged during the study period. We found differential association between the abundance of the two mosquito species with environmental conditions, percent development, and median household income. Of 110 *Ae. albopictus* and 97 *Ae. japonicus* bloodmeals successfully identified to species, 98% and 100% were derived from mammalian hosts, respectively. Among 12 mammalian species, domestic cats, humans, and white-tailed deer served as the most frequent hosts for the two mosquito species. A limited number of *Ae. albopictus* acquired bloodmeals from avian hosts solely or in mixed bloodmeals. West Nile virus was detected in 31 pools (*n*= 3,582 total number of pools) of *Ae. albopictus*

and 12 pools (*n*= 977 total number of pools) of *Ae. japonicus*. Extensive distribution, high abundance, and frequent interactions with mammalian hosts suggest potential involvement of *Ae. albopictus* and *Ae. japonicus* in the transmission of human arboviruses including Cache Valley, Jamestown canyon, La Crosse, Dengue, chikungunya, and Zika should any of these viruses become prevalent in Pennsylvania. Limited interaction with avian hosts suggests that *Ae. albopictus* might occasionally be involved in transmission of arboviruses such as West Nile in the region.

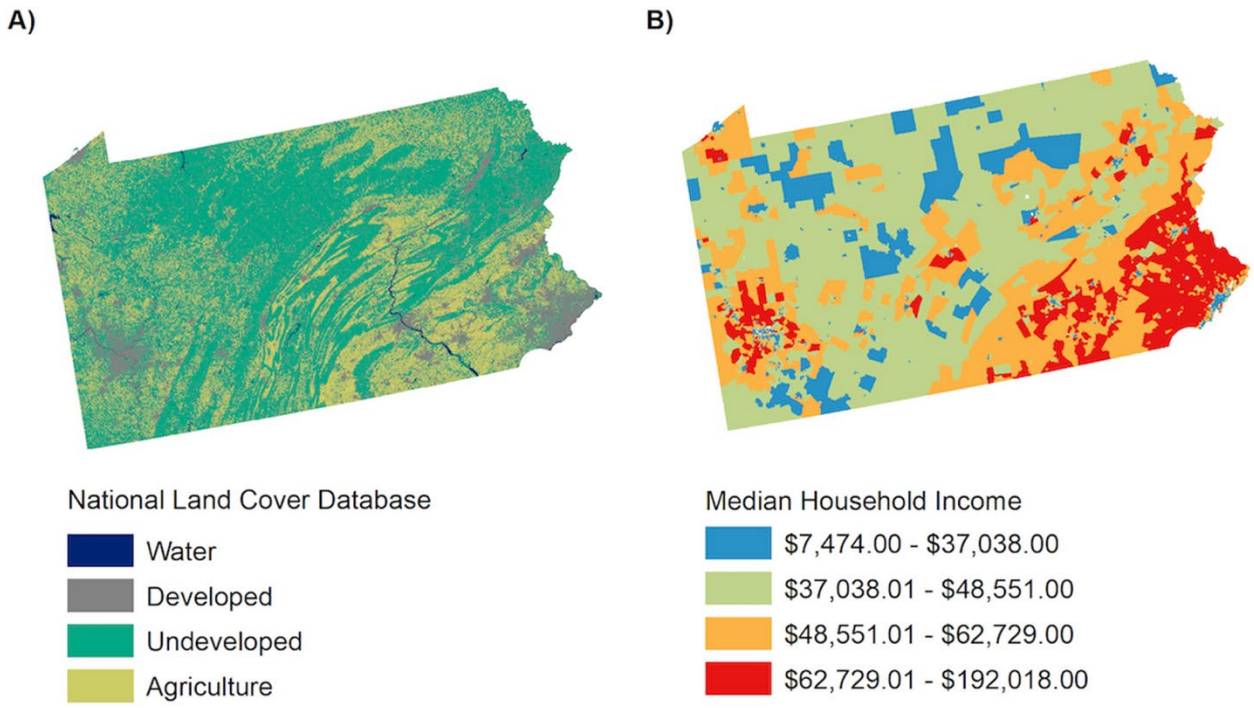


Number and percentage of avian- and mammalian-derived bloodmeals from *Aedes albopictus* collected in Pennsylvania, 2018.

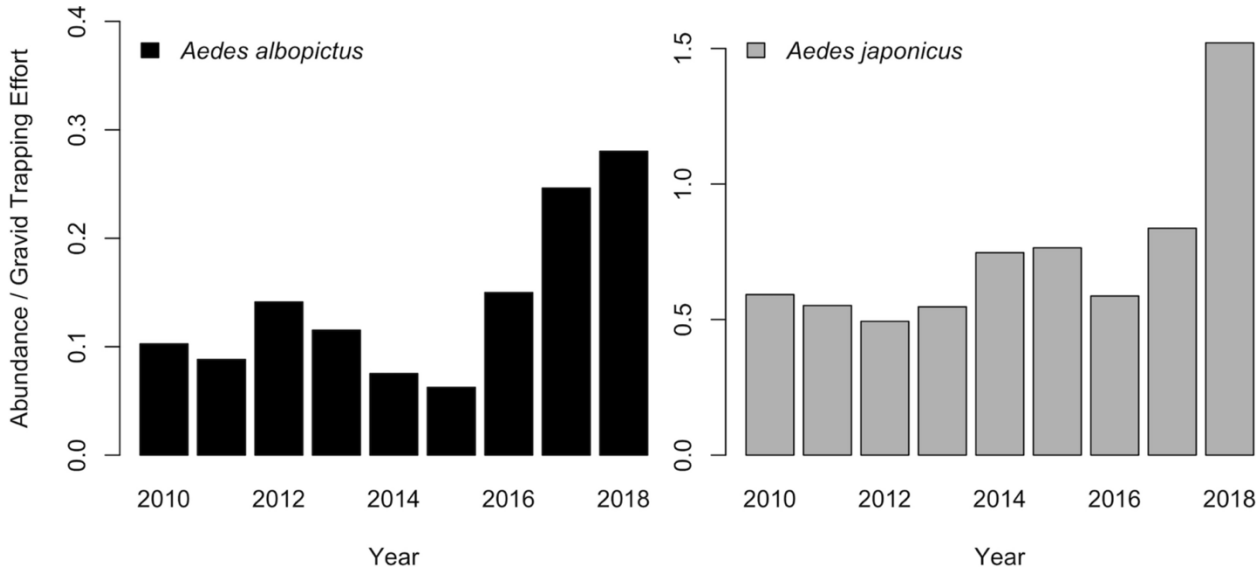
Vertebrate Hosts **Common Name (Species Name)**	**Frequency of Bloodmeals** **No. (%)**
Mammalian	
Domestic cat *(Felis catus)*	46 (41.82)
Human *(Homo sapiens)*	28 (25.45)
Virginia Opossum (*Didelphis virginiana*)	14 (12.73)
White-tailed deer *(Odocoileus virginianus)*	8 (7.27)
Brown rat *(Rattus norvegicus)*	3 (2.73)
Dog (*Canis lupus familiaris*)	1 (0.91)
Red fox (*Vulpes vulpes)*	1 (0.91)
Avian	
House finch (*Haemorhous mexicanus*)	2 (1.82)
Mixed	
Human & House finch (*Homo sapiens* & *Carpodacus mexicanus*)	2 (1.82)
Virginia opossum & House finch *(Didelphis virginiana* & *Carpodacus mexicanus*)	2 (1.82)
Dog & House finch (*Canis lupus familiaris* & *Carpodacus mexicanus*)	1 (0.91)
Domestic cat & House finch (*Felis catus* & *Carpodacus mexicanus*)	1 (0.91)
Domestic cat & Human (*Felis catus* & *Homo sapiens*)	1 (0.91)
Total	110 (100)

Number and percentage of mammalian-derived bloodmeals from *Aedes japonicus* collected in Pennsylvania, 2010-2015.

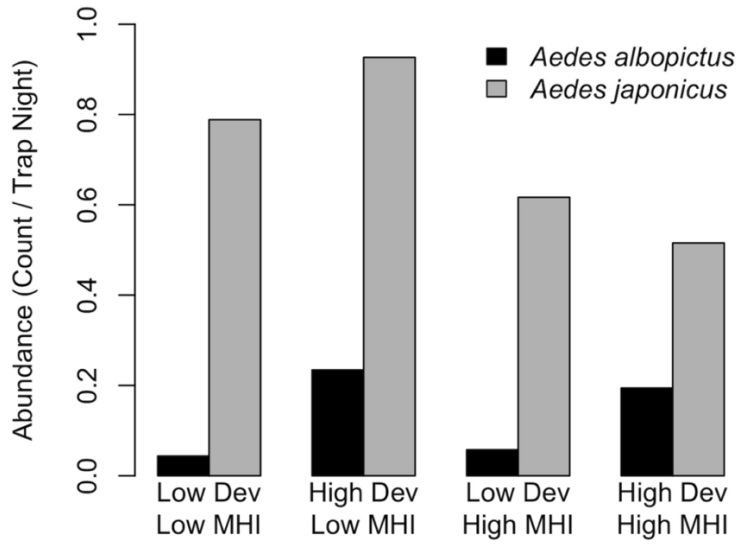
Vertebrate Hosts	**Frequency of Bloodmeals**
Common Name (Species Name)	**No. (%)**
Mammalian	
White-tailed deer *(Odocoileus virginianus)*	77 (79.38)
Domestic cat *(Felis catus)*	6 (6.19)
Dog (*Canis lupus familiaris*)	5 (5.15)
Human *(Homo sapiens)*	4 (4.12)
Eastern Cottontail rabbit *(Sylvilagus floridanus)*	2 (2.06)
Cow (*Bos taurus*)	1 (1.03)
Horse (*Equus caballus)*	1 (1.03)
Mixed	
Cat & Groundhog (*Felis catus & Marmota monax*)	1 (1.03)
Total	97 (100)



Explanatory variables percent development derived from the National Land Cover Database (a) and median household income **(b)** in Pennsylvania.



Aedes albopictus **(left) and** ***Ae. japonicus*** **(right) total abundance divided by trap nights across gravid trap sites in Pennsylvania 2010–2018**.



Aedes albopictus **and** ***Ae. japonicus*** **abundance across urban landscapes, percent development and median household income, both stratified at the mean.**

Impact: Better understanding of the distribution, abundance, infection prevalence, and host interaction of *Ae. albopictus* and *Ae. japonicus* in nature is vital for assessing their vectorial capacity and contribution to arboviruses transmission in different virus foci. Our study indicates widespread distribution, high abundance, range expansion, and frequent interactions of *Ae. albopictus* and *Ae. japonicus* with mammalian hosts, including humans, and highlights their potentials for transmission of arboviruses to humans in the region. Avian-derived bloodmeals in *Ae. albopictus*, albeit at lower frequency, and infection with arboviruses in field-collected mosquitoes also suggest that this mosquito species might occasionally serve as a bridge vector of West Nile virus to humans and other mammals in the region.

B. Range Expansion of Native and Invasive Ticks and Epidemiology of Tick-Borne Diseases


Blacklegged or Deer Tick


Lone Star Tick


Asian Longhorned Tick


Gulf Coast Tick

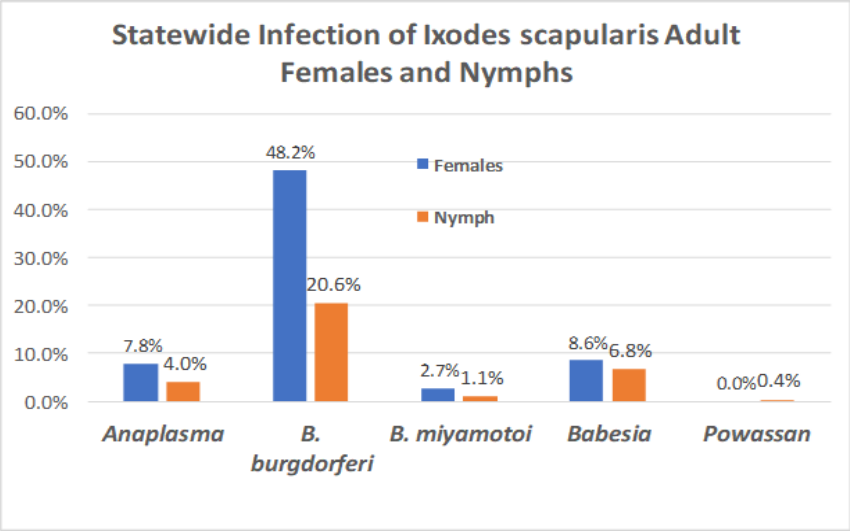

American Dog Tick

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, an increasing number of communities are at risk of exposure to ticks and tick-borne pathogens. It was estimated that 90% of the U.S. human vector-borne disease cases in 2017 were those transmitted by ticks. Based on recent estimates, 476,000 people have been treated for Lyme disease annually from 2010 to 2018, though this estimate is based on commercial insurance claims and may not reflect the unequal access to healthcare or the presumptive treatment of patients in the absence of a proper diagnosis. With a total of 14,571 disease cases from 2010 to 2019, Connecticut is among the 14 states from which 95% of all Lyme disease cases are reported, and had the 9th highest incidence rate (disease cases per 100,000 population) in 2019. Similarly, the incidence of other tick-borne diseases, including anaplasmosis and babesiosis, has also been on the rise in Connecticut and the Northeast. In response to the growing challenges of ticks and tick-borne diseases, The Connecticut Agricultural Experiment Station has established active and passive tick and tick-borne pathogen 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.

B.1. Active Tick and Tick-borne Pathogen Surveillance Program

An active tick surveillance program was initiated in Connecticut in 2019 and continued in 2021 funded in part by a grant from the Centers for Disease Control and Prevention (CDC) through the Epidemiology and Laboratory Capacity (ELC) program at the Connecticut Department of Public Health. The field program is run by Dr. Scott C. Williams (Department of Forestry and Horticulture), Dr. Megan A. Linske, and Dr. Kirby C. Stafford (Department of Entomology) with sampling conducted by research assistant Jamie Cantoni. All the tick testing is conducted by Dr. Douglas E. Brackney and Duncan W. Cozens (Department of Environmental Sciences).

The blacklegged tick, *Ixodes scapularis* Say, is the primary vector for at least seven pathogens that cause human disease: *Borrelia burgdorferi*, the agent of Lyme disease, *Babesia microti* (babesiosis), *Anaplasma phagocytophilum* (anaplasmosis), *B. miyamotoi* (a relapsing fever *Borrelia*), *B. mayoni* (a new Lyme *Borrelia* spp.), the *Ehrlichia muris*-like agent, now *E. muris* subsp. *eauclairensis* (ehrlichiosis) (known only from upper mid-west so far), and Powassan virus.

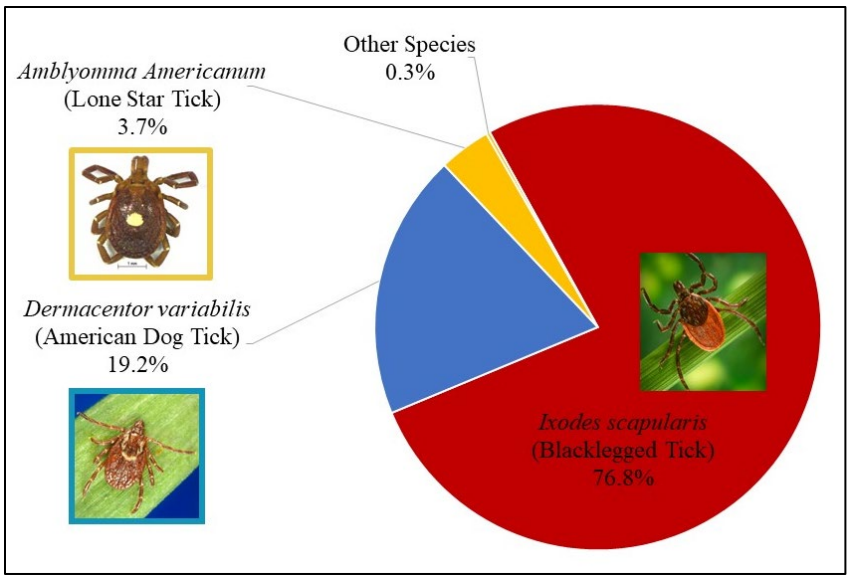


Ticks are collected at 40 paired publicly-accessible active tick surveillance sampling locations throughout CT's eight counties (see map) from April through October with a focus on the blacklegged tick, *Ixodes scapularis*. Other tick species that are being found and tabulated include American dog ticks, *Dermacentor variabilis*, the vector of Rocky Mountain spotted fever, the lone star tick, *Amblyomma americanum*, an aggressive southern species that is becoming established in Connecticut and parts of coastal New England, and the exotic Asian longhorned tick, *Haemaphysalis longicornis*. In calendar year 2020, a total of 2,068 blacklegged ticks, 437 American dog ticks, 3 lone star ticks, and 2 Asian longhorned ticks (total 3,409 for period July 1-June 30). A multiplexed RT-qPCR assay for *Ixodes scapularis* can detect *Borrelia burgdorferi s.l.*, *Babesia microti*, *Anaplasma phagocytophilum*, *Borrelia miyamotoi*, and Powassan virus lineage II. The 2020 testing results for adult blacklegged ticks are shown in the accompanying graph.

B.2. Passive Tick and Tick-borne Pathogen Surveillance Program and Tick Testing Laboratory Services for Assessing Human Health Risk with Tick-borne Diseases
(Goudarz Molaei assisted by Noelle Khalil)

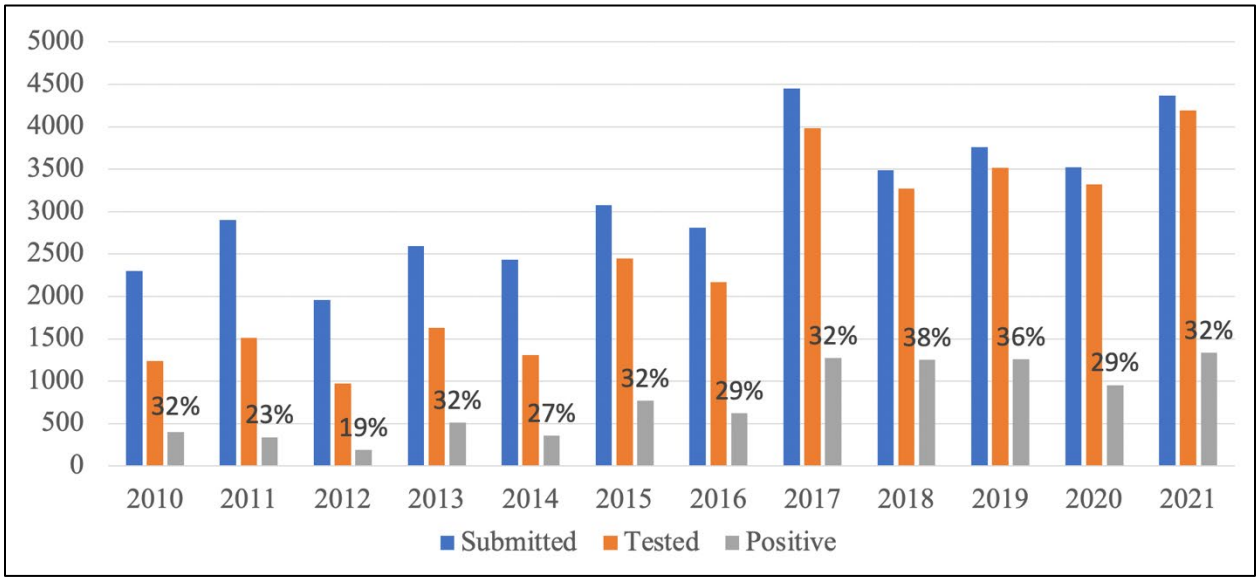
The passive tick and tick-borne pathogen surveillance program was established in 1990 following the first discovery of Lyme disease in Connecticut and several years of research on this disease at the CAES. Within the framework of the passive surveillance program, the CAES Tick Testing Laboratory (TTL) was initially mandated to screen the blacklegged tick for evidence of infection with *Borrelia burgdorferi*, the causative agent of Lyme disease. However, in 2015, the program was expanded to include testing for *Anaplasma phagocytophilum* and *Babesia microti*, the two important tick-borne pathogens responsible for human granulocytic anaplasmosis and babesiosis, respectively. The CAES-TTL receives nearly 3,000 tick submissions each year from residents, health departments, and physician's offices; however, this number has increased to 6,000 in recent years.

Blacklegged/deer tick, *Ixodes scapularis,* is currently responsible for transmitting seven pathogens to humans, of which the three most common are *Borrelia burgdorferi, Babesia microti,* and *Anaplasma phagocytophilum*, causing Lyme disease, babesiosis, and anaplasmosis, respectively. In 2021, the CAES-TTL received a total of 5,685 ticks submitted by residents, health departments, and physicians' offices for identification and testing. Of these, 4,365 (76.8%) were identified as *Ixodes scapularis* (blacklegged or deer tick), 1,092 (19.2%) as *Dermacentor variabilis* (American dog tick), 213 (3.7%) as *Amblyomma americanum* (lone star tick), and 15 (0.3%) as other tick species.

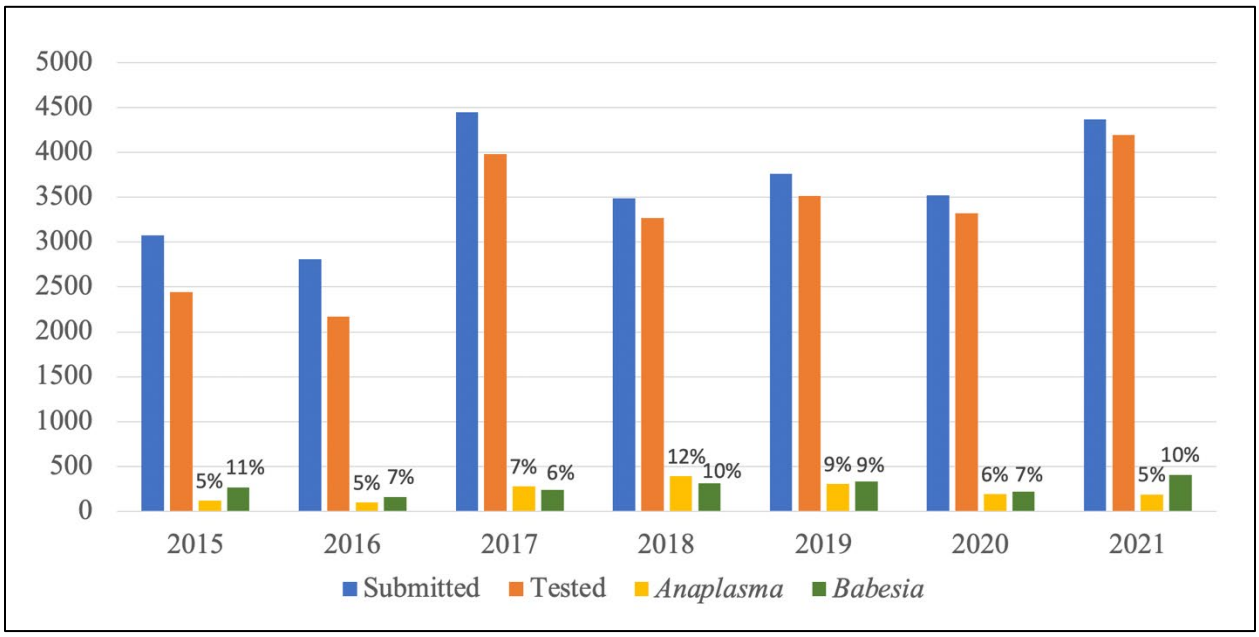


Tick species abundance and composition, Connecticut, 2021.

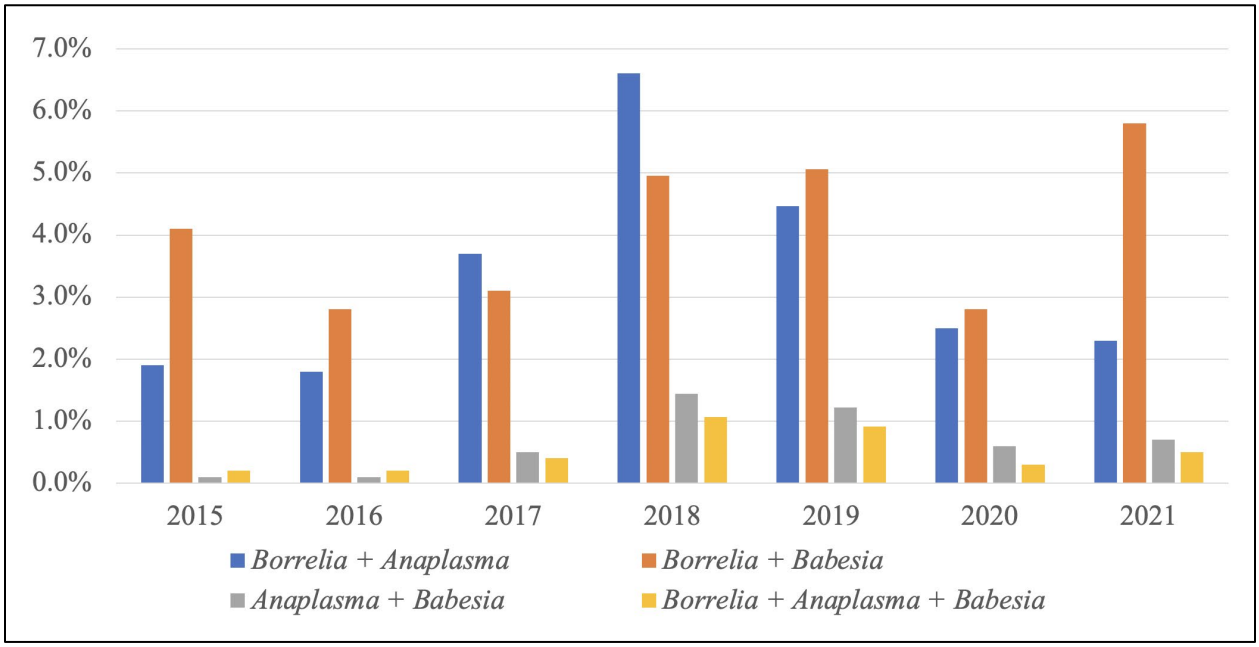
Of 4,196 adult female and nymphal blacklegged ticks screened for evidence of infection with three most prevalent tick-borne pathogens, 1,335 (31.8%) tested positive for *B. burgdorferi*, 189 (4.5%) for *A. phagocytophilum*, and 409 (9.5%) for *B. microti*. A total of 391 ticks were co-infected with two or more pathogens. Co-infection with more than one pathogen in ticks could lead to concurrent human infection with *B. burgdorferi* and *B. microti* or *A. phagocytophilum*, which may complicate diagnosis, lead to insufficient treatment, and increase the severity of disease.



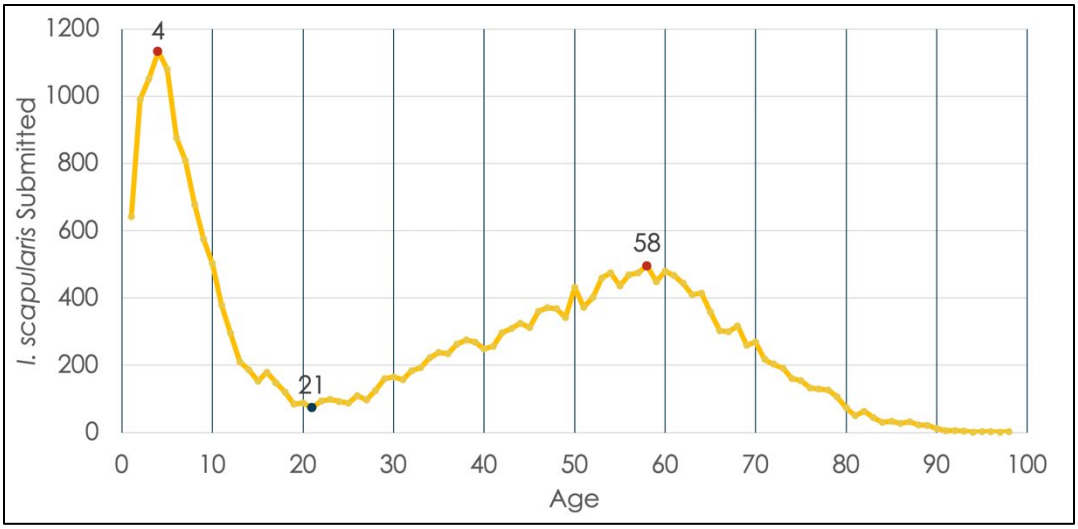
Blacklegged tick infection with Lyme disease pathogen in Connecticut, 2010-2021.



Blacklegged tick infection with pathogens responsible for Lyme disease, Anaplasmosis, and Babesiosis Agents, Connecticut, 2015-2021.



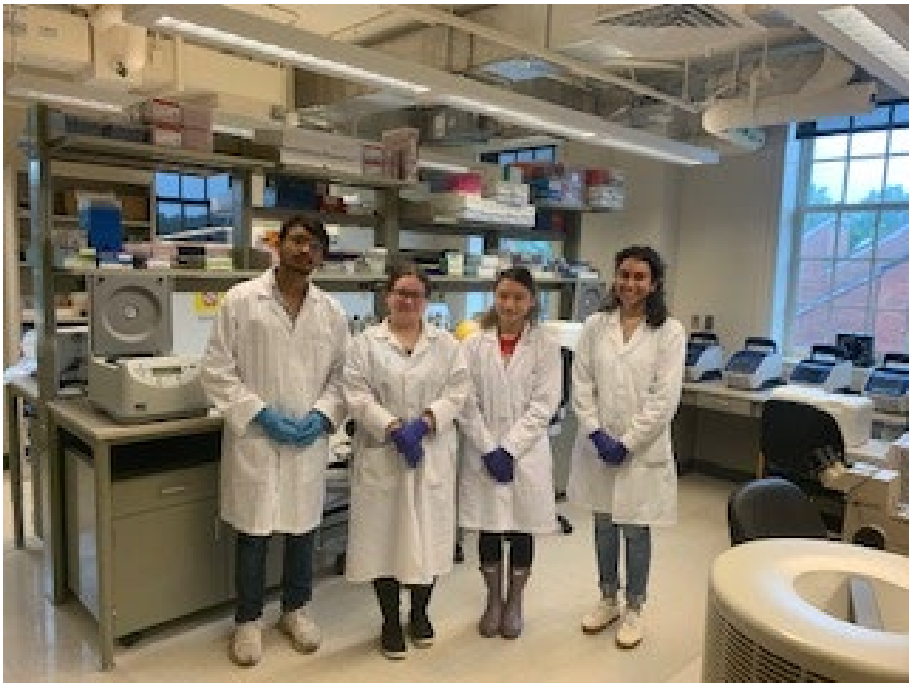
Blacklegged tick co-infection with pathogens responsible for Lyme disease, Anaplasmosis, and Babesiosis, Connecticut, 2015-2021.



Age of human hosts bitten by blacklegged ticks in Connecticut

Impact: Influenced by changes in climatic and other environmental conditions, globalization, and the frequency of trade and travel, it is expected that populations of native tick species will continue to increase, and additional exotic tick species will invade and establish new populations in Connecticut. The increased likelihood of tick interactions with humans and wildlife, in conjunction with the ability of ticks to carry numerous pathogens, highlights the importance of proper surveillance and accurate identification of ticks and tick-borne pathogens to protect human and veterinary health. With the ongoing introduction and establishment of invasive ticks and tick-borne pathogens as well as range expansion of native ticks, it is unclear if and how these changes will alter the tick-borne disease landscape in Connecticut and Northeast.

In addition, within the framework of a passive tick surveillance program, the CAES-TTL continues to monitor the range expansion of native ticks and incursion of invasive ticks in Connecticut. On August 26, 2021, we discovered an established population of the Asian longhorned tick (*Haemaphysalis longicornis*) in New Haven County in addition to reported populations of this tick in Fairfield County in September 2020.



Tick Testing Laboratory Staff 2022. Right to left: Noelle Khalil, Kristy Lok, Morgan Fitch, and Sagar Bhatta.

DEPARTMENT OF ENVIRONMENTAL SCIENCE AND FORESTRY

The Department of Environmental Sciences merged with the Department of Forestry and Horticulture in June 2022. See subheadings for the work conducted in the original departments.

DEPARTMENT OF ENVIRONMENTAL SCIENCES

I. ENVIRONMENTAL CHEMISTRY PROGRAMS

The Environmental Chemistry component of the Department has been involved in research topics dealing with the interactions of pollutants with environmental particles, the bioavailability of pollutants in environmental solids such as soils and sediments, pollution prevention and remediation, natural chemical processes in the environment, and environmental analytical chemistry applied to characterization of pollution, assessment of human exposure, and remediation options. It covers many types of pollutants, including industrial solvents and chemicals, fumigants, insecticides, herbicides, pharmaceutical compounds, personal care products, per- and polyfluoroalkyl substances, engineered nanomaterials, and greenhouse gases.

A. Interactions of Contaminants with Environmental Particles

(Joseph Pignatello)

1. Interaction of a munitions compound with carbonaceous materials through charge-assisted hydrogen bonding (CAHB)
(Joseph Pignatello, Wael Abdelraheem, and external collaborators)

We are testing the hypothesis that especially strong hydrogen bonds, known as (negative) charge-assisted hydrogen bonds, (-)CAHB, contribute significantly to adsorption of weak acid or base pollutants to carbonaceous materials, such as carbons, biochar, and the like. The (-)CAHB is exemplified by structures such as $(–CO_2···H···O_2C–)^–$ and $(–CO_2···H···O–)^–$ that may form between weak acid groups with similar proton affinity reflected in their pKa value. The (-)CAHB is shorter, more covalent, and much stronger than ordinary hydrogen bonds.

We have in the past year gathered evidence that a (-)CAHB may account for the unexpectedly-strong sorptive affinity of the munitions compound, NTO, for the commercial activated carbon, F400. NTO is a highly polar molecule and ionic (pKa = 3.67) at the pH of sorption (pH = 7), and thus not expected to sorb strongly to the carbon, which is hydrophobic. We presume that the (-)CAHB binding occurs through the dissociated form of NTO and carboxylate groups on the carbon which have closely-similar pKa values (~4). The evidence includes a 'hump' in the pH curve of the sorption distribution coefficient near the pKa of NTO that is difficult to explain any other way, and preferential competition sorption by other CAHB-capable solutes over similar compounds that are not capable of forming a CAHB.

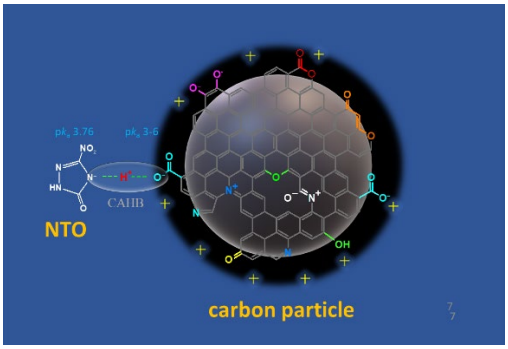
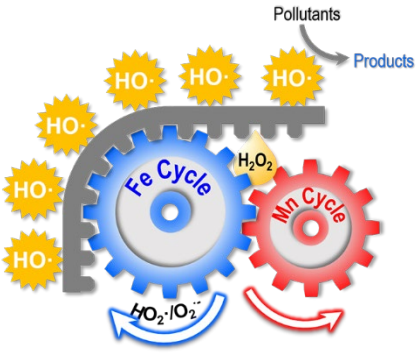


Illustration showing (-)CAHB between NTO and the carboxyl group on a carbon particle. The NTO anion and the carboxylate anion share a hydrogen ion approximately equally.

B. Pollution Remediation
(Joseph Pignatello)

1. The Fenton reaction in water assisted by picolinic acid: Manganese acceleration.
(Joseph J. Pignatello, Zhichao Yang, and researchers from Nanjing University, China)

Fenton and related reactions represent an important and well-studied class of advanced oxidation processes (AOPs) for treating contaminated water. In a study from the previous year we employed the harmless and biodegradable chelating agent picolinic acid (PICA) to address shortcomings of the homogeneous Fenton reaction that has hampered its economical use—namely, the slow rate-limiting reduction of Fe^{III} to Fe^{II} and the requirement for acidic conditions. This year we have shown the ability of low concentrations of Mn^{2+} to accelerate this reaction.

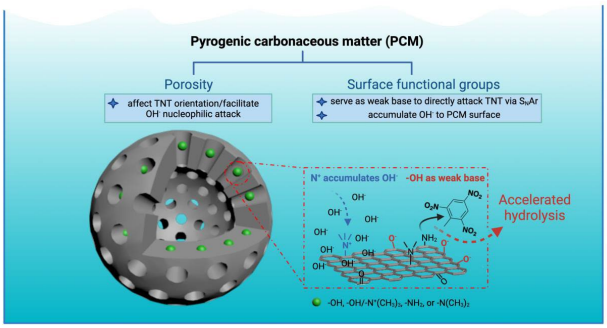


We report a systematic kinetic and spectroscopic investigation into Mn(II) acceleration of atrazine or 2,4,6-trichlorophenol degradation by the PICA-assisted Fenton reaction at pH 4.5–6.0. Mn(II) accelerates Fe(III) reduction, superoxide radical ($HO_2^{\bullet}/O_2^{\bullet-}$) formation, and hydroxyl radical ($HO^{\bullet}$) formation. A Mn(II/III)-H_2O_2 redox cycle as an independent source of reactive oxygen species, as proposed in the literature, is shown to be insignificant. Rather, Mn(II) assists by participating directly and catalytically in the Fe(III)/Fe(II) redox cycle. Initially, Mn(II) (as $Mn^{II}(PICA)^{+}$) reacts with a ferric hydroperoxo species, PICA-Fe^{III}-OOH. The resulting binuclear complex undergoes intra-molecular electron transfer to give Fe(II), which generates $HO^{\bullet}$ from H_2O_2, plus MnO_2^{+}, which decomposes to $HO_2^{\bullet}/O_2^{\bullet-}$ (an Fe(III) reductant) and Mn(II), completing the catalytic cycle. This scheme may apply to other Fenton-type systems that go through an Fe^{III}-OOH intermediate. The findings here will inform the design of practical and sustainable Fenton-based AOPs employing Mn(II) in combination with chelating agents. The results are reported in Yang et al., *Environ. Sci. Technol*, 2022.

2. Base hydrolysis of munitions compounds catalyzed by carbonaceous materials: a mechanistic study.

(Joseph J. Pignatello, with collaborators from Villanova University and Old Dominion University)

In past research we and others have discovered that pyrogenic carbonaceous materials (PCM), such as graphite, biochars and activated carbons, can catalyze or mediate base hydrolysis. To understand what properties of PCM enable its reactivity, we employed PCM-like polymers (PLP) that resemble key PCM attributes. This approach allows us to investigate the role of functional groups and nanopore characteristics individually using 2,4,6-trinitrotoluene (TNT) as a model. Six PLP were synthesized via cross-coupling chemistry with specific functionality (-OH, $-NH_2$, $-N(CH_3)_2$, or $-N^+(CH_3)_3$) and pore characteristics (mesopore, micropore). The results suggest that PCM functionality catalyzed TNT transformation by: (1) serving as a weak base (-OH, $-NH_2$) to attack TNT, or (2) accumulating OH- near PCM surfaces ($-N^+(CH_3)_3$). Additionally, TNT hydrolysis rates, pH and co-ion effects, and products were monitored. Microporous PLP accelerated TNT decay compared to its mesoporous counterpart, as further supported by molecular dynamics modeling results. We also demonstrated that quaternary ammonium-modified activated carbon enhanced TNT hydrolysis. These findings have broad implications for pollutant abatement and catalyst design. The results are reported in Li, et al. *Applied Catalysis B: Environmental,* in press.



3. <u>Removal of sulfuryl fluoride from fumigant vent streams in Quarantine and Pre-Shipment (QPS) fumigation operations.</u>
(Joseph Pignatello and Chengjin Wang with collaborators at USDA-ARS and Stanford University)

Sulfuryl fluoride (SF) is an effective and convenient fumigant for sanitizing agricultural commodities in international trade. However, it is a powerful greenhouse gas and cost-effective methods for removal of spent vapors from fumigation chamber vent streams are urgently needed. Current technology employs alkaline hydrolysis in a spray scrubber to degrade SF,

$SO_2F_2 + 2OH^- \rightarrow FSO_3^- + H_2O + F^-$

However, ordinary base hydrolysis with hydroxide is sluggish and releases only one mole of fluoride, the remaining fluoride being present in fluorosulfate, whose environmental hazard is unknown. In this work in progress, we have investigated the use of hydrogen peroxide in combination with base to remove SF from vent streams. That reaction is faster and releases both fluorides. The final S product (sulfate ion is the likely one) and the fate of hydrogen peroxide are yet to be determined:

$SO_2F_2 + 2OH^- + H_2O_2 \rightarrow SO_4^{2-}$ (?) $+ 2H_2O + 2F^-$ + (?)

The F^- ions can be removed by precipitation with Ca salts or lime. A preliminary patent has been assigned and a full patent application is in preparation.

C. Nutrient Removal and Recycling.

(Joseph Pignatello)

1. Design of carbonaceous materials for phosphate delivery.
(Joseph Pignatello, Philip Wang, Wade Elmer, Tyler Swanson, and Alex Waller)

The conventional use of soluble phosphate fertilizer in agriculture represents a drain on a diminishing global supply and is a major nonpoint source of phosphorus pollution to water bodies. In past studies, we have modified carbons to greatly increase adsorption of phosphate. These include 1) a biochar doped with nano-scale coatings or particles of magnesium oxide (MgO) that bind phosphate by coordination with Mg, and 2) a biochar irreversibly adsorbed with the quaternary ammonium polymer, poly(diallyldimethylammonium) chloride (pDADMAC), which binds phosphate by anion exchange.

In FY 2022 both the MgO and the pDADMAC chars underwent testing for their ability to act as a bioavailable, yet non-leachable source of phosphate P to crop plants, here Dragoon lettuce. Also tested was the hypothesis that bioavailability is facilitated by arbuscular mycorrhizal fungi (AMF), which are known to be capable of "mining" P from soil particles and conveying it to plant roots in exchange for sugars and other C nutrients from the plants.

The potting soil (SS) was a pre-sterilized mixture of fine sand and peatmoss, fertilized at each watering event with half-strength Hoagland's macro/micro nutrient solution absent phosphate. Phosphate or AMF were added to certain pots. The biochar materials were mixed with SS at 0.02 or 0.03 g carbon per g SS. In trial 1, MgO-BC pre-loaded with phosphate (P-MgO-BC) and MgO-BC plus soluble phosphate (MgO-BC + P) performed equally well and dramatically out-performed the controls with respect to both lettuce growth and reduction of P leaching. In trial 2, pDADMAC-BC pre-loaded with phosphate (P-pDADMAC-BC) and pDADMAC-BC + P performed equally well and greatly outperformed controls, as well as P-MgO-BC and MgO-BC + P at two-thirds concentration. The controls included SS alone or SS together with: soluble P (added once at the start or with every watering); BC with or without P; MgO-BC; and crushed dolomite, a phosphate containing mineral. AMF added to the soil in some sets affected root:shoot ratio but otherwise had little impact. The results show that the tested modified biochars can greatly reduce P leaching while providing a bioavailable source of P for crop growth.

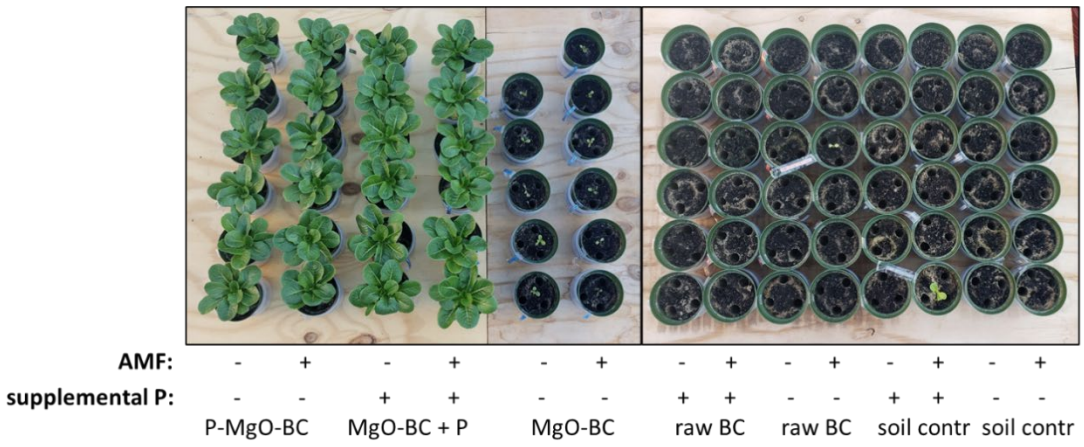


Figure 1. Outcome of Trial 1 showing that only pots containing MgO-BC pre-loaded with phosphate (P-MgO-BC) or pots containing MgO-BC supplemented with phosphate (MgO-BC + P) supported significant lettuce growth in 6 weeks.

D. Chemistry of the Environment

(Joseph Pignatello, Itamar Shabtai)

1. <u>Charge-assisted hydrogen bonding as a cohesive force in dissolved terrestrial organic matter</u>.
(Joseph Pignatello, Philip Wang, and Hiro Murano from Meijo University, Japan)

Naturally occurring organic matter (OM) is a heterogeneous mixture of molecules derived from the degradation of lignin, cellulose, lipids, proteins and other biological polymers. These molecules have different masses, charges, properties, and reactivities. Because OM is ubiquitous in aquatic and terrestrial waters and soils, it plays critical roles in the biogeochemical cycling of carbon, carbon storage, the physical and chemical properties of soil, soil microbial activity, soil structure, mineral weathering, nutrient availability to plants, and the fate and transport of anthropogenic compounds. Solid and adsorbed forms of OM ("SOM") strongly influence soil formation and structure, biological activity, mineral dissolution, metal-ion sequestration, redox reactions, and pH buffering, which are all related to soil health.

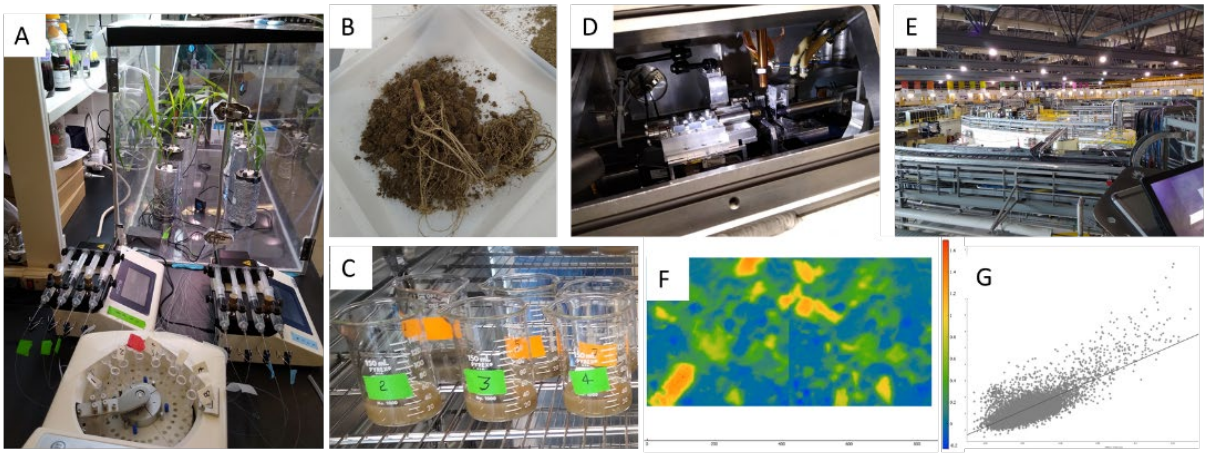
Weak bonds between molecular segments and between separate molecules of natural organic matter (OM) govern its solubility, adsorption, supramolecular association in solution, and complexation with metal ions and oxides. We are testing the hypothesis that especially strong hydrogen bonds, known as (negative) charge-assisted hydrogen bonds, (-)CAHB, contribute significantly to OM cohesion. The (-)CAHB is exemplified by structures such as $(–CO_2\cdots H\cdots O_2C–)^-$ and $(–CO_2\cdots H\cdots O–)^-$. It may form between weak acids with similar proton affinity, and is shorter, more covalent, and much stronger than ordinary hydrogen bonds. Previous published work in the group has shown that disruption of such bonds can result in increased water solubility of SOM and increased sorption of acidic pollutants to carbonaceous solids that have acidic groups on their surfaces capable of undergoing (-)CAHB. In the past year we have studied dissolved organic matter (DOM) using Suwanee River Humic Acid and Suwanee River Fulvic Acid as OM reference standards.

DOM is important in a myriad of biotic and abiotic environmental processes. The current 'supramolecular' paradigm of DOM holds that entities are aggregates of smaller molecules held together by weak forces. However, the forces holding DOM supramolecular aggregates are not well understood. We conducted experiments on aqueous solutions of Suwanee River humic and fulvic acids (HA and FA) to probe these forces. DOM aggregates appear to be substantial in size, failing to leak over many days through membranes of nominal molecular-weight cutoff up to 3.5 kDa (FA) or 8 kDa (HA). Moreover, molecular weight distribution or aggregate size is insensitive to DOC concentration (10x range), pH (6-7), and ionic strength (0.1-1.6 M), suggesting that intra-aggregate forces are substantial. We provide evidence for the intra-aggregate formation of exceptionally strong, charge-assisted hydrogen bonds (CAHB) between acidic groups on DOM (e.g., $-CO_2H$ groups), a portion of which help stabilize the aggregate. Furthermore, we show that DOM groups can form CAHBs with added weak acids have similar pK_a and thus capable of forming CAHB (e.g., formate, acetate, phosphate). Some of the CAHB compete for intra-aggregate CAHB links and therefore promote DOM disaggregation. Evidence for intra-aggregate CAHB formation includes the following: *i*) We observe a shift in the UV size exclusion chromatogram of HA to higher retention time (i.e., lower molecular weight distribution) after adding phosphate or acetate at controlled pH of 5 or 6. *ii*) A 'hump' appears in the zeta potential-pH curve of DOM centered at pH 5-6, consistent with loss of negative charge through intra-aggregate CAHB formation: i.e., ♒-CO_2^- + ♒-CO_2^- + H^+ → (♒-$CO_2^-\cdots H^+\cdots {}^-O_2C$-♒), where ♒ represents the DOM material. This hump persists in the presence of non-CAHB forming molecules such as DMSO or methanol, but disappears when a CAHB-capable ion, acetate or phosphate, is present. *iii*) Leakage of HA or FA through a dialysis membrane is accelerated upon addition of phosphoric or acetic acids, consistent with disruption of aggregate cohesion and formation of smaller molecules. *iv*) Starting at pH 6, an increase in pH is observed after addition of weak acid anions XO^- consistent with CAHB formation of free carboxyl groups with the added anion: i.e., ♒-CO_2^- + XO^- + H_2O → ♒-$CO_2^-\cdots H^+\cdots {}^-OX$ + OH^-.

2. <u>Organo-mineral interactions in the water-stressed rhizosphere: leveraging isotope pulse labeling and synchrotron-radiation spectromicroscopy</u>.

(Itamar Shabtai and scientists from Cornell University)

The rhizosphere is a hotspot for soil organic carbon (SOC) input and biological activity. Plants modify the amount and composition of root exudates to adapt to, and alter, the root-zone environment in response to stress, such as low water availability. Since exudates provide fuel for microbial activity, a change in exudation pattern is likely to impact rhizosphere SOC cycling and persistence. However, there is little information on how root-zone conditions might impact exudation patterns, and subsequently rhizosphere SOC dynamics. We hypothesized that water-stress will decrease microbial activity and increase exudation, resulting in a greater proportion of exudate C interacting with minerals vs mineralized and assimilated by microbes. To address this gap in knowledge, we grew maize in soil (and control sand pots) under well-watered and water-stressed conditions and pulse-labeled the plants with $^{13}CO_2$ to trace the root exudate C in the soil. Using micro-dialysis probes installed in the rhizosphere, we sampled the root-zone pore solution at timed increments to evaluate exudation amount, composition, and temporal dynamics. Post-labeling, we isolated the clay-sized fraction from well-watered and water-stressed rhizospheres and investigated the chemical and spatial characteristics of the organo-mineral interactions using synchrotron radiation spectromicroscopy (STXM-NEXAFS and FTIR). Our results show very rapid (<2 hours) allocation of $^{13}CO_2$ into the rhizosphere pore water due to exudation and a marked diurnal exudation pattern. Preliminary findings show a close spatial relationship between carboxylic acids and clay minerals in the rhizosphere soil, indicating that root exudates maybe directly adsorbed onto minerals surfaces. Integrating our full findings from ^{13}C tracing and spectromicroscopy will enable us to better understand the relationship between abiotic conditions, exudation, and rhizosphere C dynamics.



Experimental overview: (A) Maize plant in isotope labeling chamber. (B) Collecting rhizosphere soil. (C) Isolation of clay-sized soil particles. (D) The STXM-NEXAFS endstation at the (D) Canadian Light Source synchrotron (E). (F) Chemical imaging showing abundance of carboxylic acid groups. (F) Plot showing the statistical association between carboxylic acids and clay minerals.

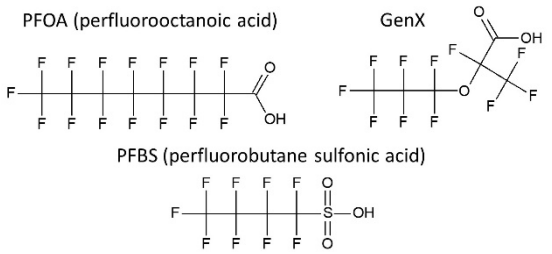
E. Applied Environmental Analytical Chemistry
(Sara L. Nason)

The Applied Environmental Analytical Chemistry program is an interdepartmental effort between Environmental Sciences and Analytical Chemistry. We focus on developing and testing methods for analyzing environmental contaminants in samples and on applying our methods to field samples and studies that characterize pollution, assess human exposure to contaminants, and investigate contaminant remediation options. Our emphasis is on organic chemical contaminants and our primary analytical technique is liquid chromatography coupled with high resolution mass spectrometry (LC-HRMS) We currently have several projects that focus specifically on per- and polyfluoroalkyl substances (PFAS) and several others that focus more broadly on contaminants in wastewater related matrices. We also have work that is more broadly focused on expanding usage of high-resolution mass spectrometry and non-targeted analysis within the broader analytical community.
1. Per- and Polyfluoroalkyl Substances

Per- and polyfluoroalkyl substances (PFAS) are a widespread, emerging class of highly toxic environmental contaminants. PFAS are a key ingredient in aqueous film forming foam (AFFF), used for fighting fires, and have been used in consumer products, such as waterproof and stainproof coatings, Teflon pans, and car waxes, since the 1940s. They are very persistent in the environment as their chemical structure is based on extremely strong the carbon-fluorine bonds. While PFAS are not currently regulated at the federal level, an increasing number of states (including Connecticut) are defining their own limits for PFAS in drinking water, groundwater, and other matrices. Good methods for measuring PFAS and for removing PFAS from the environment will be necessary as knowledge about and regulation of these chemicals increases. We participated in a PFAS Symposium at Yale University in December 2019 that provided an overview of current research on PFAS. A literature review-based summary of the symposium was published in *Science of the Total Environment* (Hagstrom et al., 2021).

a) FluoroMatch: novel software for non-targeted analysis of PFAS in environmental samples.
(Sara Nason and collaborators from Yale, the University of Florida, and others)

Over 7,500 PFAS exist, but analytical standards are available for less than 2% of compounds, complicating their analysis. Therefore, approaches such as non-targeted analysis using liquid chromatography coupled with high resolution tandem mass spectrometry (LC-HRMS/MS) are necessary for complete sample characterization. Typically, data processing for this type of analysis is a slow and complicated process. We developed, released, and validated FluoroMatch: a new open source, vendor neutral software program for annotating PFAS in LC-HRMS/MS data. Our software is an important new resource for making this type of analysis more effective and accessible than previous approaches. The initial publication on FluoroMatch (Koelmel et al., 2020, *Analytical Chemistry*) introduces the software and a second (Nason et al., 2020, *Journal for the American Society of Mass Spectrometry*) provides a comparison of the new software to an established non-targeted analysis program. A third publication, released this year, introduces a new version of FluoroMatch with increased functionality (Koelmel et al., 2022, *Analytical and Bioanalytical Chemistry*). We are using this software to conduct data analysis in several of our other projects on PFAS.



Chemical structures of three common PFAS

b) Phytoremediation of PFAS at the former Loring Air Force Base.
(Sara Nason, Nubia Zuverza-Mena, and collaborators)

The use of Aqueous Film-Forming Foams (AFFFs) has caused widespread contamination with PFAS in areas that have been used for fire-fighter training. Such is the case at the Burn House site of the former Loring Air Force Base in northern Maine, USA (pictured), where the land now belongs to the Aroostook band of the Micmac nation. PFAS have been dubbed "forever chemicals" as they are extremely persistent in the environment, and exposure to PFAS has been linked to cancer and other diseases.

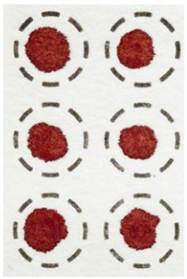
The Burn House at the former Loring Airforce Base.

A group of concerned citizens is attempting phytoremediation at the Burn House site in an attempt to reduce the contamination levels, and we are assisting them with assessing the effectiveness of their efforts. So far, we have determined that perfluorooctane sulfonic acid (PFOS) is the primary PFAS contaminant at the site and have detected a total of 68 PFAS in the soil. Soil samples from this site were used for testing FluoroMatch software (described above).

In summer of 2019, we conducted a pilot study testing the use of industrial hemp plants for PFAS phytoremediation and found that 4 out of 19 quantified PFAS decreased in soil over the course of the growth season, with an additional 5 PFAS showing some evidence of decrease in soil. We detected 8 PFAS in hemp tissue, including PFOS. Continued work in 2020 showed decreases in PFOS levels in two hemp growth plots. Hemp is a promising plant for phytoremediation due to its large size, fast growth rate, and high water usage. This work was featured in a backstory

article for the journal *iScience* that included interviews with community members involved with the work (Nason et al., 2021, *iScience*). We are currently conducting a third season of field work where multiple varieties of hemp are being tested for phytoremediation efficacy in collaboration with the Berger Lab from the University of Virginia. Additionally, we are making plans for expanded collaboration to explore methods for degrading PFAS that are taken up by the hemp plants

c) Measuring PFAS to assess human exposure.
(Sara Nason and collaborators from the Yale School of Public Health)



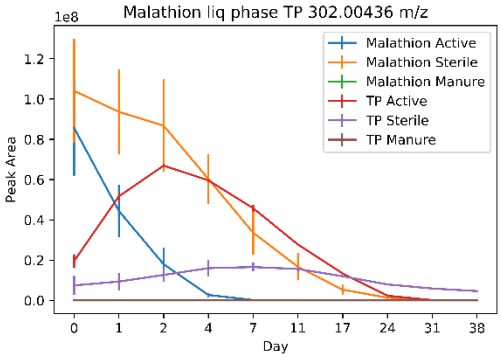
Dried blood spots

While PFAS have been in use for decades, we have only recently become aware of their potential health impacts. Therefore, PFAS contamination is extremely widespread, but there are not yet standardized methods for measuring them in most sample matrices. We worked to develop methods (including sample preparation, instrumental analysis, and data processing) for measuring PFAS in dried blood spots and whole blood samples. As PFAS have only recently become a health concern, we do not have long-term records human exposure. However, long term blood spot archives exist, and could be an important resource for characterizing historic human exposures. Method development has been completed, and a methods-based manuscript is in preparation. We are actively working with samples from multiple study cohorts for projects focused on links between PFAS levels and cancer and other diseases.

2. Organic Microcontaminants (OMCs) in wastewater and related matrices.

a) Contaminant transformation during anaerobic digestion
(Sara Nason and collaborators at Johns Hopkins University)

Anaerobic digestion is a common strategy used to produce biogas from waste materials from both farms and wastewater treatment plants. While many organic microcontaminants (OMCs) are present in the sludge and manure used for digestion, we know little about the fate of these chemicals. Digestate is often land applied to agricultural fields, so contaminants and toxic transformation products not destroyed during digestion may reach soil, groundwater, or crop plants intended for human or animal consumption. We designed experiments to examine the transformation of contaminants during anaerobic digestion. Our work has focused on veterinary drugs and pesticides that are likely to be present in digestion in agricultural areas. We found that 11 out of 20 tested compounds degraded biotically or abiotically during anaerobic degradation and identified 47 transformation products. A publication featuring this work is currently in review.



Graph showing degradation of malathion and the formation of a transformation product with a mass to charge ratio of 302.00436 in both active digestion samples and sterile controls.

b) Assessing the impacts of reclaimed wastewater reuse for agricultural irrigation.
(Sara Nason, Nubia Zuverza-Mena, and collaborators from the University of Maryland Baltimore County)

Water scarcity is a problem throughout the modern world and is expected to increase as human population expands and climate change intensifies. Wastewater effluent reuse for agricultural irrigation is an important strategy to reduce demand from surface and ground water sources and is gaining momentum as obtaining freshwater from other sources becomes more difficult. While an important strategy for combating water scarcity, wastewater reuse for agriculture is not without risks. Wastewater effluent can contain higher levels of bacteria, heavy metals, salts, and other contaminants than conventional water sources. Specifically, there is increasing concern over organic microcontaminants (OMCs) such as pharmaceuticals, pesticides, and endocrine disrupting compounds that may be taken up into irrigated crop plants. Our work in in the past year focused on assessing how rain events affect the chemical profile of reclaimed wastewater. We developed a sampling protocol for collecting wastewater during rain events and corresponding dry periods that will enable us to determine the impacts of storm water infiltration on contaminant presence in wastewater effluent. We also conducted a pilot scale sampling campaign that included a major storm event in New Haven, CT in summer 2021. Preliminary results show that most inorganic elements measured were stable over time during dry weather, but had lower concentrations when there was extended stormwater infiltration. This group included sodium, potassium, calcium, magnesium, sulfur, boron, and silicon. Other elements such as phosphorus, iron, and zinc had greater variability not explained by weather. These results indicate that our sampling method is sufficient to investigate weather driven differences in wastewater effluent. We presented this data at the 2021 SETAC North America conference. A larger sampling campaign is underway in 2022.

CAES researchers visit the New Haven Water Pollution Control Authority.

c) Chemical trends in wastewater sludge during the COVID-19 pandemic.
(Sara Nason, Brian Eitzer, and collaborators at Yale)

Many organic microcontaminants (OMCs) are present in wastes that enter wastewater treatment plants. OMCs include chemicals from many different sources such as pharmaceuticals, personal care products, pesticides, and illicit substances. The use of many of these chemicals was affected by the COVID-19 pandemic. The Peccia Lab at Yale began collecting primary sludge samples from the New Haven Water Pollution Control Authority on March 19, 2020 – shortly before the stay-at-home order began in Connecticut. While the initial purpose of these samples was to analyze virus concentrations, we used the extra material to conduct analysis of OMCs and assess trends in their levels over the course of the pandemic and shutdown. The sampling time period for our analysis was March 19 to June 30, 2020.

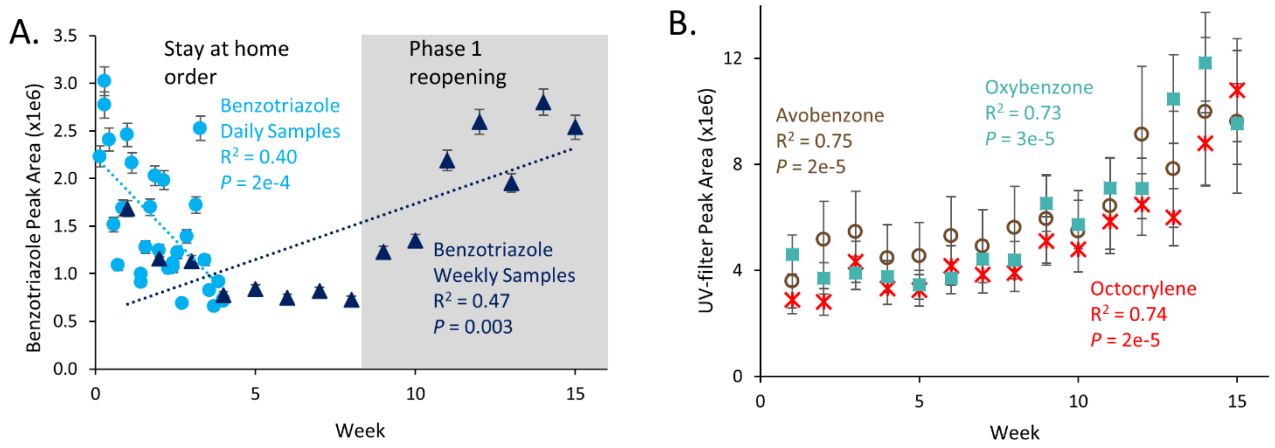
We identified 78 chemicals of interest in sludge samples, which included pharmaceuticals, illicit drugs, disinfectants, ultraviolet (UV) filters, and others. We analyzed trends over time for the identified chemicals using linear trend analyses and multivariate comparisons. We found trends related directly to the pandemic. For example, hydroxychloroquine, a drug publicized for its potential to treat COVID-19, had elevated concentrations in the week following the implementation of the US Emergency Use Authorization. We also saw increasing trends for several antidepressants, opioids, and cocaine. Some trends we observed were caused seasonal changes in chemical use, for example, increases for three UV-filter compounds used in sunscreens. Benzotriazole, an anticorrosive chemical used in cars, showed a steep decrease during the state-wide stay-at-home order, and increased again during Phase 1 reopening. We hypothesize that these changes are due to decreased vehicle traffic during the shutdown. These results are published in *Environmental Toxicology and Chemistry* by Nason et al., 2022 (Part 1).

Additionally, we conducted non-targeted analysis on the sludge samples to identify molecules whose levels correlate with COVID-19 metrics including viral RNA levels in sludge, local case numbers, and hospitalizations. We identified three potential indicator molecules for prioritization in future studies on COVID-19 biomarkers in sewage sludge. These results are published in *Environmental Toxicology and Chemistry* by Nason et al., 2022 (Part 2).

3. Expanding usage of high-resolution mass spectrometry and non-targeted analysis
(Sara Nason, Brian Eitzer, and collaborators at US FDA, US EPA, and others)

We participated in a multi-lab method validation study for detecting pesticides in food samples using non-targeted data collection methods with high resolution mass spectrometry. 25 laboratories participated internationally, and the method test included over 50 pesticides. The method is likely to be expanded in the future and represents a step forward in the technology used for pesticide screening and regulatory analysis. This methods research was published in *The Journal of Agricultural and Food Chemistry* by Wong et al., 2021.

Nason participates in the Benchmarking and Publications for Non-Targeted Analysis working group, which focuses on addressing challenges in non-targeted analysis using high resolution mass spectrometry. She serves as one of the webmasters for the group. This year, we published substantial web content on our site (nontargetedanalysis.org) including multiple pages of reference content describing study design, methodologies, and QA/QC metrics for non-targeted analysis work. The content is based on review of current literature and expertise from group members and is an extremely valuable resource for the mass spectrometry community. The website and other working group activities are featured in a publication in *Analytical Chemistry* by Place et al., 2021. Nason is also involved in ongoing research regarding stakeholder engagement with non-targeted analysis methods and the development of resources to make this novel analytical method accessible to more potential users.



A. Benzotriazole levels in sewage sludge decreased during the stay-at-home order and increased again during phase 1 reopening. We hypothesize that this is due to changes in vehicle traffic. B. Levels of three UV-filter chemicals increased during our sampling period. We hypothesize that this is due to increasing amounts of sunscreen use between March and June.

II. MOSQUITO PROGRAM

A. Mosquito Trapping and Testing Program

(Philip M. Armstrong, John Shepard, Tanya Petruff, Michael Misencik, Angela Bransfield, and Andrea Gloria-Soria)

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. Experiment Station scientists and technicians monitor mosquitoes and eastern equine encephalitis (EEE) and West Nile virus (WNV) activity at 108 locations throughout Connecticut from June-October. The objectives of the surveillance program are to provide: 1) early evidence of local virus activity; 2) information on the abundance, distribution, identity and infection rates of potential mosquito vectors and; 3) information that is used to assess the threat of WNV and EEE to warn the public and guide the implementation of disease prevention and control measures. The CAES is responsible for conducting all mosquito trapping and testing activities.

In 2021, statewide mosquito trapping was conducted from June 1 through October 15. Approximately one-third of the sites were located in densely populated residential locales along an urban/suburban corridor in the coastal southwestern corner of the state extending up through the Connecticut River Valley. Trap sites typically included parks, greenways, golf courses, undeveloped wood lots, sewage treatment plants, dumping stations, and temporary wetlands associated with waterways. Trapping locations in the other regions of the state were established in more sparsely populated rural settings that included permanent fresh-water swamps (red maple/white cedar) and bogs, coastal salt marshes, horse stables, and swamp-forest border environs.

Mosquito trapping was conducted with CO_2 (dry ice)-baited CDC miniature light traps equipped with aluminum domes, and gravid mosquito traps baited with a lactalbumin-yeast-hay infusion. Traps were placed in the field in the afternoon, operated overnight, and retrieved the following morning. Trapping frequency was minimally made once every ten days at each trap site over the course of the entire season. Adult mosquitoes were transported alive to the laboratory each morning in an ice chest lined with cool packs. Mosquitoes were immobilized with dry ice and transferred to chill tables where they were identified to species with the aid of a stereo microscope (90X) based on morphological characters. Female mosquitoes were pooled in groups of 50 or fewer by species, collection date, trap type, and collection site and stored at -80°C until processed for virus.

Aliquots of each mosquito pool were inoculated into Vero cell cultures for detection of West Nile virus (WNV), eastern equine encephalitis (EEE), and other mosquito-borne arboviruses of public health importance. Isolated viruses were identified by Real Time (TaqMan) reverse transcriptase polymerase chain reaction (RT-PCR) or standard RT-PCR using virus-specific primers. All of the virus isolation work was conducted in a certified Bio-Safety Level 3 laboratory at The CAES.

During 2021, a total of 384,913 mosquitoes representing 21,932 pools were trapped and tested for arboviruses. West Nile virus was isolated from 208 pools, obtained from 10 species: *Culex pipiens* = 118, *Cx. restuans* = 55, *Cx. salinarius* = 8, *Culiseta melanura* = 8, *Psorophora ferox* = 8, *Aedes cinereus* = 6, *Ochlerotatus trivittatus* = 2, *Ae. vexans* = 1, *Oc. japonicus* = 1, and *Uranotaenia sapphirina* = 1. WNV isolates obtained from 50 trapping sites in 43 towns located among all eight counties. The first WNV positive mosquitoes were collected on June 21 and the last on October 18. The majority of WNV virus activity was detected in densely populated urban and suburban regions in Fairfield, Hartford and New Haven counties. Six human cases of WN virus-associated illness were reported (4 neuroinvasive, 2 fever), with no fatalities reported. Dates of onset of symptoms ranged from August 20 to October 14. Patients ranged from 35 to 77 years of age. All human cases were locally acquired, with no out of state travel reported.

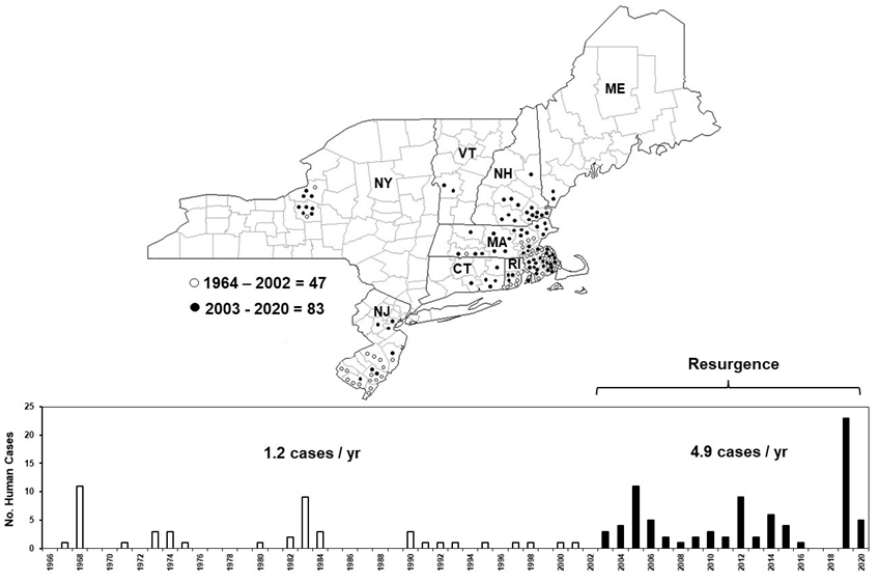
Eastern Equine encephalitis was isolated from two mosquito pools: *Cs. melanura* = 1 and *Oc. canadensis* = 1, from a single trap location in Voluntown collected on September 23. There were no EEE infections reported in humans or equines. Other mosquito-borne viruses isolated included: Jamestown Canyon virus = 18 isolates from 10 species (June 2 -September 21), Cache Valley virus = 41 isolates from 11 species (August 4 – October 13), Highlands J virus = 15 isolates from 6 species (August 16 – October 14), Trivittatus virus = 6 isolates from 1 species (July 21– September 13), and Flanders virus = 1 isolate from 1 species (August 31).

Impact: Participation in the statewide surveillance program provides timely information about levels of virus activity in the mosquito population which is used to monitor virus amplification within enzootic transmission cycles and assess risk of human infection. This information is used to inform the public and health care providers of these risks, guide disease prevention and mosquito control efforts, and prevent disease outbreaks. In addition, this large-scale sampling effort also informs our understanding of the ecology of mosquitoes and mosquito-borne viruses. Additional studies on the role of different mosquito species to serve as vectors of viral pathogens may be used to target anti-vector interventions more effectively.

B. Population Genetics of Mosquitoes and Epidemiology of Mosquito-borne Viral Diseases

1. Ecology and epidemiology of eastern equine encephalitis virus in the northeastern United States: an historical perspective.

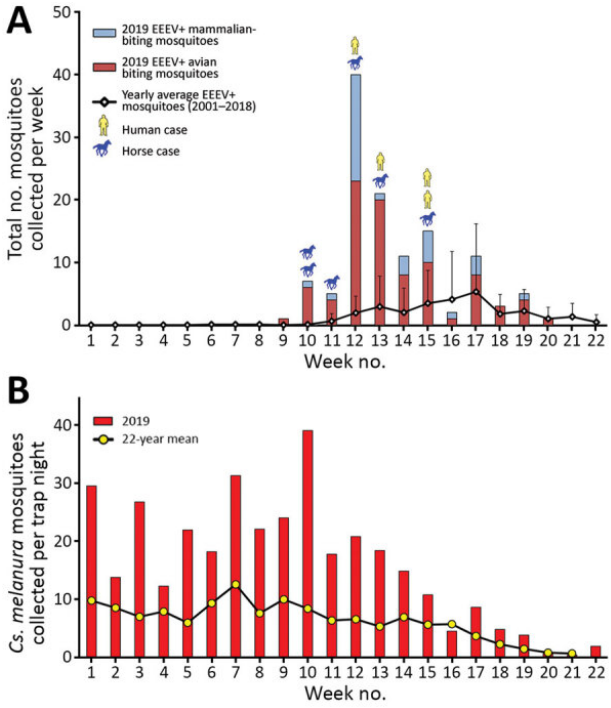
(Philip Armstrong and Theodore Andreadis)



We examined the regional history, ecology, and epidemiology of eastern equine encephalitis virus (EEEV) to investigate the major drivers of disease outbreaks in the northeastern United States. EEEV was first recognized as a public health threat during an outbreak in eastern Massachusetts in 1938, but historical evidence for equine epizootics date back to the 1800s. Since then, sporadic disease outbreaks have reoccurred in the Northeast with increasing frequency and northward expansion of human cases during the last 20 yr. *Culiseta melanura* (Coquillett) (Diptera: Culicidae) serves as the main enzootic vector that drives EEEV transmission among wild birds, but this mosquito species will occasionally feed on mammals. Several species have been implicated as bridge vectors to horses and humans, with *Coquillettidia perturbans* (Walker) as a leading suspect based on its opportunistic feeding behavior, vector competence, and high infection rates during recent disease outbreaks. A diversity of bird species are reservoir competent, exposed to EEEV, and serve as hosts for Cs. melanura, with a few species, including the wood thrush (*Hlocichia mustelina*) and the American robin (*Turdus migratorius*), contributing disproportionately to virus transmission based on available evidence. The major factors responsible for the sustained resurgence of EEEV are considered and may be linked to regional landscape and climate changes that support higher mosquito densities and more intense virus transmission.

2. Four human cases of eastern equine encephalitis in Connecticut, USA, during a larger regional outbreak, 2019

(Philip Armstrong and collaborators from Yale University)



During three weeks in 2019, four human cases of Eastern equine encephalitis (EEE) were diagnosed at a single hospital in Connecticut, USA. The cases coincided with notable shifts in vector–host infection patterns in the northeastern United States and signified a striking change in EEE incidence. All four cases were geographically clustered, rapidly progressive, and neurologically devastating. Diagnostic tests conducted by a national commercial reference laboratory revealed initial granulocytic cerebrospinal fluid pleocytosis and false-negative antibody results. EEE virus infection was diagnosed only after patient samples were retested by the arbovirus laboratory of the Centers for Disease Control and Prevention in Fort Collins, Colorado, USA. The crucial diagnostic challenges, clinical findings, and epidemiologic patterns revealed in this outbreak can inform future public health and clinical practice.

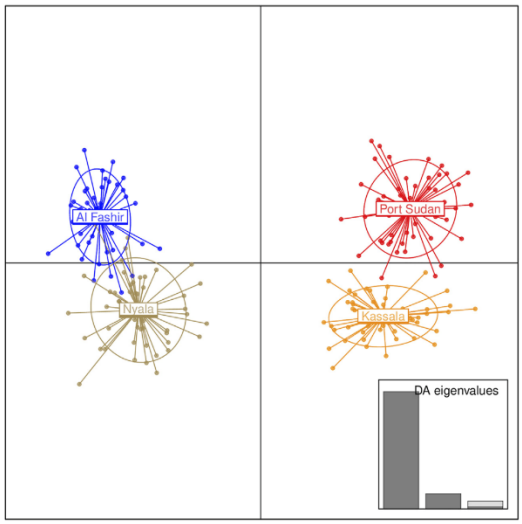
3. Seasonal Dynamics of Mosquito-Borne Viruses in the Southwestern Florida Everglades, 2016, 2017.
(John Anderson, Philip Armstrong. Michael Misencik, Angela Bransfield, Frank Ferrandino, Theodore Andreadis)

Mosquitoes were collected for 12 consecutive months beginning June 2016, from 11 locations in the Florida Everglades, Collier County, and tested for viruses by isolation in Vero cells and subsequent identification. One species complex and 31 species of mosquitoes were identified from 668,809 specimens. *Ochlerotatus taeniorhynchus* comprised 72.2% of the collection. Other notable species were *Anopheles crucians* complex, *Culex nigripalpus*, *Cx. erraticus*, and *Cx. cedecei.* Seven species of virus were identified from 110 isolations: Everglades, Gumbo Limbo, Mahogany Hammock, Pahayokee, Shark River, Tensaw, and West Nile viruses. Everglades, West Nile, Tensaw, and Mahogany Hammock viruses were most frequently isolated. Largest numbers of viruses were identified from *Cx. cedecei*, *Cx. nigripalpus*, and *An. crucians* complex. Five species of virus were isolated from *Cx. cedecei*. Viruses were isolated from mangrove, cypress swamp, hardwood hammock, and sawgrass habitats. West Nile virus was isolated August through October when *Cx. nigripalpus* was most abundant. Everglades virus was the most frequently isolated virus from nine species of mosquitoes collected from June through August. Tensaw virus was isolated primarily from Anopheles species. Isolations were made in July, August, January, February, and April, suggesting that this virus may be present in host-seeking mosquitoes throughout the year. Mahogany Hammock, Shark River, Gumbo Limbo, and Pahayokee viruses were isolated primarily from *Cx. cedecei* from June through December. Shotgun metagenomic sequencing was used to document that seven pools of *Cx. cedecei* were infected with two arboviruses. As communities expand into the Everglades, more humans will become exposed to arboviruses.

4. Recent Independent Colonization Events of *Aedes aegypti* Mosquitoes From Sudan.
(Andrea Gloria-Soria in collaboration with colleagues from the University of Khartoum, Sudan)

Increases in arbovirus outbreaks in Sudan are vectored by *Aedes aegypti,* raising the medical importance of this mosquito. We genotyped 12 microsatellite loci in four populations of *Ae. aegypti* from Sudan, two from the East and two from the West, and analyzed them together with a previously published database of 31 worldwide populations to infer population structure and investigate the demographic history of this species in Sudan. Our results revealed the presence of two genetically distinct subspecies of *Ae. aegypti* in Sudan. These are *Ae. aegypti aegypti* in Eastern Sudan and *Ae. aegypti formosus* in Western Sudan. Clustering analysis showed that mosquitoes from East Sudan are genetically homogeneous, while we found population substructure in West Sudan. In the global context our results indicate that Eastern Sudan

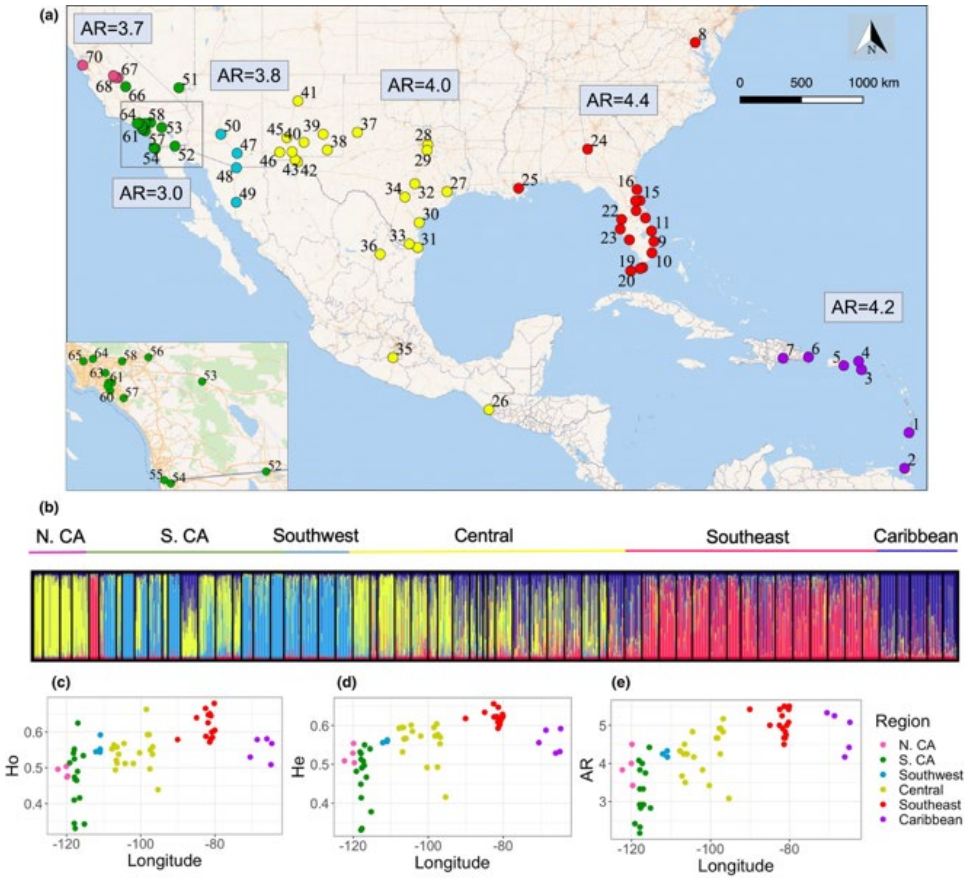
populations are genetically closer to Asian and American populations, while Western Sudan populations are related to East and West African populations. Approximate Bayesian Computation Analysis supports a scenario in which *Ae. aegypti* entered Sudan in at least two independent occasions nearly 70–80 years ago.



Impact: This study provides a baseline database that can be used to determine the likely origin of new introductions for this invasive species into Sudan. The presence of the two subspecies in the country should be consider when designing interventions, since they display different behaviors regarding epidemiologically relevant parameters, such as blood feeding preferences and ability to transmit disease.

5. Serial founder events during the colonization of North America by the yellow fever mosquito, *Aedes aegypti*.
(Andrea Gloria-Soria in collaboration with Evie E. Pless and Jeffrey Powell (Yale))

The *Aedes aegypti* mosquito first invaded the Americas about 500 years ago and today is a widely distributed invasive species and the primary vector for viruses causing dengue, chikungunya, Zika, and yellow fever. Here, we test the hypothesis that the North American colonization by *Ae. aegypti* occurred via a series of founder events. We present findings on genetic diversity, structure, and demographic history using data from 70 *Ae. aegypti* populations in North America that were genotyped at 12 microsatellite loci and/or ~20,000 single nucleotide polymorphisms, the largest genetic study of the region to date. We find evidence consistent with colonization driven by serial founder effect (SFE), with Florida as the putative source for a series of westward invasions. This scenario was supported by (1) a decrease in the genetic diversity of *Ae. aegypti* populations moving west, (2) a correlation between pairwise genetic and geographic distances, and (3) demographic analysis based on allele frequencies. A few *Ae. aegypti* populations on the west coast do not follow the general trend, likely due to a recent and distinct invasion history. We argue that SFE provides a helpful albeit simplified model for the movement of *Ae. aegypti* across North America, with outlier populations warranting further investigation.



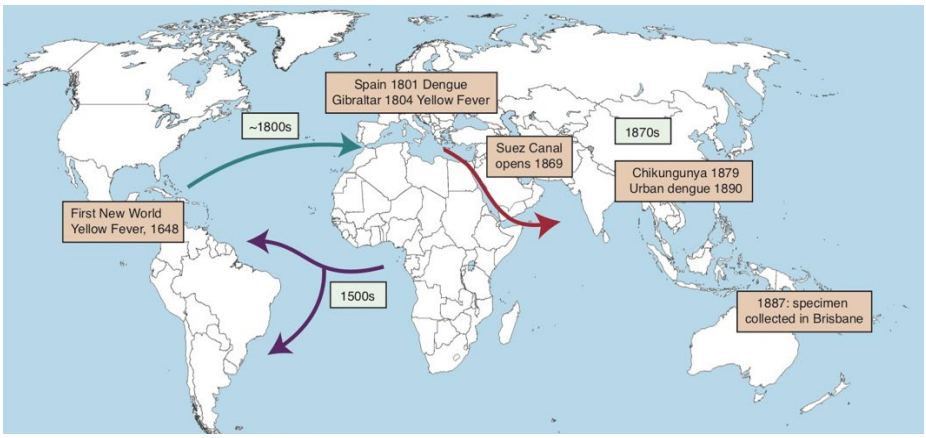
(a) Locations for each *Aedes aegypti* sampling, colored by regional group. Mean allelic richness estimated from microsatellites by rarefaction of all sites within each region is shown in the boxes. (b) Genetic clusters inferred from microsatellites. The longitude of each site is plotted against its mean observed heterozygosity (c), expected heterozygosity (d), and allelic richness estimated by rarefaction using microsatellite data (e). Colors are consistent and correspond to regional groups.

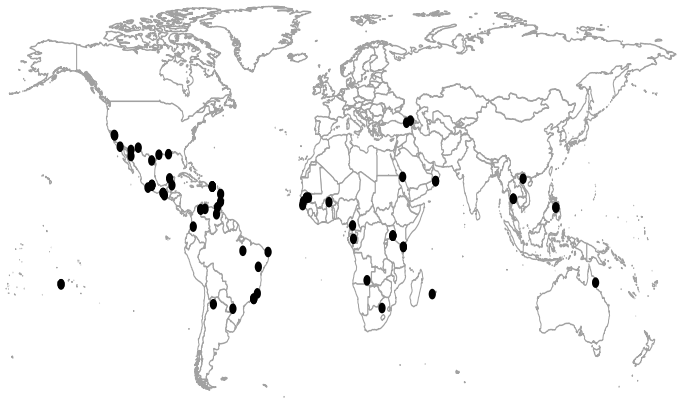
Impact: We demonstrate the relevance of serial founder effects on *Ae. aegypti* gene flow, which indicates that short-distance migration is important for the dispersal of this species. Controlling *Ae. aegypti* in one area should help protect surrounding areas from becoming infested. These short-distance migrations occur across the state and country lines, highlighting the importance of international cooperation to prevent further invasions and control vector-borne diseases.

C. Virus-Vector Interactions

1. Saliva collection via capillary method may underestimate arboviral transmission by mosquitoes.
(Andrea Gloria-Soria, Doug Brackney, and Phillip Armstrong)

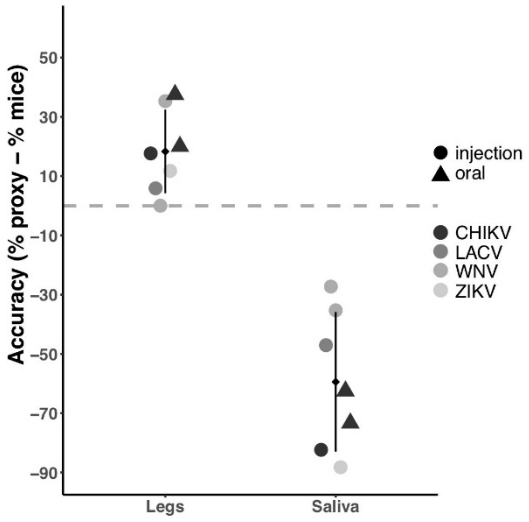
Arthropod-borne viruses (arboviruses) impose a major health and economic burden on human populations globally, with mosquitoes serving as important vectors. Measuring the ability of a mosquito population to transmit an arbovirus is important in terms of evaluating its public health risk. In the laboratory, a variety of methods are used to estimate arboviral transmission by mosquitoes, including indirect methods involving viral detection from mosquito saliva collected by forced salivation. We compared three commonly used proxies of arboviral transmission, namely, the presence of virus in mosquito legs, in salivary glands (SG) and in saliva collected in capillary tubes using forced salivation, with direct transmission estimates from mosquitoes to suckling mice. We analyzed five vector-virus combinations, including *Aedes aegypti* infected with chikungunya virus, West Nile virus and Zika virus; *Culex quinquefasciatus* infected with West Nile virus; and *Aedes triseriatus* infected with La Crosse virus.





Comparatively, the methods of detecting virus infection in mosquito legs and in SG were equally accurate in predicting transmission. Overall, the presence of virus in mosquito legs was a more accurate predictor of transmission than the commonly implemented viral detection method using forced salivation into a capillary tube, and was subject to less technical variation.

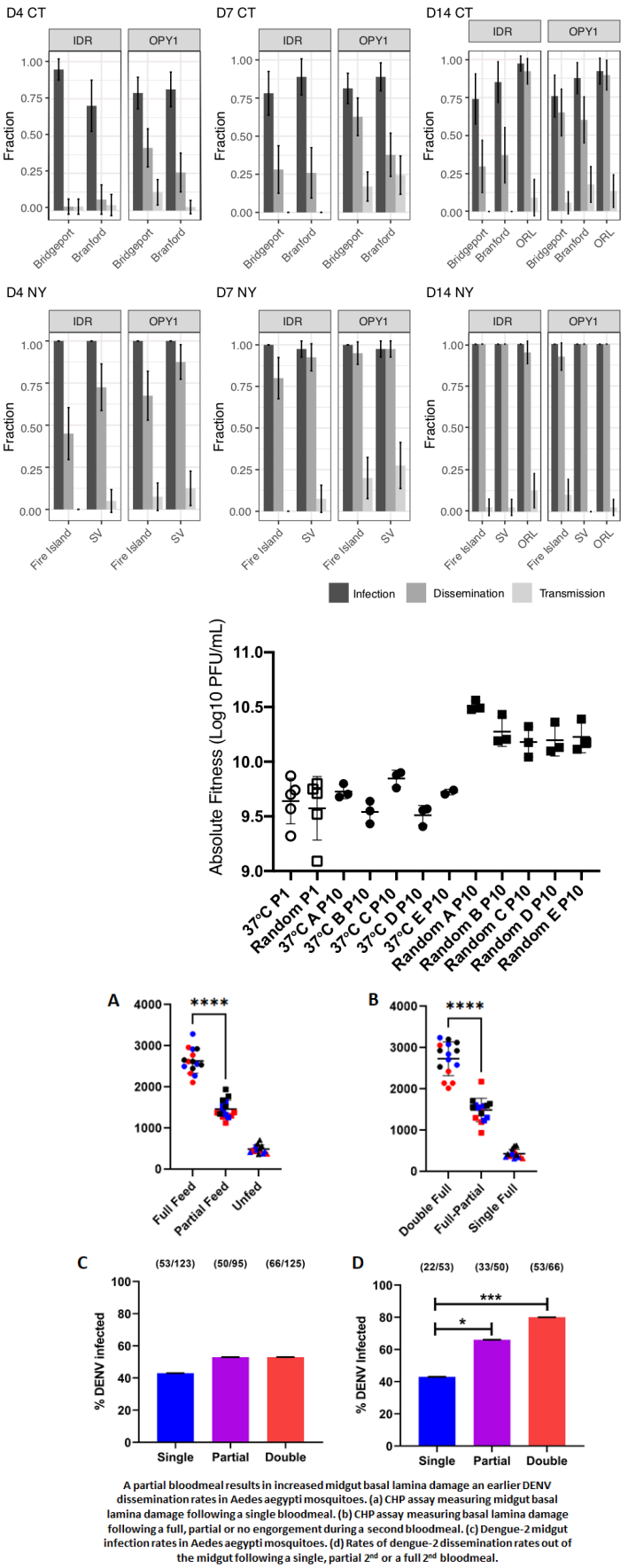
Importance: The accuracy of indirect methods to estimate arbovirus transmission to live animal hosts has not been fully evaluated. These results suggest that, in general, forced salivation methods tend to underestimate virus transmission, and they provide confidence in the use of mosquito leg screens to evaluate the transmission potential of a mosquito population. This information will lead to a more efficient arboviral screening process that does not rely on unnecessary time-consuming dissection of salivary glands or saliva collection.



3. The impact of partial blood meals on midgut damage and viral dissemination.

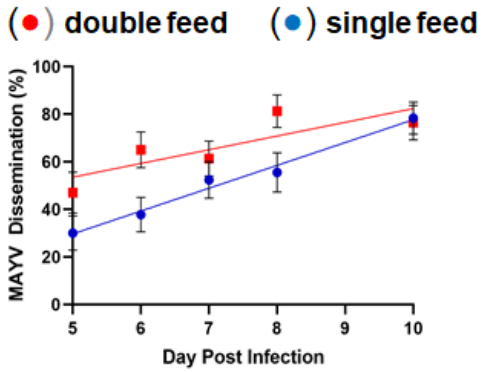
(Doug Brackney, Philip Armstrong, Rebecca Johnson, Duncan Cozens, and Zannatul Ferdous)

Studies of vector competence rarely consider the impacts that successive blood meals have on arboviral transmission by mosquitoes. *Aedes aegypti* mosquitoes readily feed more than once and often take partial blood meals. The impact this behavior has on viral transmission needs to be better understood and incorporated into models of mosquito-borne disease epidemics. Previously it was shown that *Ae. aegypti* infected with dengue virus (DENV) via a primary blood meal had earlier viral dissemination when given a second non-infectious blood meal three days later. Evidence suggests that gut distention during blood feeding leads to damage of the midgut basal lamina and faster viral escape. While mosquitoes are usually allowed to feed to repletion in the laboratory, mosquitoes in the wild are often interrupted and only acquire partial blood meals. Therefore, we examined the effects that partial blood feeding has on midgut basal lamina damage and DENV dissemination. To assess midgut basal lamina integrity, we performed a collagen hybridizing assay on cohorts of *Ae. aegypti* given either a full, partial or no blood meal. *Ae. aegypti* provided a partial blood meal had an intermediate degree of damage compared to fully engorged or naive cohorts. We also assessed if midgut basal lamina damage accumulated across multiple blood meal and whether the size of a second additional blood meal impacted damage. Mosquitoes given a partial second blood meal three days after an initial full feed had less midgut damage than mosquitoes given a full second blood meal, but significantly more damage than the cohorts provided no additional blood meals. Thus, midgut damage appears proportional to distention and feeding volume and is not cumulative across multiple feedings. Consistent with this, we observed that individuals provided a partial second blood meal had an intermediate early dissemination phenotype for DENV. This indicates that damage from a partial feed is sufficient to cause accelerated dissemination, further demonstrating the significance of sequential blood meals on arbovirus epidemiology. This work has strong implications for our understanding of disease transmission in the field and this data will be useful in creating more accurate models to predict viral spread and maintenance.



A partial bloodmeal results in increased midgut basal lamina damage an earlier DENV dissemination rates in Aedes aegypti mosquitoes. (a) CHP assay measuring midgut basal lamina damage following a single bloodmeal. (b) CHP assay measuring basal lamina damage following a full, partial or no engorgement during a second bloodmeal. (c) Dengue-2 midgut infection rates in Aedes aegypti mosquitoes. (d) Rates of dengue-2 dissemination rates out of the midgut following a single, partial 2nd or a full 2nd bloodmeal.

4. Multiple blood meals enhance early dissemination of arboviruses in three medically relevant mosquito genera.
(Doug Brackney, Phil Armstrong, Zannatul Ferdous, Rebecca Johnson, and NYS Wadsworth collaborators)

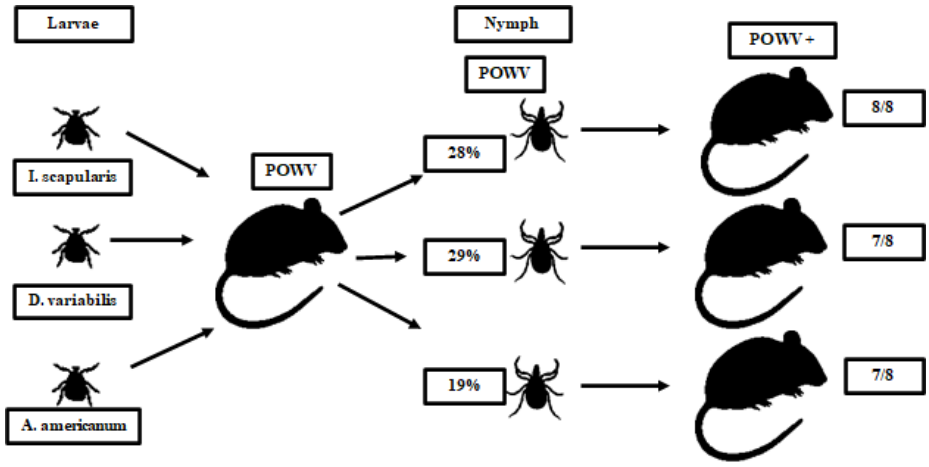


Rates of Mayaro virus dissemination from the Aedes aegypti midgut following either a single bloodmeal or a double blood meal.

Numerous anautogenous mosquito vectors have the propensity to acquire multiple blood meals within a single gonotrophic cycle; however, incorporation of this feeding phenotype into laboratory vector competence studies is rarely done. We have previously shown that this frequent feeding behavior can enhance the early dissemination of Zika virus, dengue virus, and chikungunya virus in *Aedes aegypti* and *Aedes albopictus* mosquitoes, yet it is unknown if arboviruses show a similar trend in non-Aedes species mosquitoes under a sequential feeding regimen. To test this, we evaluated the impact of a second non-infectious meal on the vector competence of *Ae. aegypti*, *Anopheles quadrimaculautus*, and *Culex quinquefasciatus* for Mayaro virus (MAYV) and *Cx. quinquefasciatus* for West Nile virus (WNV). Mosquitoes were offered an infectious MAYV or WNV bloodmeal and three days later the double-feed group (DSG) was offered a second non-infectious bloodmeal. Midgut infection and dissemination rates were determined by RT-qPCR between 5-10 days post infection. For MAYV, midgut infection rates were comparable between the single-feed group (SFG) and DFG for all three species; however, infection rates were extremely low in *Cx. quinquefasciatus* and, therefore, the double-feed phenotype is being evaluated in this species using WNV. Consistent with other viruses, MAYV dissemination rates were significantly higher in the *Ae. aegypti* DFG compared to the SFG at earlier timepoints. Similarly, the *An. quadrimaculatus* DFG displayed higher rates of dissemination compared to the SFG at earlier timepoints. Our results suggest that frequent blood-feeding improves MAYV dissemination in *Ae. aegypti* and *An. quadrimaculatus* and may allow for higher levels of viral transmission than previously expected. Further, these findings suggest that the shortened extrinsic incubation period of arboviruses associated with sequential blood feeding is generalizable across some, if not most, virus-vector pairings.

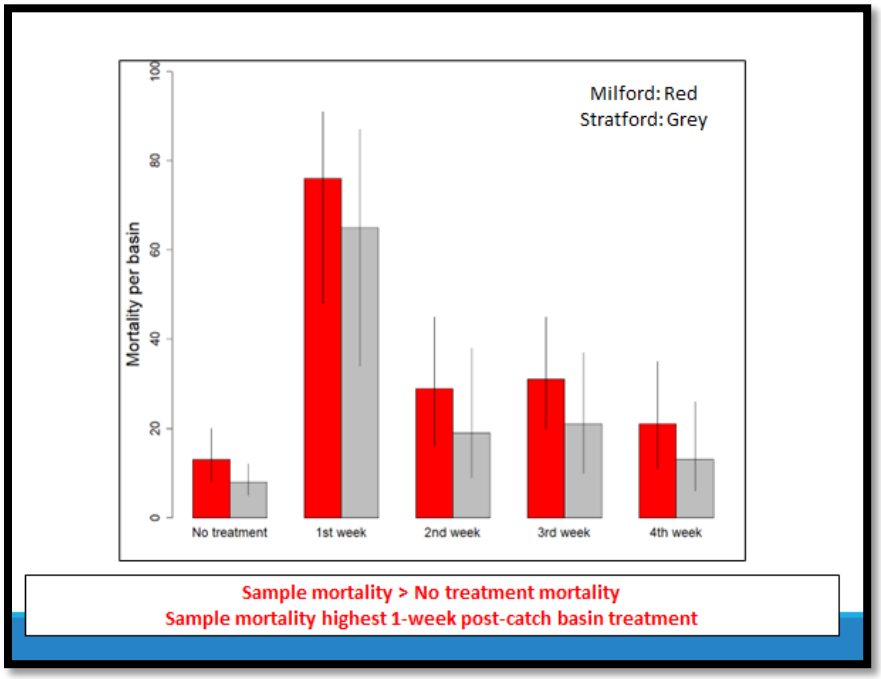
3. Vector competence of human-biting ticks *Ixodes scapularis*, *Amblyomma americanum* and *Dermacentor variabilis* for Powassan virus.
(Doug Brackney, Phil Armstrong, Rohit Sharma, Duncan Cozens)

Powassan virus (POWV; *Flavivirus*) is the sole North American member of the tick-borne encephalitis sero-complex and an increasing public health threat in the United States. Maintained in nature by *Ixodes* spp. ticks, POWV has also been isolated from species of other hard tick genera, yet it is unclear if these species can serve as vectors. *Dermacentor variabilis* and *Amblyomma americanum* share geographic and ecologic overlap with *Ixodes* spp. ticks and POWV transmission foci raising the possibility that POWV could become established in these tick species leading to range expansion and increased human risk. Therefore, we assessed the competency of *I. scapularis*, *D. variabilis* and *A. americanum* for POWV lineage II and found that all three species were equally efficient at acquiring the virus and then transmitting it to mice in the subsequent life stage. These findings highlight the potential role of non-*Ixodes* species in the ecology and epidemiology of POWV.



D. Mosquito Management

1. The community-wide effectiveness of municipal larval control programs for West Nile virus risk reduction in Connecticut, USA.
(Philip Armstrong, Theodore Andreadis, Joseph McMillan, John Shepard, Tanya Petruff, Michael Misencik, and Angela Bransfield)



Mosquito larval control through the use of insecticides is the most common strategy for suppressing West Nile virus (WNV) vector populations in Connecticut (CT), USA. To evaluate the ability of larval control to reduce entomological risk metrics associated with WNV, we performed WNV surveillance and assessments of municipal larvicide application programs in Milford and Stratford, CT in 2019 and 2020. Each town treated catch basins and nonbasin habitats (Milford only) with biopesticide products during both WNV transmission seasons. Adult mosquitoes were collected weekly with gravid and CO_2 -baited light traps and tested for WNV; larvae and pupae were sampled weekly from basins within 500 m of trapping sites, and Culex pipiens larval mortality was determined with laboratory bioassays of catch basin water samples. Declines in 4th instar larvae and pupae were observed in catch basins up to 2-week post-treatment, and we detected a positive relationship between adult female C. pipiens collections in gravid traps and pupal abundance in basins. We also detected a significant difference in total light trap collections between the two towns. Despite these findings, C. pipiens adult collections and WNV mosquito infection prevalence in gravid traps were similar between towns. Larvicide applications reduced pupal abundance and the prevalence of host-seeking adults with no detectable impact on entomological risk metrics for WNV. Further research is needed to better determine the level of mosquito larval control required to reduce WNV transmission risk.

III. ENVIRONMENTAL MICROBIOLOGY

A. Employing Experimental Systems to Characterize Wetland Responses to Disturbance
(Blaire Steven)

Our overarching objective is to better understand how interactions between plant community composition and water quality alter freshwater wetland carbon fluxes. A series of mesocosms were established to test the effects of carbon and oxygen manipulations to the soil. Our findings suggest that dominant salt marsh vegetation is generally resilient to perturbations. This will be important for modeling how these systems will potentially change in the face of climate change. We also maintain a program of monitoring local wetlands and assessing different remediation strategies in maintaining wetland ecosystems.

Wetland mesocosms to test various disturbances to vegetation and sediment microbial communities. Students observe a natural coastal wetland in Branford, CT.

B. Introducing Environmental Bacteria to Colony Mosquitoes Alters Host and Microbiome Phenotypes

(Blaire Steven and Doug Brackney)

We have recently developed an axenic (microbe-free) mosquito model, which can be recolonized with bacteria of interest. We investigated the difference between mosquitoes reared with bacteria from the insectary in which they are raised versus from an environmental water source. Mosquitoes colonized with bacteria from the environment digested blood faster, and the bacteria isolated from the environmentally colonized mosquito showed a higher propensity for blood digestion (Figure 2). This suggests that microbiome composition may explain some of the observed differences between colony reared mosquitoes compared to those in the wild.

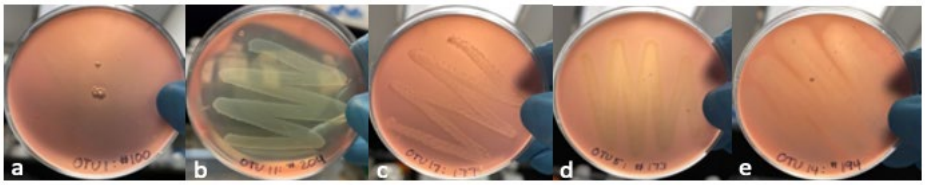
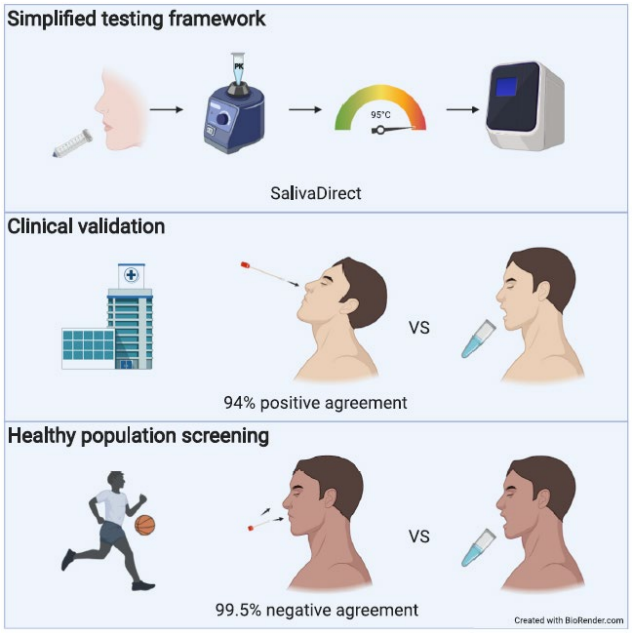
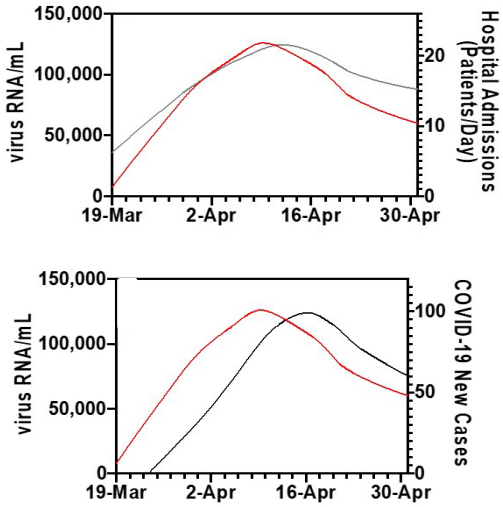


Figure 2. Blood digestion phenotypes of mosquito associated bacteria. Panel A shows a blank blood agar plate. Panel B-E are bacteria isolated from mosquitoes. The bacterium in panel B was isolated from a mosquito colonized by environmental bacteria and demonstrates an increased capability for blood digestion.

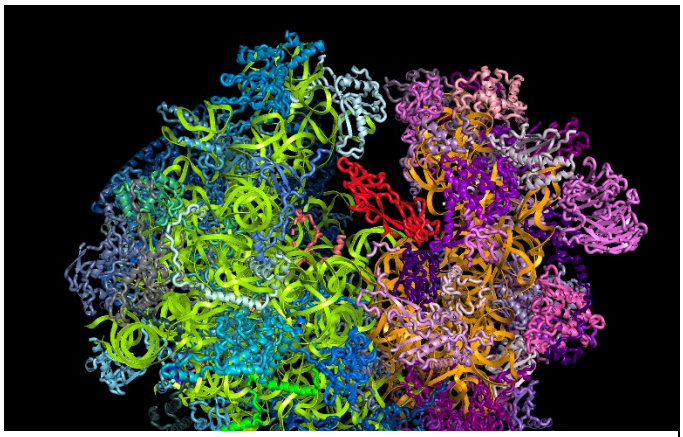
C. The Microsporidia

1. Three-dimensional structure of the Microsporidial ribosome.
(Charles R. Vossbrinck)

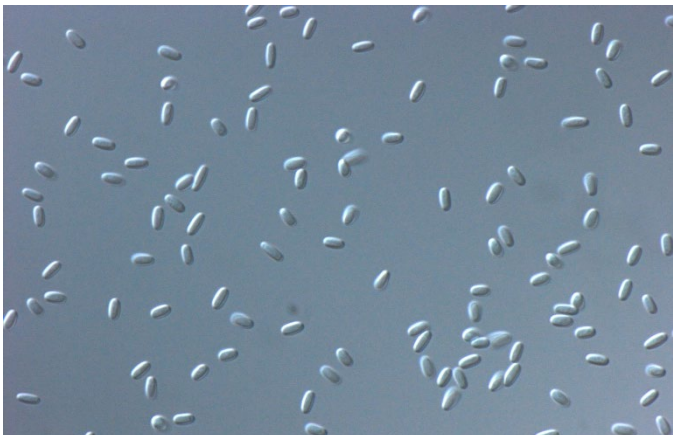




Dr. Vossbrinck, along with Jonas Barandun at the University of Umea, Umea, Sweden, and his colleagues, have published the three-dimensional structure of the ribosome from the microsporidial parasite *Vairimorpha necatrix*. We have discovered a "dormancy" factor that may be shutting down protein synthesis or protecting the ribosome from external factors during its spore stage. Microsporidia are devastating parasites of the world's two most important domesticated insects, honey bees and silkworms. We have submitted a grant proposal to the USDA in an effort find antibiotic (anti-microsporidial) compounds that can be fed to the bees to allow them to stop this parasite from killing them and thus destroying beehives. We propose to take a two-pronged approach. First to test compounds in the lab to see if they block ribosome function and second to make three-dimensional models of the ribosome using a computer to see if there is a compound that is likely to block the ribosome's active site and test those compounds. In either case we propose to test the compounds on honey bees in the field.



The three-dimensional structure of the microsporidial ribosome showing the various proteins and RNAs in different colors. The dormancy factor is in the middle of the structure in red



Spores of *Vairimorpha necatrix*, our model species, a close relative of the highly pathogenic honey bee microsporidian *Vairimorpha ceranae*.

2. A new species of microsporidia infecting the spotted winged fruit fly *Drosophila suzuki*.
(Charles R. Vossbrinck and colleagues)

Working with a student, Sarah Biganski and scientists from the Institute for Biological Control at the Federal Research Centre for Cultivated Plants at the Julius Kuehn Institute in Darmstadt, Germany, we have discovered and are describing a new species of microsporidia. This species of parasite is of particular interest as a biological control agent because it infects the very harmful fruit fly *Drosophila suzukii.* This small fly has now invaded much of the United States, including all regions of Connecticut and can be found in the fruits of raspberries, blueberries, figs, cherries, blackberries as well as many wild or native fruits such as yew, wineberry, and chokecherry. This recently discovered microsporidial parasite has potential for infecting and controlling this destructive spotted winged fruit fly.

3. The Asian honey bee, *Apis cerana*, in China.
(Charles R. Vossbrinck and Jinshan Xu)

In cooperation with colleagues in China, we have completed a population analysis of the Asian honey bee, *Apis cerana*, in that country. What we, in Connecticut, refer to as the honey bee, *Apis mellifera*, is a species brought over from Europe by the pioneers. There were no honey bees in North America prior to that time. In Asia, there is a separate species of honey bee, *Apis cerana*, used on honey production in China and elsewhere. We have compared honey bees from various locations and have identified several genes that are responsible for helping the Asian honey bee to adapt to different conditions of temperature and humidity. We are starting to understand the evolutionary adaptations honey bees have evolved to cope with these various conditions at the genomic level.

A comparison of the Asian honey bee, *Apis cerana* (left) and the European honey bee, *Apis mellifera* (right), which we culture for honey in Connecticut. The Asian honey bee is smaller, less hairy, slenderer, and faster in flight.

IV. INVASIVE AQUATIC PLANT PROGRAM

(Gregory Bugbee and Summer Stebbins)

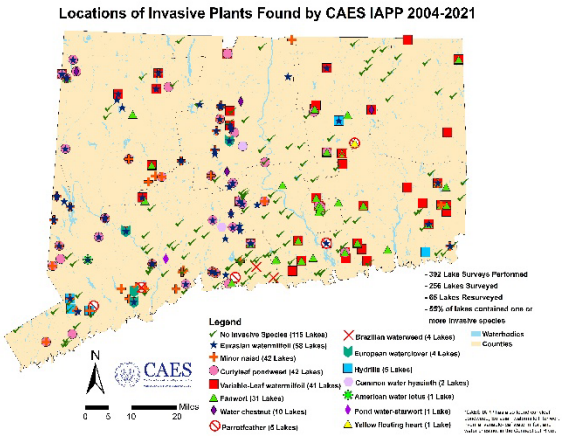
We are quantifying the locations of invasive aquatic plants in Connecticut's lakes and ponds, determining their effects on native plant communities, establishing baseline data to track their spread, and providing information that is critical for management strategies.

A. Surveillance and Monitoring

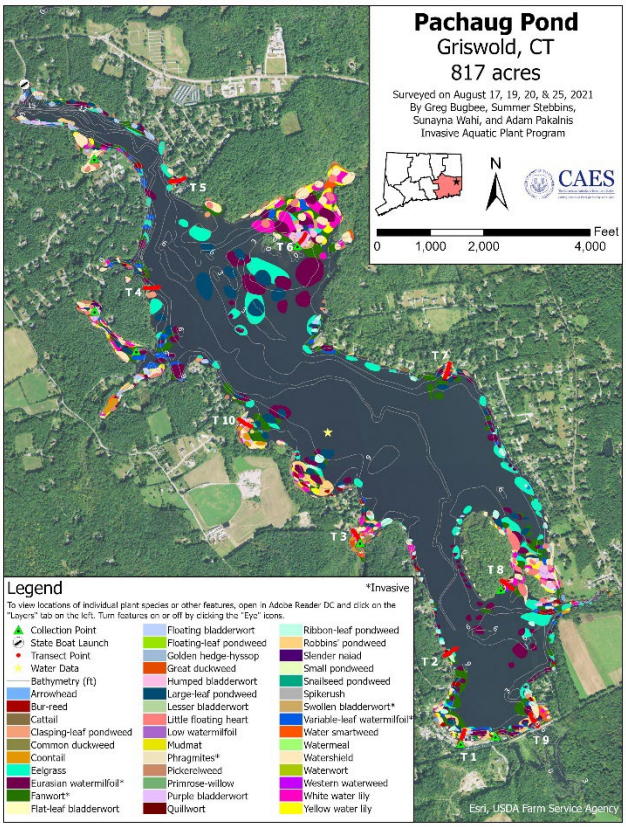
Since 2004, The Connecticut Agricultural Experiment Station Invasive Aquatic Plant Program (CAES IAPP) has completed 392 aquatic vegetation surveys of 256 Connecticut lakes and ponds. A total of 65 waterbodies have been resurveyed to determine how invasive plants are changing the quality of lakes and the effectiveness of management practices over time. In fiscal year 2021-2022, Gregory Bugbee and Summer Stebbins mapped the aquatic vegetation in five new and 15 previously surveyed waterbodies. Lake Candlewood, Connecticut's largest lake, was surveyed for the 13th consecutive year to determine the effects of deep and shallow winter drawdown and grass carp *(Ctenopharyngodon idella)* on Eurasian watermilfoil (*Myriophyllum spicatum*), minor naiad (*Najas minor*), and curlyleaf pondweed (*Potamogeton crispus*). Nearby Squantz Pond was also surveyed. We established transects in each waterbody using global positioning systems to quantify changes in native and invasive aquatic species abundance and distribution. We collected water samples and analyzed them for pH, temperature, dissolved oxygen, clarity, alkalinity, conductivity, and phosphorus. These data, along with watershed information, are being used to investigate the factors that influence the susceptibility of waterbodies to individual invasive species. We archived dry specimens of all plant species in the CAES herbarium for future reference. We designed our Invasive Aquatic Plant Program to utilize the latest digital technology to report our findings rapidly and comprehensively to the public. Lake survey maps and other data are published online (https://www.portal.ct.gov/caes-iapp). Nearly 60 percent of the waterbodies contained one or more invasive plant species and some lakes contained as many as four invasive plant species.

CAES IAPP Surveys/Research 2021/22

Number	Lake Name	Town	Acres
1	Bashan Lake	East Haddam	273
2	Beseck Lake	Middlefield	116
3	Candlewood Lake	Danbury	5064
4	Canoe Brook Lake	Trumbull	63
5	City Lake	Wilton	155
6	Connecticut River	many	_
7	Fence Rock Lake	Guilford	17
8	Lake Chaffee	Ashford	52
9	Middlebrooks Diversion	Wilton	0.2
11	New Canaan Reservoir	New Canaan	20
12	Pachaug Pond	Griswold	817
13	Popes Pond	Wilton	82
14	Quonnipaug Lake	Guilford	99
15	Rock Lake	Wilton	19
16	Rogers Lake	Old Lyme	260
17	Squantz Pond	New Fairfield	266
18	Staffordville Reservoir	Stafford Springs	149
19	West Lake	Guilford	52



The most common invasive plants are Eurasian watermilfoil, variable watermilfoil (*Myriophyllum heterophyllum)*, minor naiad, curlyleaf pondweed, and fanwort *(Cabomba caroliniana*). Less common are water hyacinth (*Eichhornia crassipes*), water shamrock (*Marsilea quadrifolia*), hydrilla (*Hydrilla verticillata*), and water chestnut (*Trapa natans*). Our 2009 survey of Fence Rock Lake in Guilford discovered Connecticut's first infestation of Brazilian waterweed (*Egeria densa*) and our resurveys in 2010, 2011, 2012, and 2013 found the population expanding. We have since found Brazilian waterweed in Lower Moodus Reservoir (East Haddam), Staffordville Reservoir (Stafford Springs), Dogwood Lake (Trumbull), and Mono Pond (Coventry). We tested the efficacy of a CT DEEP approved herbicide in Fence Rock Lake and eliminated the plant for several years but observed regrowth in 2021. We have surveyed Pachaug Pond from 2017 - 2021 to document changes in aquatic vegetation over time. In the early spring of 2018, the level of Pachaug Pond was lowered 1-2 m and then raised to normal by summer. Our surveys found similar occurrence and species richness of aquatic plants between the three years, but the abundance had decreased throughout the center of the lake. These results suggest early spring lake drawdowns may be an alternative to the typical winter drawdowns.



Aquatic vegetation survey of Pachaug Pond 2021.

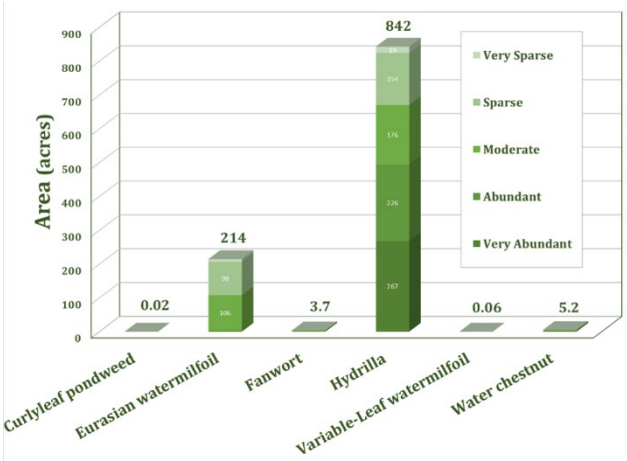
Hydrilla is a destructive invasive aquatic plant in many southern states. Following reports of the plant occurring in the Connecticut River, a task force led by the CAES IAPP was formed. Comprising over 30 experts from throughout the northeast, the task force performed preliminary surveillance of the river from central Vermont to southern Connecticut in 2018. Hydrilla was not found in New Hampshire or Vermont and the first sightings were just north of the Massachusetts/Connecticut border. Traveling south, hydrilla became common, creating large dense stands between Hartford and East Haddam.

The hydrilla found in the river is more robust than seen elsewhere in Connecticut. CAES IAPP in collaboration with the University of Wisconsin-Whitewater and the United States Army Corps of Engineers, performed genetic tests on the Connecticut River hydrilla and found it to be a different strain than previously found in North America. This could mean the plant has an enhanced ability to spread, harm aquatic ecosystems and resist current control practices. Movement of the CT River hydrilla to lakes and ponds via fragments on trailered boats and wildfowl is of utmost concern. In 2019 CAES IAPP was commissioned to survey hydrilla and other invasive plants in the Connecticut portion of the river. The work was completed in 2021. A total of 842 acres of hydrilla occurred from just north of the Connecticut border to within a few miles of Long Island Sound. It often formed monostands that spread out on the surface blocking navigation.

Connecticut River hydrilla investing a marina

B. Control Technologies

The goals of this objective are 1) to research novel means of control that minimize herbicide usage and protect native vegetation and 2) to investigate non-chemical management options such as winter water level drawdown.



Acreage and abundance (1 = sparse to 5 = dense) of hydrilla and other invasive aquatic plants in the Connecticut River from Agawam, MA to Long Island Sound.

1. Herbicides.

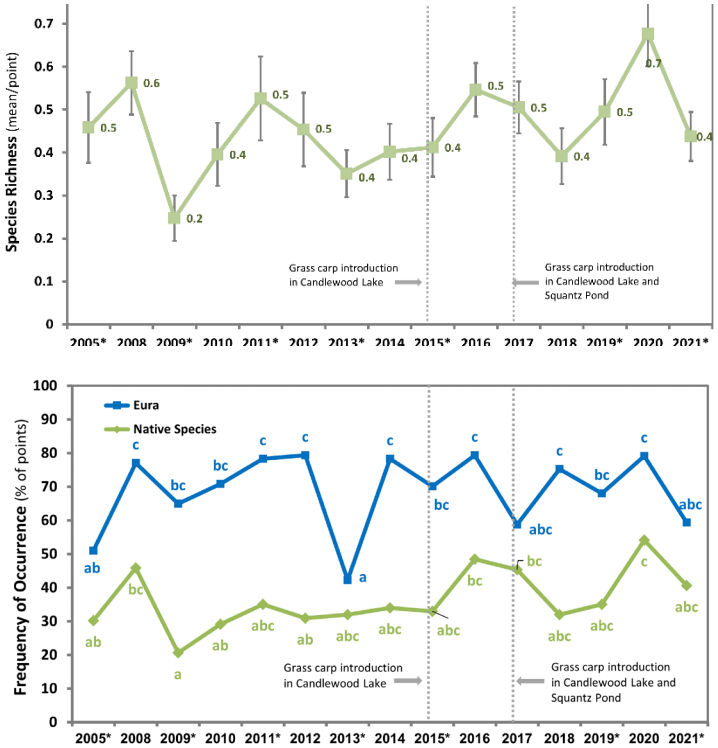
Novel methods of chemical control with herbicides can rapidly remove invasive plants and begin to restore native plant communities to aquatic ecosystems.

Bashan Lake – East Haddam, CT. We are in the 20th year of research involving the use of spot applications of herbicides to control variable watermilfoil in Bashan Lake. We had largely restored the lake to preinfestation conditions prior to lowering the lake for dam repairs in 2014. Surveys of Bashan Lake in 2018 found a regrowth of variable watermilfoil and several areas where phragmites (*Phragmites australis*) had become established. A new herbicide called ProCellaCOR was registered in 2018 for use on variable watermilfoil. In collaboration with the Bashan Lake Association, the Town of East Haddam, SePro Corp., and Solitude Lake Management Inc., CAES IAPP lead a targeted application of the product that was applied in late September. Control attributed to the ProCellaCOR treatment was excellent in all sites except for the south cove where most of the variable watermilfoil was unaffected. These areas were treated in June 2020. CAES IAPP surveys 2020 and 2021 found no variable watermilfoil.

Connecticut River – Large scale control of hydrilla may require targeted herbicide applications. Treating a large tidal river with high flow rates and numerous state listed species requires considerable preliminary research. CAES IAPP is leading this aspect and in collaboration with CT DEEP, national hydrilla experts, and other stakeholders will begin in 2022.

2. Winter water level drawdown and grass carp.

Candlewood Lake - Brookfield, New Fairfield, New Milford, Sherman, CT. Candlewood Lake's aquatic plant community is dominated by Eurasian watermilfoil. Winter water level drawdown has been used for decades to manage the plant. In 2015 and 2017, a total of nearly 10,000 sterile plant-eating grass carp were introduced to provide additional control. Using state-of-the-art geospatial technology, we have documented the success of the drawdowns each year since 2007 and have begun to determine the effects of the grass carp. The surface coverage of milfoil shows a negative relationship to drawdown depth. Eurasian watermilfoil reductions attributable to the grass carp appear limited to some shallow coves and minimal in most of the lake. Squantz Pond is attached to Candlewood Lake via a large pipe under a causeway. Virtually all vegetation in Squantz Pond has been eliminated suggesting that some of the grass carp from Candlewood Lake have migrated into the waterbody. CAES IAPP surveillance has found excessive plant reduction is possible if grass carp populations are excessive.



The effects of winter drawdown and grass carp on the species richness and frequency of occurrence of Eurasian watermilfoil and native species in Candlewood Lake (*= deep drawdown years).

3. Benthic barriers—Lake Quonnipaug, Guilford; Bashan Lake, East Haddam; Lake Beseck, Middlefield; and the Connecticut River.

Benthic barriers are blankets designed to be placed over nuisance vegetation in lakes and ponds. They provide an alternative to herbicides and are thought to control vegetation by blocking the light aquatic plants need to grow. Benthic barriers are not new; they are typically placed over weed beds early in the growing season and removed in the fall. Recently, marketers of benthic barriers have claimed that their products need only be placed over weeds for a few weeks and then moved to another location or removed. To test this practice, we collaborated with the Towns of Guilford and Middlefield and placed benthic barriers at the Lake Quonnipaug and Lake Beseck public beaches. The beaches had problems with Eurasian watermilfoil and other invasive and native aquatic plants. We placed the benthic barriers in April and removed them within two months. In the Connecticut River, we tested short term placement of benthic barriers to control hydrilla which hindered navigation at Portland Boat Works. The results are promising with little vegetative regrowth throughout the summer. We are also testing the use of benthic barriers to control a pioneer infestation of fanwort in Bashan Lake and hydrilla in the Connecticut River. Further tests are needed to determine why these barriers provide impressive weed control even when they are used for short periods of time.

Benthic barriers installed at Portland Boat Works.

C. Outreach.

We strive to disseminate all information from our program to the public in a timely fashion and educate stakeholders in the identification, prevention, and management of invasive aquatic species. We make every effort to engage citizens, lake associations, and other stakeholders. CAES IAPP scientists have organized several workshops on the identification of invasive aquatic plants. We also have given presentations to professional organizations such as the Northeast Aquatic Plant Management Society, the North American Invasive Species Management Association, and the Connecticut Invasive Plant Working Group. In addition, CAES IAPP staff members speak to numerous lake associations, town meetings, and student groups such as the Connecticut Envirothon. We have made our information freely and readily available via our website. Included are digitized interactive lake maps, our herbarium, and publications (https://www.portal.ct.gov/caes-iapp).

Our invasive aquatic plant control and outreach efforts have resulted in the protection of lakes and provided scientifically proven methods for use by others. Our workshops have trained hundreds of citizens to recognize and report new infestations to prevent future problems and the associated control expenditures.

Invasive aquatic plant talk presented at the 2022 Northeast Aquatic Plant Management Society Conference.

Talk on improving soil fertility presented to the West Haven Garden Club.

VI. SOIL TESTING LABORATORY

(Gregory Bugbee)

Testing soil samples for fertility and suggesting methods for growing better plants are provided for citizens of Connecticut. At the laboratory in New Haven, 6,617 samples were tested representing one of the highest totals on record. Approximately 2,000 phone calls, emails and in person inquiries were answered.

The soil testing services and recommendations made by The Connecticut Agricultural Experiment Station reduce unnecessary fertilizer treatments to lawns and nursery stock throughout the state. This provides direct economic and environmental benefit to the suburban community by reducing nitrogen runoff into soil and water.

DEPARTMENT OF FORESTRY AND HORTICULTURE

Connecticut's landscape is a quilt of forests, farms, towns, and cities. Scientists in the Department of Forestry and Horticulture are studying the factors that influence forest and farm productivity as well as ticks and public health, including how trees respond to novel pests and a changing climate, innovative forest management practices, the effect of the growing deer population on natural and managed landscapes, novel growing techniques for crops in urban areas, impacts of systemic treatment of deer to kill ticks, fall application of acaricide to kill ticks and avoid beneficial pollinators, and identifying tick habitats in residential backyards to effectively target ticks with acaricide applications.

Effectiveness of slash walls to enhance regeneration
Dr. Jeffrey S. Ward is assisted by Mr. Joseph P. Barsky and working in collaboration with Cornell University, Metropolitan District Commission, South Central Connecticut Regional Water Authority, and Massachusetts Department of Conservation and Recreation.

Obtaining adequate quality regeneration, especially oak regeneration, can be problematic in area with high deer densities. Our earlier study found that it is unlikely to obtain sufficient oak unless there is both a low level of deer browse damage and high levels of sunlight. High levels of sunlight can be obtained by appropriate management prescriptions (i.e., more intense harvesting). Reducing browse damage by restricting deer access is necessary in forests where hunting is restricted by deed, regulation, or social pressure.

The traditional method of restricting deer access has been construction of 8-ft tall woven wire fences. However, these fences are expensive to construct, approximately $4 per linear foot, often require maintenance after severe weather, and may incur an additional expense if they have to be removed when regeneration has been established. Peter Smallidge and Brett Chedzoy at Cornell University have developed a lower cost alternative – slash wall – using the tops of harvested trees and low value poletimber and culls. These materials are piled into a continuous wall 10-ft tall (to allow for settling) at a cost of ~$2 per linear foot. The fences also have the advantages of becoming taller if a tree falls on them and now requiring removal.

Completed slash wall in Oakham, MA (left) and aerial view of slash wall cut in North Madison, CT (right).

We have initiated a study replicated at four sites in southern New England and several sites in at the Cornell University Arnot Forest in upstate New York. Both inside and outside of the slash walls, all regeneration taller than 140 cm was tallied on 231 10-m^2 sample points along with 30-140 cm tall regeneration on 4-m^2 points. Additionally, we identified and geo-referenced 1740 that were cut during the harvests. We will compare growth and survival of sprouts developing from these trees after they are harvested.

Precommercial crop tree release of white oak saplings

Dr. Jeffrey S. Ward is assisted by Mr. Joseph P. Barsky working in collaboration with the Forest Stewards Guild, South Central Connecticut Regional Water Authority, and Massachusetts Department of Conservation and Recreation.

While oaks are the predominant canopy tree species over much of southern New England, obtaining oak regeneration is often unsuccessful through the region, especially white oak (*Quercus alba*) regeneration. Earlier research by Dr. Ward demonstrated that precommercial crop tree release of northern red, black, and scarlet oaks saplings increases both diameter growth and persistence in an upper canopy position. However, there have been no scientific studies examining whether early release also benefits white oak. Our objective was to determine whether early release of white oak saplings increases survival, proportion remaining in a free-to-grow or better canopy position, diameter growth, and height growth.

As part of a USDA Forest Service grant to enhance regional oak resiliency, we established three demonstration research study areas to examine this question – two sites in Massachusetts and one site in Connecticut. One difficulty we quickly encountered was find sapling stands with sufficient white oak saplings that were 2-m tall or taller. We needed at least 90 potential crop trees (PoCT) to have adequate sample sizes – hence two of the study areas were in Massachusetts. The minimum height was to ensure that stems were above typical deer browse height. The following measurements were taken prior to treatment assignment and implementation: PoCT diameter (mm) at a permanently marked position 1.4 m aboveground, PoCT height (dm) of top and bottom of live crown with a telescoping pole, and PoCT canopy position (suppressed, gap, upper canopy). We also recorded the species, diameter, and height of up to the four nearest neighboring trees interfering with PoCT growth. Each tree was permanent identified with a numbered tag attached with a wire loop. Stems were painted pink to permit quick field identification.

DBH growth (inches)	Released	Uncut	Increase
Upper canopy	0.21	0.14	45%
Gap	0.16	0.08	106%
Suppressed	0.13	0.04	220%

After initial measurements, each of the 395 PoCTs were randomly assigned to one of two initial treatments: control/no release or complete release. No competing/interfering neighboring trees removed for the control treatment. For release treatments, all competing/interfering neighboring trees with crowns within an inverted 45-degree cone of the middle of the PoCT live crown were cut. PoCT diameter and crown class were measured during the dormant season. While it will take at least 10 years to know if that objective is achieved, we did observe immediate and dramatic first year diameter growth increases 45%-220%.

***Impact*:**

- Although white oak is the state tree of Connecticut (also Illinois and Maryland), our earlier surveys found less than five percent of young stands had more than few white oak saplings in a competitive position that would allow them to grow into mature trees. It is likely that white oaks will become a rare sight in future years without proactive management practices such as precommercial crop tree release. Natural resource managers will be able to maintain viable populations of this charismatic species if we find white oak has the same positive response to release as was observed in earlier studies of the red oak group.

Fall acaricide spraying to manage blacklegged tick pathogen vectors and reduce mortality to beneficial insects
Drs. Scott C. Williams and Megan A. Linske assisted by Michael Short, Heidi Stuber, and Jamie Cantoni. Funded by the Centers for Disease Control and Prevention, 75D30121P10726.

The main objective of this research is to evaluate the effectiveness of fall application of lambda-cyhalothrin (Demand®) on the host-seeking nymphal *Ixodes scapularis* cohort (the primary vector of many pathogens including Lyme disease in the Northeast) the following spring while minimizing impact to beneficial pollinators such as native bees, honeybees, and butterflies that are dormant or have migrated by fall. We also tested the effectiveness of differing combinations of formulations (liquid and granular) using a high-pressure sprayer and powered backpack blowers. We compared effectiveness of fall 2021 application using these methods to that of the more traditional spring application (2022) and both in combination (fall 2021 & spring 2022) as compared to untreated control. We determined effectiveness of the differing delivery, timing, and formulations using traditional tick dragging methodologies in cooperating residential properties in North Branford in fall 2021 and spring 2022 to determine densities of host-seeking *Ixodes scapularis*. Fall application of lambda-cyhalothrin should not only impact questing adult *Ixodes scapularis* but may also be effective against fed larvae and molted nymphs. We suspect high-pressure spray will be most effective in reducing questing nymphs the following spring as this delivery method readily upsets leaf litter on the forest floor, increasing exposure of quiescent juveniles beneath to lambda-cyhalothrin.

CAES research assistant Jamie Cantoni applies a high-pressure application during the fall.

We found that high-pressure spraying from a truck-mounted sprayer resulted in no sampled adult *Ixodes scapularis* that same fall, the following spring, and no sampled nymphs the following spring/summer. Fall backpack blower delivery resulted in a few adults sampled in fall and spring, but no nymphs the following spring/summer.

Impact:

- Fall delivery of synthetic acaricides is effective in killing host-seeking adult and nymphal *Ixodes scapularis* ticks the following spring while limiting negative impacts to beneficial pollinators and simultaneously reducing public health risk.

Evaluation of landscaping and vegetation management to suppress host-seeking *Ixodes scapularis* nymphs on residential properties
Drs. Scott C. Williams and Megan A. Linske assisted by Michael Short, Heidi Stuber, and Jamie Cantoni. Funded by the Centers for Disease Control and Prevention, 75D30121P12302.

The main purpose of the work was to evaluate the impact of commonly recommended non-pesticide-based tick control methods in the form of landscaping and vegetation management techniques on the density of host-seeking *Ixodes scapularis* nymphs when these measures are applied at the level of individual residential properties. An additional goal was to clarify the density of host-seeking *Ixodes scapularis* nymphs in different habitat types encountered on residential properties. The outcome of the research will be of direct relevance for homeowners and professional landscaping firms engaging in tick control activities.

We solicited cooperation from 50 homeowners in Guilford, CT to permit us to sample ticks from various habitats in their backyards including next to bird feeders, stone walls, wood piles, in tall grass, wooded edges, shrubland habitats, woodland habitats, short grass, in areas where leaf litter was removed, and along edges where wood chip barriers were placed to prevent ticks from migrating into properties. We sampled over 400 ticks from the various habitats on all the

properties in spring 2022. We are in the process of compiling all the data to determine where the highest concentrations exist in residential areas to effectively target their management.

Impact:

- By better understanding habitats where the majority of ticks reside in residential habitats, homeowners and pesticide control operators alike can better target their management with lesser amount of product and lesser impact to beneficial species while reducing public health risk to ticks and tick-borne diseases.

Effectiveness of oral delivery of a modern systemic acaricide to white-tailed deer in the management of the pathogen vectors *Amblyomma americanum* and *Ixodes scapularis*

Drs. Scott C. Williams and Megan A. Linske assisted by Michael Short, Heidi Stuber, and Jamie Cantoni. Funded by the Centers for Disease Control and Prevention, 75D30120C09843.

Drawing blood from a live, sedated deer.

Systemic acaricide delivery to white-tailed deer is a similar concept to modern-day tick and flea treatment for pets. Pet owners provide their pets with an edible acaricide that renders their pet toxic to ticks after treatment. Instead of obtaining a bloodmeal and progressing to the next life stage, ticks that feed on treated pets, or deer in this case, fall off and die shortly after ingesting blood of acaricide-treated animals. This strategy has been attempted with deer in the past as deer are the primary reproductive host for tick pathogen vectors such as lone star ticks (*Amblyomma americanum*) and blacklegged ticks (*Ixodes scapularis*) using a product that is meant for similar use in cattle. But past efforts used older formulations which required 45-48 day withdrawal periods before the cattle could be consumed by humans. Because deer are a game species hunted and consumed by humans, the same withdrawal period for consumption would be in place, but because ticks are active during hunting season, the product could not be used in fall when ticks were seeking bloodmeals from deer.

We found a modern-day product (Cydectin®) that is also meant for use on cattle but has an FDA-recommended withdrawal period of 0-days; meat and milk from cattle can be consumed any time post-treatment. As a result, this product can be used during hunting season when ticks are active and the possibility exists for a human to consume a treated animal. We are testing product efficacy during spring when adult and nymphal lone star ticks are feeding on deer and in the fall when blacklegged ticks feed on deer.

In spring 2021 and again in 2022, we fed out treated corn to a herd of deer in Norwalk, CT infested by lone star ticks. We captured 40 deer over the two years, and those from 2021 showed increased levels of the active ingredient in their system reported to be fatal to feeding ticks. We captured 21 deer in fall 2021 and while levels were lesser, they were still fatal to feeding ticks. We feel as though leaner deer in spring have less fat tissue to store the product and as a result, we see higher levels in the blood. Fattier fall deer have the capacity to store active ingredient for long-term release.

Two live, blindfolded and sedated deer await processing to determine active ingredient levels in the blood.

Impact:

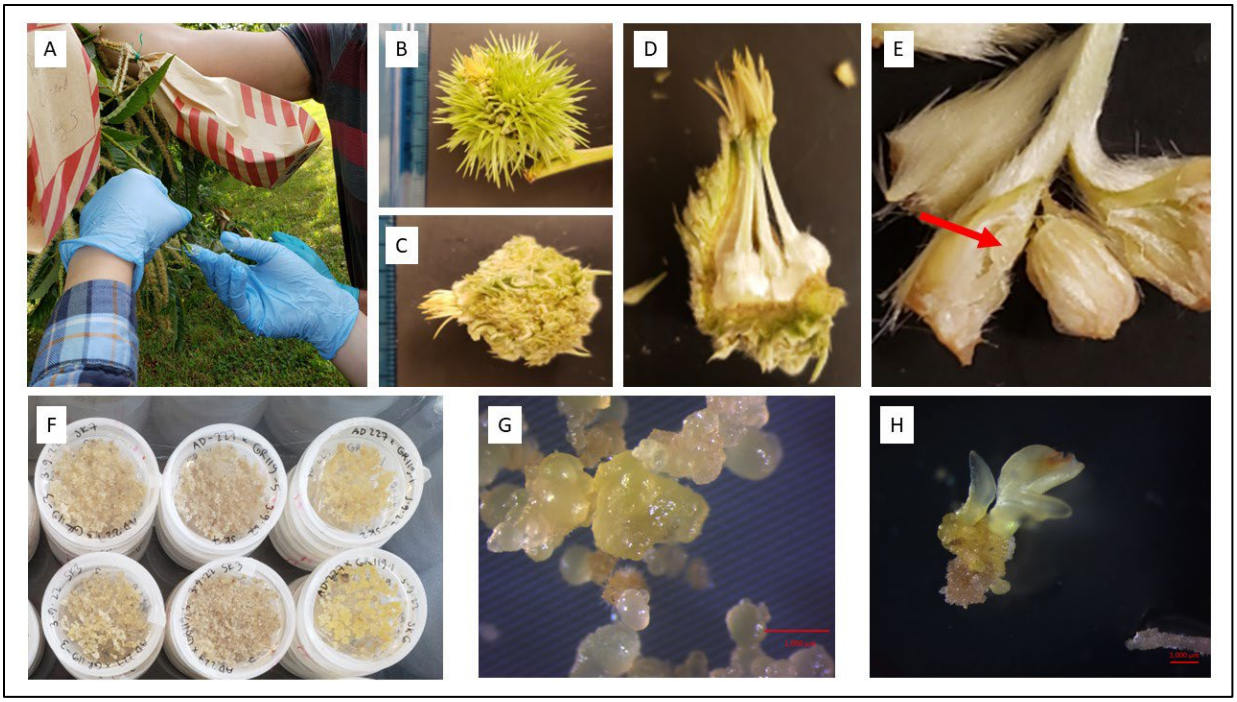
- We have shown that deer can be successfully treated with active ingredient which has the capacity to have an impact on tick management at a neighborhood scale. If a few cooperating homeowner permit feeders on their property and enough deer are treated, this has serious potential to reduce tick abundances and human cases of Lyme and other tick-borne diseases and have an impact at a town-wide level.

Impact of media composition on somatic embryogenesis in Chinese chestnuts

Dr. Susanna Keriö, collaborator Prof. Scott Merkle at University of Georgia. Funded by the American Chestnut Foundation. Assisted by Jacqueline Lemmon.

Tissue culture is widely used for commercial production of tree species to produce clonal plant material and has been long studied in chestnuts. Tissue culture makes clonal propagation possible for tree species including chestnuts that are difficult to clone from cuttings. Clonal propagation methods are especially important for tree species that are in danger of losing large part of their genetic variation due to invasive pests, pathogens, or climate change. For instance, American chestnut has become functionally extinct due to chestnut blight caused by an invasive fungal pathogen *Cryphonectria parasitica*. Chestnut blight has made natural regeneration of American chestnut largely impossible. Compared to American chestnuts, Chinese chestnuts have much higher blight resistance. This has made Chinese chestnut a prime target for the discovery of genes underlying the higher blight resistance. Having efficient tissue culture and clonal propagation methods for Chinese chestnuts would expedite the discovery of these genes.

A central process in chestnut tissue culture is the initiation of cell lines through somatic embryogenesis (SE). The mechanisms controlling SE in chestnut are not entirely understood, which has made the optimization of SE protocols a challenge. Plant genotype and heritage greatly affect how the cell lines respond to the modifications in culture conditions. Somatic embryogenesis success has been relatively high with American chestnuts and hybrids with high American chestnut heritage, but low with pure Chinese chestnuts and in hybrids with high Chinese chestnut heritage. Development of more optimized SE protocols for Chinese chestnuts would enable more efficient conservation of chestnut germplasm, investigation of the resistance genes, and higher adaptational potential regarding the species restoration efforts. This would be a significant improvement for the ongoing work on chestnut breeding, genetic conservation, and identification of blight resistance genes. The project lead by Dr. Susanna Keriö in the Department of Environmental Science and Forestry is currently testing the impact of media composition, temperature adjustments, and silver compounds on somatic embryogenesis (SE) success and plant conversion in Chinese chestnuts. The project was initiated in January 2022, and results of plant conversion rates can be expected in January 2023.



Process of establishing embryogenic lines from chestnut. A) Female flowers are pollinated, and the immature burs (B) are de-spined (C). The burs are opened to harvest the nuts (D) which carry the seeds with embryos (E). The seeds are cultivated on tissue culture medium to induce somatic embryogenesis (F). The properly developed embryos (G) will eventually produce cotyledons (H), and these embryos have the potential to convert into plantlets.

***Impact*:**

- This project will support the efforts to develop blight-resistant American chestnut trees and will support the efforts to restore the American chestnut into the hardwood forest ecosystems of North America.

Impact of mycorrhizal inoculation on tree stress tolerance– Chestnuts as a model system

Dr. Susanna Keriö. Assisted by Jacqueline Lemmon, Aaliyah Santini (Albertus Magnus College Intern), Dyami Wood (Albertus Magnus College Intern), and Juniper Allen-Cantu (Plant Health Fellows Intern).

Understanding how trees respond to abiotic and biotic stress is key to developing effective management strategies and tools to maintain a healthy forest canopy cover. Climate change is predicted to amplify the abiotic and biotic tree stress, thus resulting in increased mortality. Severe stress events caused by droughts, invasive pathogens, and invasive pests are predicted to amplify tree mortality, and especially urban trees are vulnerable to these disturbances.

As part of the urban tree stress research program in the Department of Environmental Science and Forestry, Dr. Susanna Keriö has initiated a project that studies the impact of mycorrhizal inoculation on stress responses using chestnut seedlings as a model. The greenhouse experiments were started in February 2022 and are expected to run until the summer of 2023. The project will study the interaction of mycorrhizal inoculation with tree growth, chestnut blight severity and drought stress tolerance, and drought stress recovery.

Figure 2. Chestnut seedlings were planted in CAES greenhouse in February 2022 by Dr. Susanna Keriö, Aaliyah Santini, and Jacqueline Lemmon. The trees were later allocated to mycorrhizal inoculation or control treatments, and will be exposed to various stress factors, including chestnut blight infection.

***Impact*:**

- Results will provide insights into how mycorrhizal inoculation impacts chestnut stress responses and will support the efforts to restore the American chestnut into the hardwood forest ecosystems of North America. The results will also provide insights into the mechanisms underlying biotic and abiotic stress tolerance in *Castanea* and *Fagaceae*. The information has potential to improve tree drought tolerance in silvicultural and arboricultural settings.

Examination of urban agriculture techniques to increase production, decrease nutrient resource use, and reduce nutrient leaching

Dr. Leigh Whittinghill is a new scientist in the department and her research focus is on urban agriculture.

Vegetable Production in Urban Areas

Vegetable production in urban areas is growing in popularity, but is faced with numerous challenges including limited space, contaminated soils, start-up and operational costs, and knowledge gaps. Some of these barriers can be overcome through innovative production practices. The use of small plastic pools as containers, for example, could help expand production area to spaces with contaminated soils or otherwise unused surfaces such as parking lots and rooftops. These pools have a relatively low cost compared to other growing systems of similar size and lower cost per growing area than many other available containers, reducing startup costs. Pools may also have different drainage issues and present different plant spacing considerations that traditional nursery containers. Despite growing attention in social media, production in plastic pools has still received little attention from research, so best management practices do not yet exist. Use of cut-and-come-again harvesting of greens, a technique where a crop is planted, then harvested to leave the plant growing center so that multiple harvests from a single planting are possible, can increase production without

increasing the cost of inputs. Although this technique is recommended for greens such as kale, specific instructions for crop nutrient management do not exist. Nutrient management in greens is important for not only high yield, but for a high-quality crop. The small amount of research done on cut-and-come-again greens suggests that yields and crop quality decrease in later harvests. Adding more nutrients throughout the growing period could help improve the yield and quality of later crops but could contribute to nutrient runoff from urban agriculture. Nutrient management in urban agriculture is an area of concern and highlights knowledge gaps among urban farmers. Urban farmers have a tendency to over apply nutrients. This contributes to nutrient losses through leaching which can negatively impact downstream water quality. Efficient use of nutrients in urban agriculture depends on soil fertility testing by farmers, an understanding of how to use nutrient recommendations, and farm record keeping. Soil testing and recordkeeping are not common practice in urban farming. An understanding of how urban farmers currently use nutrients is necessary to address behaviors that lead to over application.

Three projects outlined here will examine the issues of container production, cut-and-come-again harvesting, and urban farm nutrient management with the overall goal of enabling higher urban vegetable production with more efficient nutrient use. The project objectives are 1) determine the productivity of small plastic pools as a model for urban container gardening systems compared to traditional nursery pots, 1b) compare growing media options to maximize crop production in small plastic pool containers, 1c) compare drainage strategies in small plastic pool containers to minimize drainage issues and maximize crop performance, 2) determine the optimal nutrient management to increase the yield and quality of greens produced using cut-and-come-again harvesting while minimizing nutrient leaching, and 3) pilot a study of the effects of nutrient management practices on yields and nutrient leaching from urban farms in New Haven, CT.

Impact:

- The proposed research will provide alternative growing methodologies in urban areas that will increase the production of healthy fruits and vegetables in close proximity to urban markets while circumventing the issues of limited growing space and potential soil contamination.

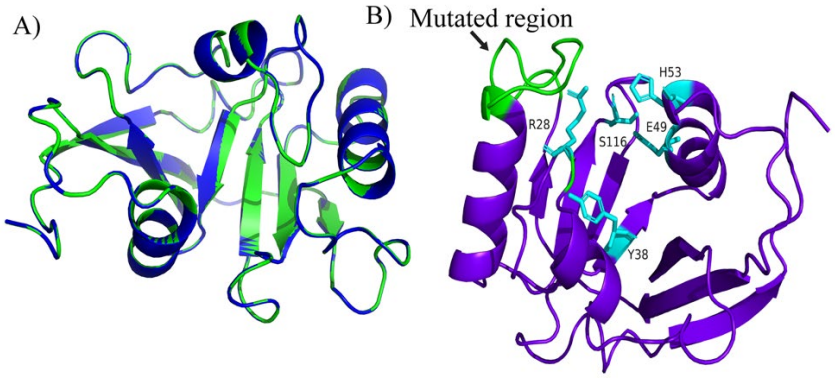
The Department of Plant Pathology and Ecology is led by Vice Director and Chief Scientist, Dr. Lindsay Triplett, and has six research scientists and one active emeritus scientist who are supported by one full-time technician. The Plant Disease Information Office serves as the Department Flag Ship serving the citizenry and agricultural industries of Connecticut and provides vital support to other Connecticut state agencies and CAES departments. The department maintains active cutting-edge research programs that address important disease problems caused by bacterial, fungal, nematode, and viral pathogens of crops and trees important to Connecticut while also addressing national and international issues.

RESEARCH ACTIVITIES:

Contribution of Toxin Antitoxin Systems to Plant Pathogen survival of disease control

Bacterial diseases cause huge economic losses in Connecticut and throughout the US, and are very difficult to control. One important defense is the use of antimicrobial sprays such as copper, antibiotics, and antimicrobial peptides, but a small proportion of the population survives to cause infection again for unknown reasons. In a collaborative project with researchers at Penn State University, Drs. Lindsay Triplett and Ravikumar Patel demonstrated that the model pathogen *Pseudomonas syringae* survives a common antibiotic spray treatment by keeping a small percentage of cells in a dormant state, and that it likely has other physiological states to help it survive membrane-disrupting treatments. This year, the team discovered a gene that is required for the survival of *P. syringae* through dormancy. By exposing many generations of bacteria to the antibiotic and then sequencing bacterial variants, they discovered that a bacterial self-poisoning toxin with a RES domain is likely a key requirement for the streptomycin survival state in *P. syringae.* The toxin is part of a toxin-antitoxin system, which are widespread gene models that are suspected but not proven to contribute to antibiotic persistence in many human and plant pathogens. In the next year the team will try to find how the toxin induces the dormant state, and why the mutants affect this function.

Impact: Finding the genes responsible for antimicrobial tolerance will help us predict the effectiveness of those antibiotics in the field, and could even lead to companion treatments that "wake up" the bacteria to minimize survival. These findings led to the USDA to award the Penn State/CAES team $689,000 to continue the project for three more years.



Survey of foliar protist communities

Protists are single cell organisms that shape bacterial communities on plant surfaces and can impact plant health. While there has been a recent increase in research on rhizosphere protists, far less is known about protist communities in the phyllosphere. In 2020, Dr. Lindsay Triplett, Dr. Blaire Steven, and Dr. Stephen Taerum planted five species of nightshade species to compare the protist communities between the phyllospheres and rhizospheres of the plants. Using high-throughput amplicon sequencing, we determined that the two compartments harbor dramatically different protist communities, although there were no major differences among the different plant species. The phyllosphere was particularly dominated by photosynthetic algae and ciliated protists. Network analysis was used to examine interactions between the protists and bacteria in both compartments. We identified several bacteria and protists that are major hubs in the network, and are potential candidates for future research on plant microbial communities. These findings were published in the journal Phytobiomes. Currently, we are examining a group of ciliated protists that are present on the surface of tomato leaves to learn how they vary across different sections of the leaf surface.

Impact: Protists can shape bacterial communities and impact plant health. By examining protist diversity in the phyllosphere, as well as their interactions with bacteria, we may be able to determine specific protists that promote beneficial bacteria or inhibit pathogenic bacteria.

A new method for detecting phytohormones in microbial samples

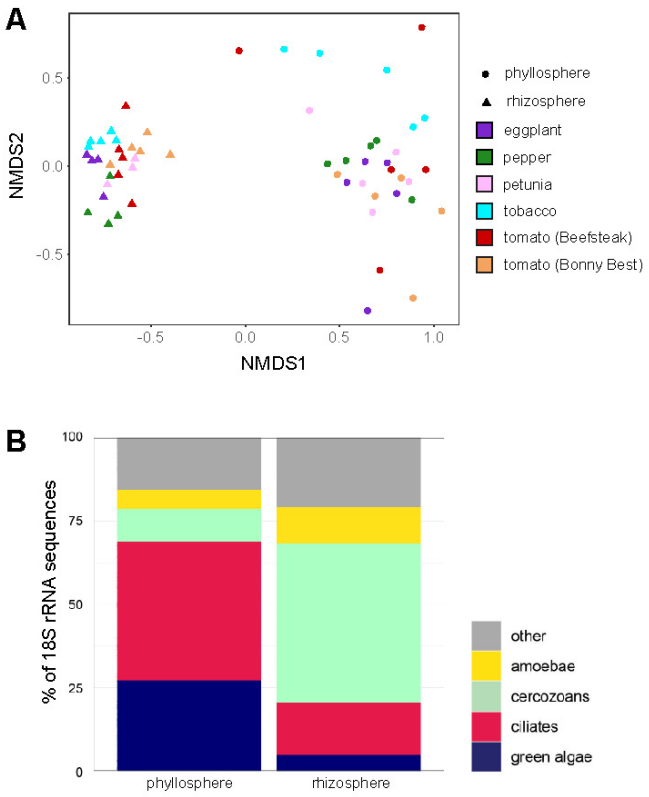


Figure caption: Differences in protist communities between the phyllosphere and rhizosphere. **A)** The protist communities in the phyllosphere and rhizosphere are highly distinct, but the communities are less distinct across hosts. **B)** The phyllosphere is dominated by ciliated protists and green algae, while the rhizosphere is dominated by cercozoans.

In 2021, Drs. Lindsay Triplett and Christina Robb initiated a project to understand the effect of predation on plant hormone production in bacteria. To do this, they first needed a way to detect multiple plant hormones from a single sample in CAES laboratories. Working with Magnarelli-funded postdoctoral researcher Dr. Ravikumar Patel, the team developed a novel plant hormone screening method that has been refined and optimized on different sample types over the last year. By extracting a sample at multiple levels of acidity, one can detect and quantify six classes of plant hormones present at as little as 0.01 parts per billion. Dr. Patel has demonstrated up to 100% recovery rate in plant, bacteria, and protist samples. The team is preparing the method for publication, and has begun using the technique to identify how predators might change the hormones produced by certain beneficial bacteria, and how that might affect the plant.

Impact: Plant hormones are regulators of almost all aspects of plant development and responses to their environment. This profiling method will help scientists get a more rapid and broad profile of plant-affecting microbial capacity, and specifically help CAES researchers study how predator-bacteria interactions affect plant health. Additionally, the capacity to profiling plant hormones will greatly benefit many plant research areas at The CAES.

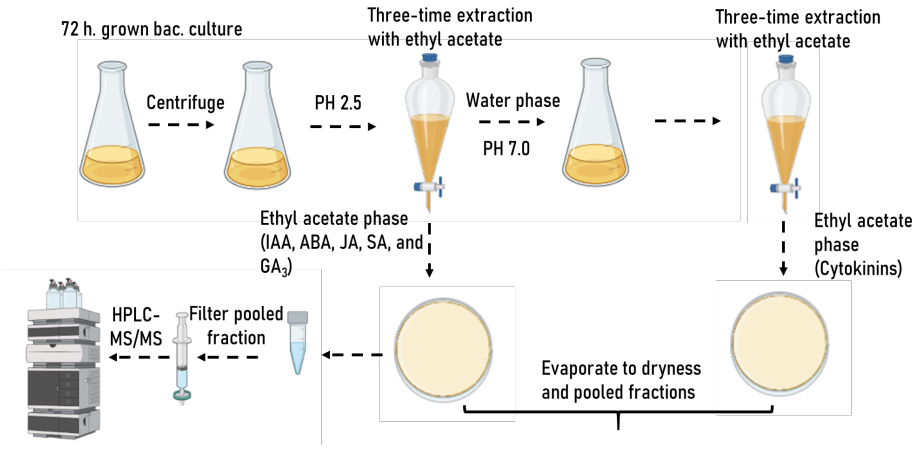


Figure caption: a two-step method for measuring plant-affecting hormones produced by microbes.

Survey for grapevine viruses in Connecticut vineyards

Dr. da Silva is leading a statewide survey of the viruses that cause grapevine leafroll disease (GLD) to develop efficient management strategies to control this devastating disease in Connecticut (CT) vineyards. GLD is the most detrimental and widespread viral disease of grapes worldwide (Figure 1). It can cause up to $40,000 loss per hectare during a single growing season. There is no cure for GLD. The only management options are to plant healthy grape seedlings and to eliminate infected plants from vineyards, because of vectors that can spread the viruses from infected to healthy plants. The problem is that GLD can take up to five years to develop visual symptoms and many common grape cultivars do not show GLD symptoms when infected. In this project, we joined experts in plant virology, entomology, and epidemiology in a collaborative effort to identify the extent of the viruses' spread and the insect vectors (hemipterans) capable of transmitting these viruses in CT. We have visited 25 vineyards and, overall, 54% of the samples tested were positive for at least one of the viruses that cause leafroll disease (Fig. 2). In this survey, we also determined the grape varieties most planted in this region (Fig. 3). CAES is partnering with the Connecticut Department of Agriculture in knowledge dissemination and outreach. The long-term goal is to develop a statewide management plan that is mechanistically and economically feasible, which might then be adopted by all growers throughout the northeastern region of the United States.

***Impact*:** With the survey results in hand, we are raising awareness among grape growers, vineyard managers, and vintners on the detrimental effects of this devastating virus disease on grape production and quality. We are providing real-time data to growers on the percentage of their vineyards that are infected with leafroll disease, and the plants that tested positive for the viruses so that growers can remove infected plants to reduce the viruses' spread. Our new virology lab at CAES is up and running - the only plant virology lab in the New England region. It is set up with all the equipment and resources needed to provide services to growers so that samples can be tested before planting to avoid the introduction of grapevine virus diseases in CT vineyards. Growing grapes is an expensive venture and having information on the presence of grapevine viruses in the state, the right identification of the virus species, the presence of vectors, and the percentage of virus incidence statewide will help to maximize resources and mitigate losses. We are already able to advise growers on when to remove plants and to spray pesticides to reduce vector populations in order to reduce the risks of virus spread in the vineyards. And, in worst-case scenarios, we will provide guidance as to when it is economically practical to remove all plants and start the vineyard afresh. Furthermore, our findings stress the need for improving the sanitary status of planting materials to avoid the introduction and dissemination of viruses to vineyards in this important wine-producing region of New England.

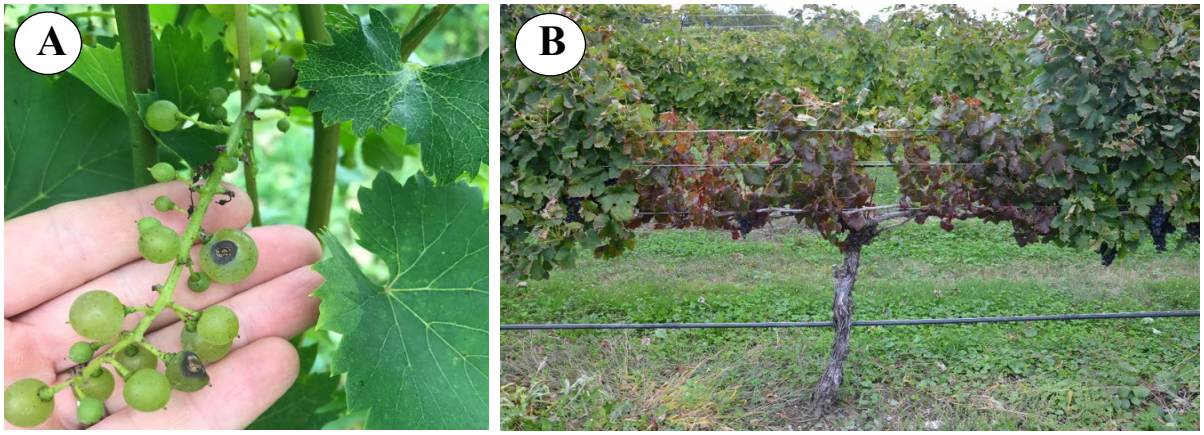
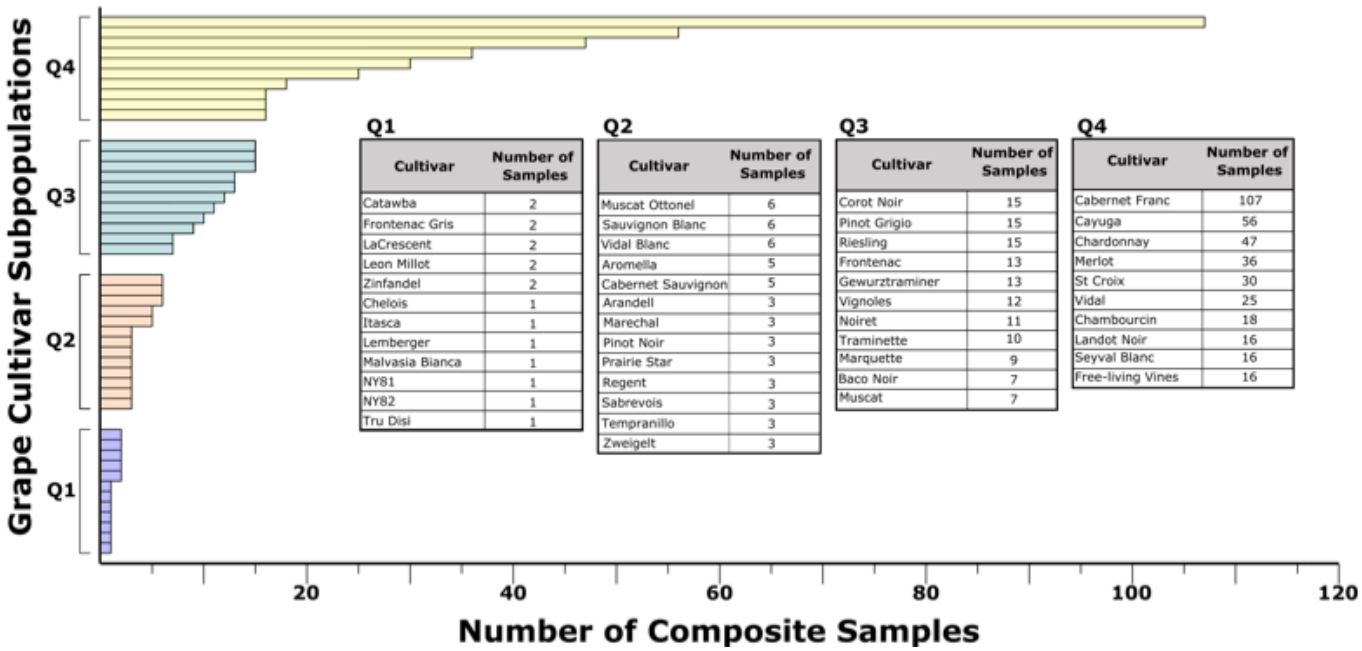


Figure 1. Mosaic-like on leaves and small berry malformation (A) and development of redness on grapevine young shoots and old leaves (B) resembling leafroll diseases.



Q1

Cultivar	Number of Samples
Catawba	2
Frontenac Gris	2
LaCrescent	2
Leon Millot	2
Zinfandel	2
Chelois	1
Itasca	1
Lemberger	1
Malvasia Bianca	1
NY81	1
NY82	1
Tru Disi	1

Q2

Cultivar	Number of Samples
Muscat Ottonel	6
Sauvignon Blanc	6
Vidal Blanc	6
Aromella	5
Cabernet Sauvignon	5
Arandell	3
Marechal	3
Pinot Noir	3
Prairie Star	3
Regent	3
Sabrevois	3
Tempranillo	3
Zweigelt	3

Q3

Cultivar	Number of Samples
Corot Noir	15
Pinot Grigio	15
Riesling	15
Frontenac	13
Gewurztraminer	13
Vignoles	12
Noiret	11
Traminette	10
Marquette	9
Baco Noir	7
Muscat	7

Q4

Cultivar	Number of Samples
Cabernet Franc	107
Cayuga	56
Chardonnay	47
Merlot	36
St Croix	30
Vidal	25
Chambourcin	18
Landot Noir	16
Seyval Blanc	16
Free-living Vines	16

Figure 3. Grape cultivar composition in vineyards of the Southeastern New England American Viticultural Area that were selected for this study. The number of composite samples of each cultivar collected was separated into quartiles, providing an indirect measure of the type and percentage of cultivars planted in the area. Quartile 1 (Q1) contains the cultivars less present in our sampling, and Q4 contains the cultivars most frequently sampled in the survey.

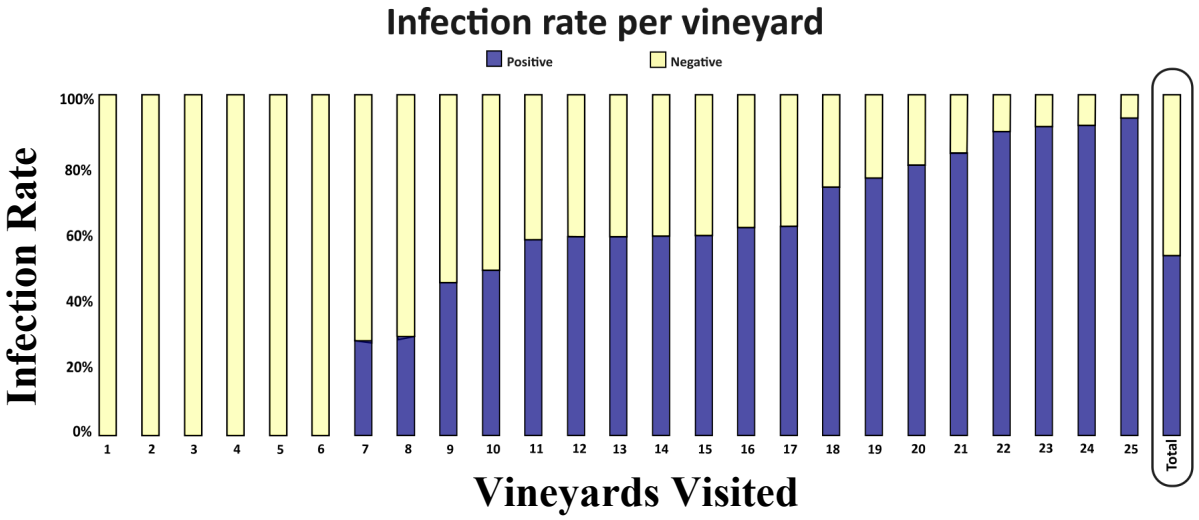


Figure 2. Twenty-five vineyards were analyzed for their incidence of GLRaV-1, -2, -3, and -4, as well as GFLV, ToRSV, and TRSV utilizing DAS-ELISA. Six vineyards tested negative for all seven viruses, whereas the remaining vineyards 7-25 had levels of overall virus infection ranging from 30% to 93%. A bar representing the total infection incidence in this study, according to DAS-ELISA, is circled at the far right with an incidence of 54%.

Tunable release of dsRNA molecules into plants from sustainable nanocarriers: A novel management tool for viral pathogens

Plant viruses cause US$30B losses annually worldwide. Viricide for control of viruses in crops is nonexistent and therefore, we rely heavily on the use of viral-resistant plant varieties and prophylactic methods. However, the lack of natural viral-resistant genes in plants coupled with a constant emergence of new virus strains, and the inefficiency of insecticides to control vector-insects of viruses, make plant virus disease management a challenging task. Thus, there is an increasing demand for innovative and sustainable ways of controlling virus epidemics in agricultural systems.

Virus resistance has been induced in plants by the application of exogenous double-stranded RNA (dsRNA), but its effectiveness is short-lived (~ five days). dsRNA is quickly assimilated by plant defense mechanisms and is also degraded by environmental factors. Herein, we propose to develop a novel and sustainable nanoparticle platform to deliver an effective and prolonged supply of dsRNAs in plants, with the long-term goal of developing innovative technologies to control plant viruses. Our two specific objectives and deliverables are: Short-term: synthesize three different nanoparticle platforms (chitosan, silica, and carbon dots) and test their capacity to provide stable and sustained delivery of dsRNA molecules into potato plant tissue. Long-term: develop a tunable platform for dsRNA delivery (nanoparticle-dsRNA complex) that can be translated to a range of viral-crop systems

Impact: The state of Connecticut (CT), like much of New England, is home to many family farms that grow a preponderance of specialty crops, which are primarily sold directly to consumers at farm stands, pick-your-own, farmers' markets, and local grocery stores - where quality is paramount, and any blemishes reduce marketability and farm value. Vegetables are the principal high-value crops with an annual farm-gate value of ~$118M. Solanaceous crops, including potatoes, account for a significant proportion of the total vegetable production, and 60-75% of the crop is sold at farm stands and farmers' markets, with the remainder sold to retail or grocery wholesale operations. While a large proportion of ~3600 acres of potato grown in this region is contracted to the potato chip industry, the fresh market outlets demand the highest quality. Produce marred by disease or pest damage is unmarketable and a total loss for the smallholder farms. Endemic and emerging virus diseases are becoming a major threat to vegetable production worldwide and there is little the growers can do to efficiently manage the losses caused by these pathogens (Fig. 1).

The results from this research have the potential to change the way we protect plants and to create sustainable plant virus disease control strategies that will help to mitigate crop losses due to virus diseases in CT potato farms. We have identified regions in the potato virus Y (PVY) genome, by Illumina high-throughput sequencing, likely to be efficiently targeted by RNAi silencing machinery and successfully designed dsRNA molecules that protect potato plants against PVY infections for up to five days (Fig. 2). As part of a USDA-NIFA grant of $636,000.00 recently awarded by our research group, we are working on designing, synthesizing, and testing different nanoparticles to act as nanocarriers for a sustainable delivery of dsRNAs to suppress PVY infections in potato plants (Fig. 3).

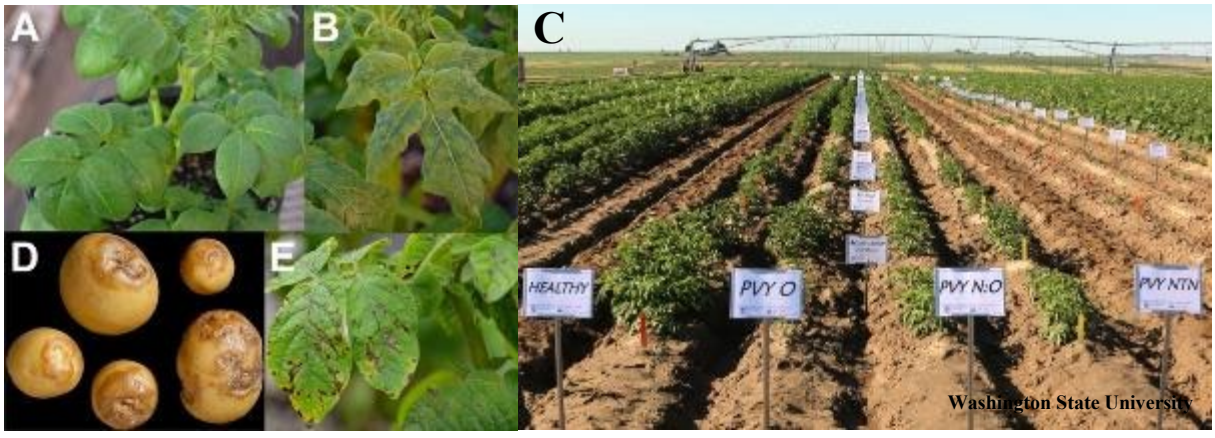


Figure 1. Symptoms caused by PVY on potato. **A)** a potato plant infected with PVY^{NWi}, but does not display any typical PVY symptom. **B)** a potato plant infected with PVY^{O} displaying mosaic on leaves. **C)** a potato field plot depicting plants infected with multiple strains of PVY. **D)** potato tubers infected by PVY^{NTN} displaying the potato tuber necrotic ringspot disease (PTNRD). **E)** a potato plant infected with PVY^{N} displaying leaf chlorosis and necrosis.

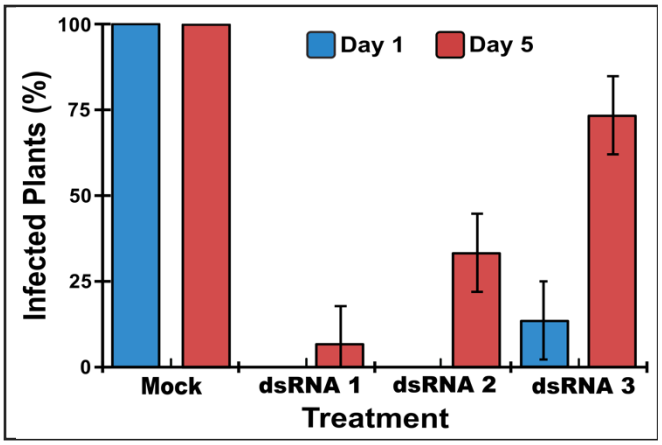


Figure 2. Percentage of infected plants (n=5) post treatment with dsRNA (from 3 different cistrons) followed by PVY^{Nwi} inoculation 1 or 5 days post dsRNA application. Three independent experiments were performed.

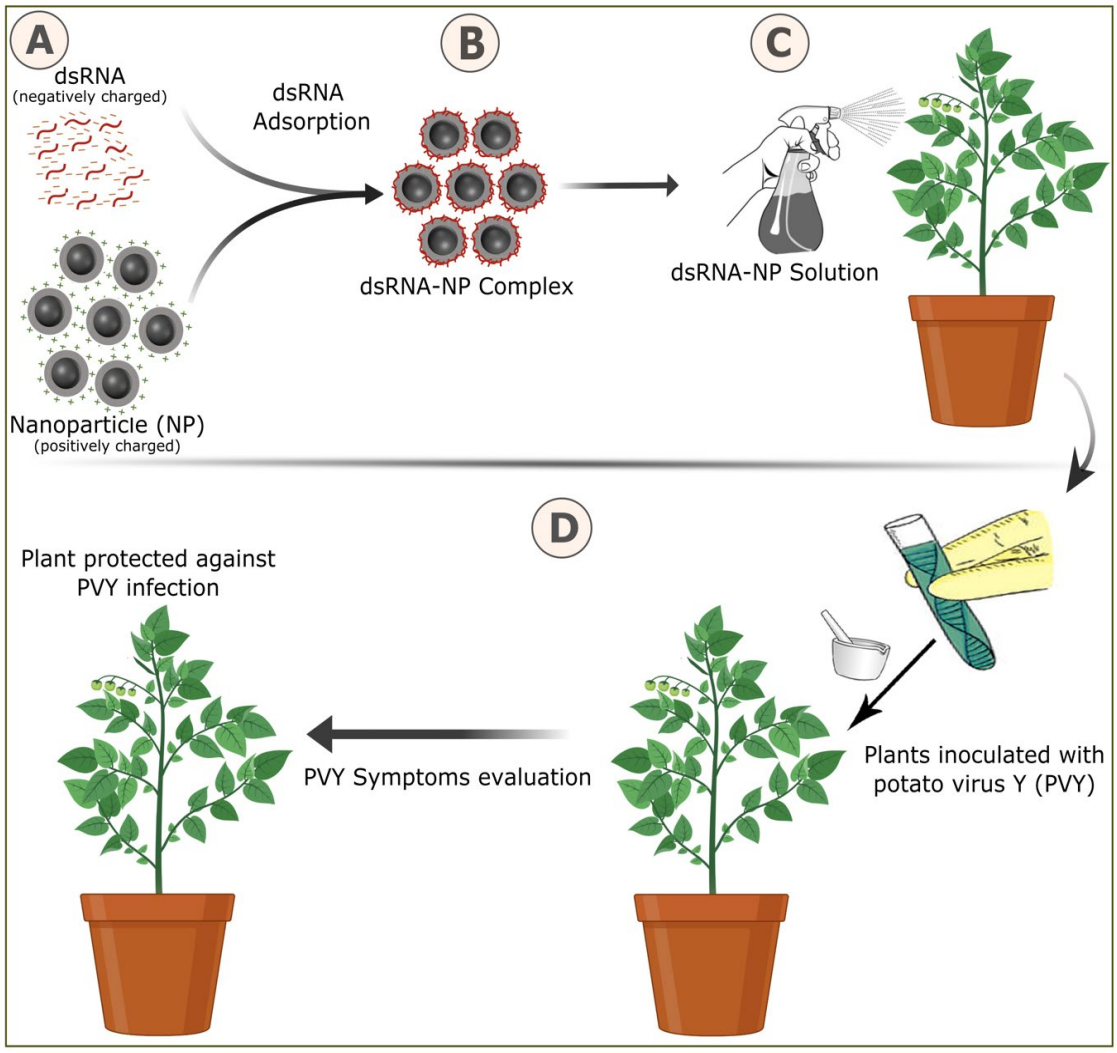


Figure 3. Overview of the research proposed. **A)** synthesis of dsRNA and chitosan, carbon dots (CDs), or silica-based nanoparticles (NP). **B)** dsRNA molecules adsorbed onto surface of positively charged chitosan, CDs, or silica-based nanoparticles (forming a dsRNA-NP complex) for slow release of dsRNA into plant leaves. **C)** dsRNA-Silica NP complex will be encapsulated by a layer of silica for slow-release. **D)** Virus inoculation post application of dsRNA-NP complexes formulations to determine which design will provide the best protection for potato plants against PVY infection. **E)** The best dsRNA-NP complex formulation will be used for treating potato plants in the field against PVY infections.

Direct application of nano-metal and metalloid oxides to control potato virus Y infection:

Nanotechnology has been established as a key factor to address inefficiencies in current agricultural practices. Different nanoparticles (NP) have been studied for their ability to effectively control plant pathogens through different strategies. Some NPs directly kill the pathogen (*e.g.,* antimicrobial NPs), while others act indirectly (*e.g.,* application of NPs to trigger plants' defense systems). However, limited studies have been conducted to investigate the potential effect of nanoparticles in controlling plant virus diseases. Our group has conducted some preliminary tests and found that the direct application of nano-metal and metalloid oxides can reduce symptoms expression of potato virus Y in tobacco (Fig. 1). We need to repeat those experiments with a larger sample size to confirm our results and test those NPs in other systems.

This research's long-term goal is to advance our understanding of the potential effect of NPs to suppress viral diseases of importance to Connecticut agriculture with the prospect of translating findings into viral disease management. Our three specific objectives are: 1) to screen different nanoparticles (*e.g.,* Ag, Cu, CuO, NiO, CeO, ZnO, Mn_2O_3, F_2O_3, and SiO_3) for their capability to suppress potato virus Y (PVY) infection in potato plants, 2) to investigate the underlying mechanisms for which the NPs potentially induce disease suppression, and 3) conduct field experiments to test the applicability of the NPs, found to suppress PVY infections, in a field set up.

Impact: The goals of this proposal will complement ongoing PVY research and attempt to provide growers with new tools to efficiently control PVY infections in potato fields.

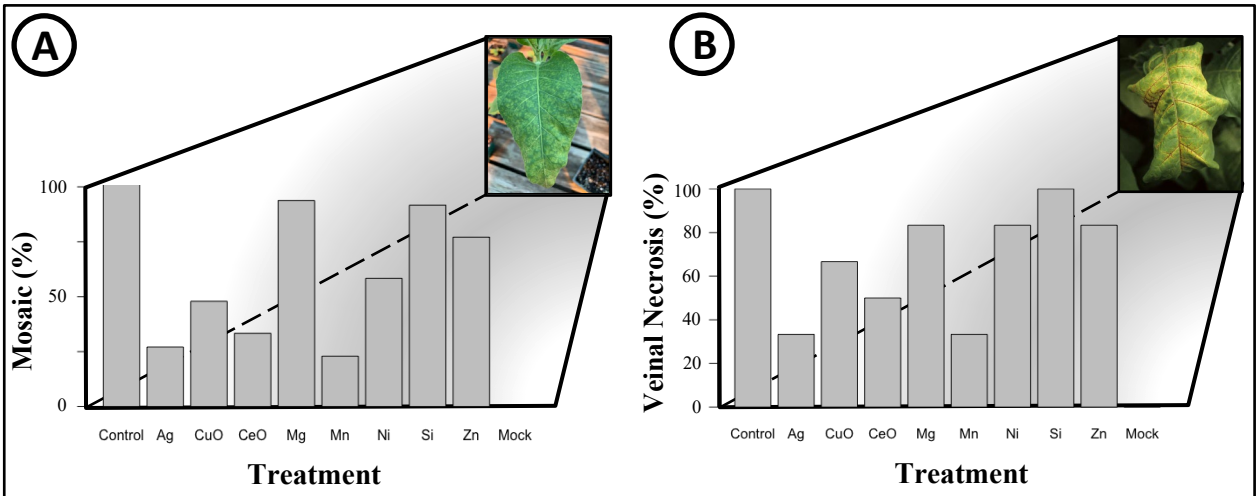
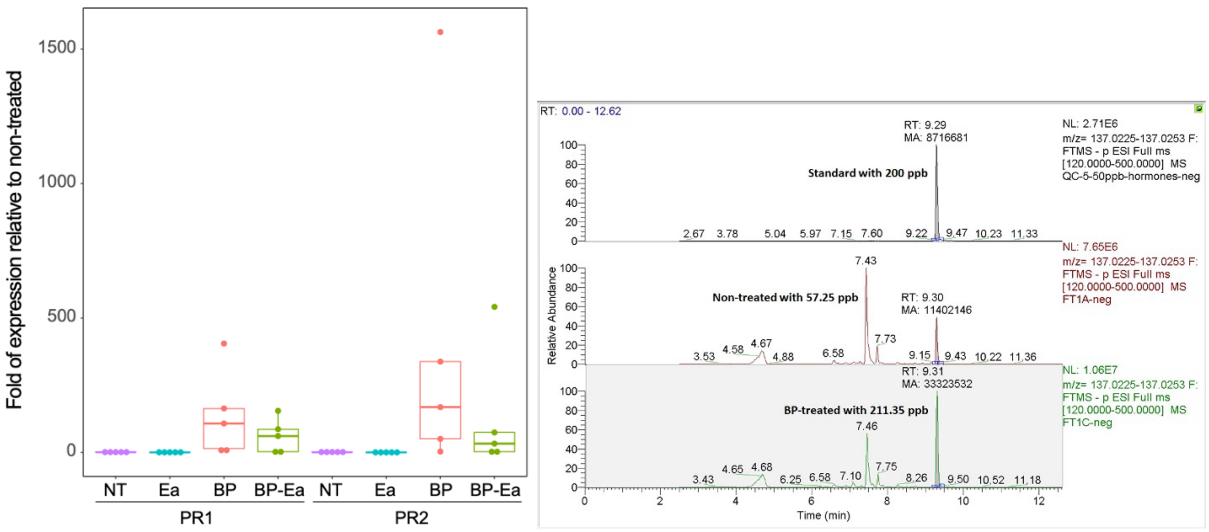


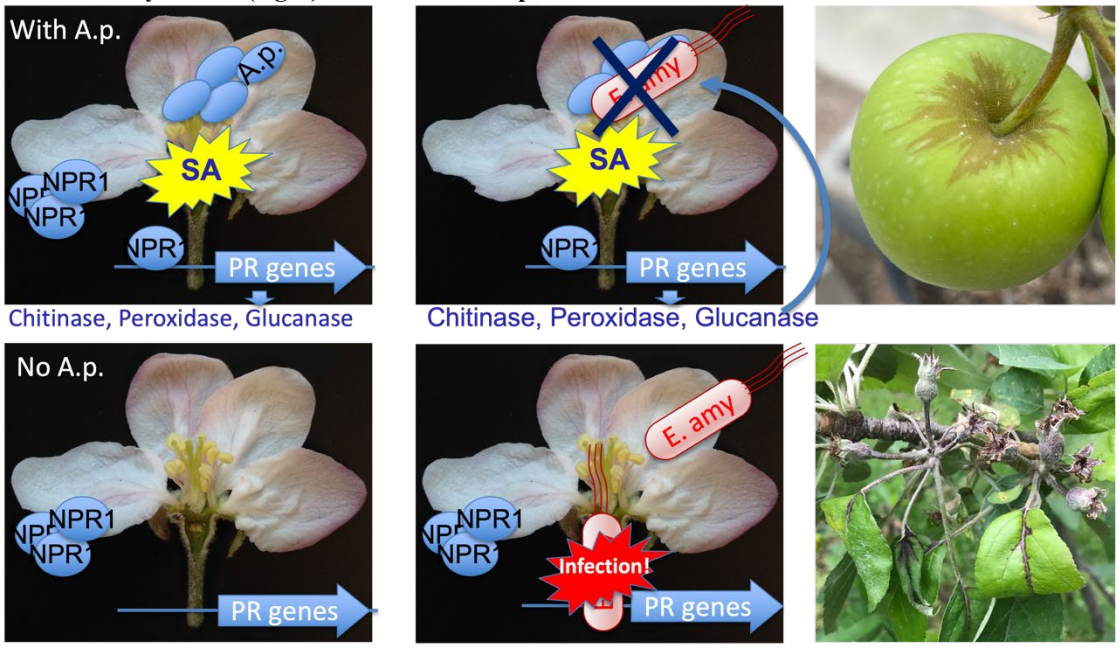
Figure 1. Preliminary studies with metal and metalloid oxides nanoparticles (NP) in suppressing potato virus Y (PVY) infection. Two-weeks old tobacco plants were foliarly treated with different NPs (500ppm) and inoculated with PVY 24 hours later. Plants treated with AgO, CeO, and Mn_2O_3 developed significantly less mosaic A) and veinal necrosis B) symptoms in comparison with plants not treated with NP.

Colonization of yeast-like fungi on apple flowers induces host immunity and prevents fire blight infection

Microbiome on plants is well recognized for its potential to influence plant disease occurrence through impacting the pathogen-host interactions. Fire blight, caused by a bacterial pathogen *Erwinia amylovora*, is a devastating disease of apple and pears. Blossom blight stage of fire blight infection, in which *E. amylovora* mutiplies eiphytically on flower surfaces such as stigma and stamen, prior to entering host through the hypanthium, is a critical step of the disease cycle. Previous research investigating the function of microbiome on fire blight mostly focused on the microbiome-pathogen interactions, however, to what extent the microbiome interacts with the host, and whether/how such interactions influence disease outcome is less understood. In collaboration with Dr. Sara Nason, Dr. Zeng and his colleagues Dr. Hassani, Dr. Mukhtar, Ms. Huntley and Ms. Smith, characterized the composition and dynamics of the mycobiome on hypanthium of apple flowers. Dr. Zeng and colleagues showed that some members of the mycobiome, namely the yeast-like fungi belonging to the *Aureobasidium* genus, induced the expression of pathogenicity related (PR) genes in the salicilic acid (SA) pathway in apple hypanthium. Some of the fungal isolates that induce host immunity genes also can colonize under cuticles of immature fruits and cause russeting of fruits. Spray-inoculating an *Aureobasidium pullulans* suspension to apple flowers significantly repressed fire blight infection. Our study indicates certain yeast-like fungi, through causing a minor russeting on apple cuticle, induced host immunity and thus primed the host to resist the infection of fire blight, a much more devastating disease that can cause tree mortality.



Upon treatment of *A. pullulans,* the expression of defense related genes, such as PR1 and PR2 (left), as well as the level of plant hormone salicylic acid (right) are elevated compared to the non-treated control.



A working model demonstrating how members of mycobiome, such as *A. pullulans*, can induce systemic infection and resist fire blight, but cause a skin defect on apple named russeting.

Impact: This research improved our understanding of the immune induction function of the plant microbiome. It also provides valuable disease management tools for fire blight, especially for organic apple productions as antibiotic use was banned since October 2014.

Manipulation of the apple stigma microbiome reduces the occurrence of fire blight disease

Flowers are important reproductive organs of Angiosperms. Flowers secrete nutrient rich exudates that support the growth of an assemblage of microorganisms, including both beneficial and pathogenic members, most of which belong to the phylum Proteobacteria. In this research, Dr. Zeng collaborated with Dr. Blaire Steven, and analyzed the interaction between the flower microbiome and the fire blight pathogen *Erwinia amylovora*. We first tested if the timing of colonization would affect *E. amylovora's* ability to interaction with the microbiome. Inoculating at an early time of bloom, but not the later time, affected flower microbiome significantly. Suggesting it is much easier for *E. amylovora* to colonize apple flowers when the microbiome is not mature. We also tested to see if *E. amylovora*, when co-cultured with members of the microbiome, would display different behavior (gene expression). Using a metatranscrptomic approach, we discovered that co-culturing *E. amylovora* with a *Pseudomonas* strain, but not a *Pantoea* strain, induced strong shifts in metatrascriptome.

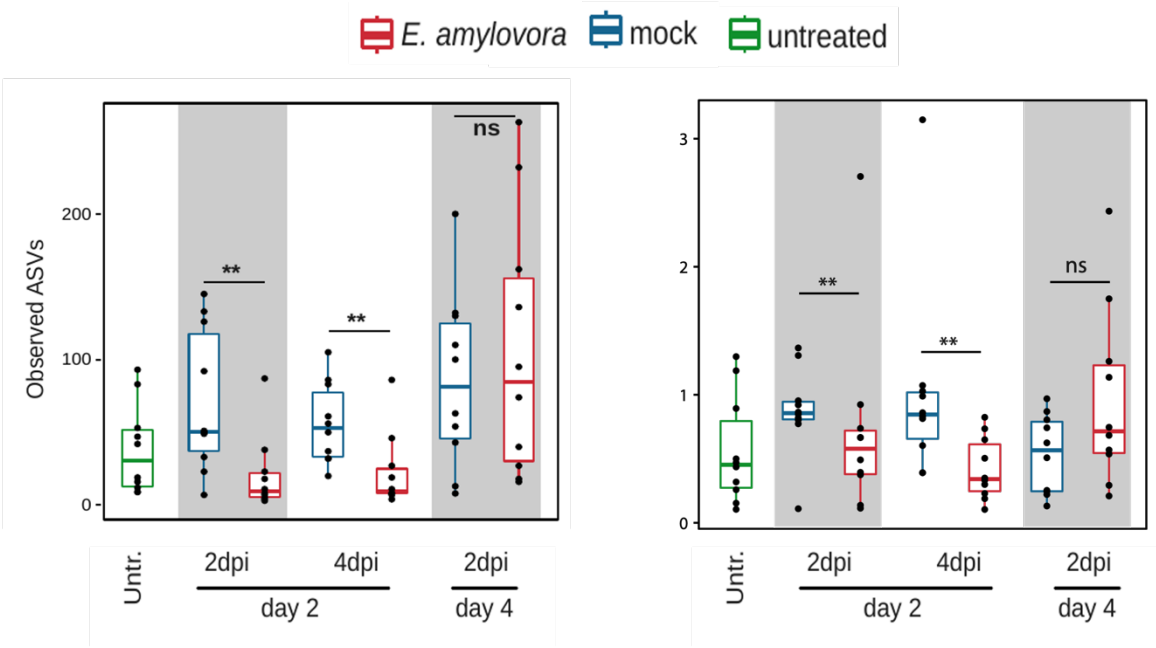


Figure illustrates the priority effect during *E. amylovora*-microbiome interactions.

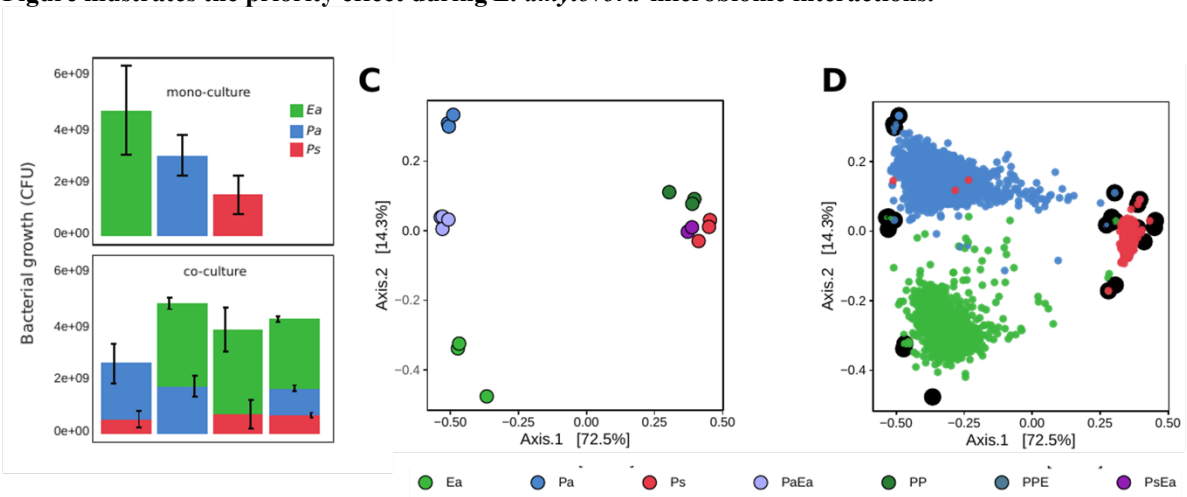


Figure illustrates *Pseudomonas* induces a strong shift of the transcriptome of *E. amylovora* during an in vitro co-culture.

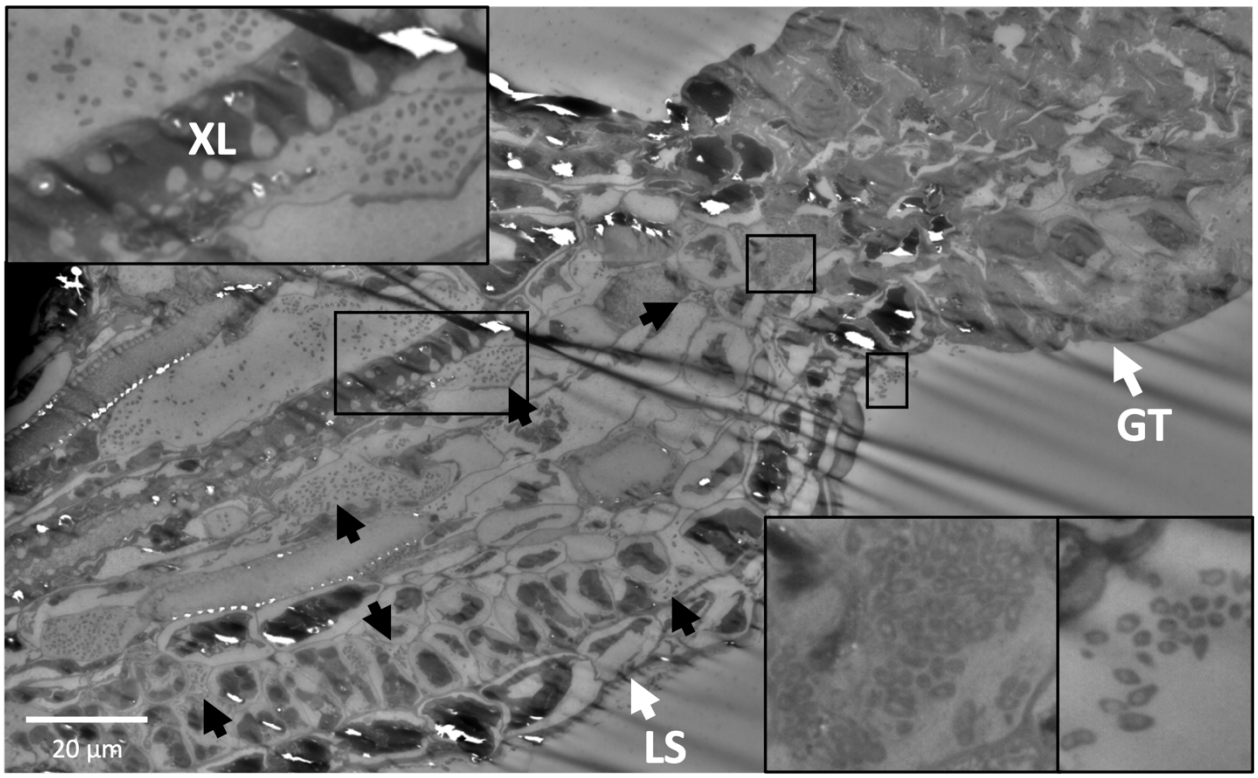
Impact: Findings from this research provided knowledge foundation of how *E. amylovora* interacts with the microbiome on apple flowers. It added new modes of action of microbiome in influencing disease occurrence, which is through affecting functions (transcriptome) of the pathogen.

Glandular and non-glandular trichomes are colonization sites and host entry points of the fire blight pathogen on apple leaves

Unlike fungal pathogens, bacterial plant pathogens do not have penetration structures thus rely on natural openings or wounds to enter host and cause disease. Characterized natural openings as host entry points by bacterial pathogens include stomata (Pseudomonas syringae) and hydathodes (Xanthomonas campestris). Fire blight, caused by a bacterial pathogen Erwinia amylovora, is a devastating disease of apple and pears. On leaves and shoots, E. amylovora has been long thought to enter host through injuries caused by insects, wind, and hailstorm, however, the level of infection observed in the field suggests there could be additional host entry points other than artificial wounds. In a recent study, Dr. Zeng and his graduate student Ms. Felicia Millett demonstrated that E. amylovora can infect apple leaves without artificial injuries (grown in a plant growth chamber). Epiphytic colonization of *E. amylovora* was observed on glandular and non-glandular trichomes. E. amylovora was later found in interceluar space of leaf tissue adjacent to the glandular trichomes and the veins. Additionally, Dr. Zeng and his team observed the glandular and non-glandular trichomes gradually rupture and fall off during leaf

development, which provide naturally occurred wounds for E. amylovora to enter. Although the type III secretion system is not required for colonization of E. amylovora on the glandular trichomes, it is however essential for E. amylovora to establish initial colonization in mesophyll tissue adjacent to the glandular trichomes. Finally the host entry and infection of shoots is heavily impacted by the shoot water content. When shoot water potential is below -18 bar, pathogen entry and shoot blight infection would not occur.

Impact: This research deepened our understanding of through what natural openings bacterial plant pathogens can enter plant hosts. By demonstrating that *E. amylovora* actually does not need to rely on artificial injuries to enter the hosts, some of the current management strategies, such as building windblocking trees around the orchards, is not necessary. The identification that the E. amylovora entry into host heavily relies on water provide mechanistic explanations why fire blight, particularly shoot blight, often occurs more heavily after a thunderstorm in the summer. Some of the information will be useful for establishing a disease prediction model to evaluate shoot blight risk and may provide precise timing of pesticide applications.



Transmission Electron Microscopy Images showing *Erwinia amylovora* cells entering glandular trichomes and colonizing in the epithem prior to migrating towards the xylem. GT, glandular trichome, LS, leaf serration, XL, xylem vessel.

Metabolic interactions of *Erwinia amylovora* and Apple in the establishment of Fire blight (Schultes lab)

Dr. Schultes is studying metabolic requirements of *Erwinia amylovora* to establish disease. *E. amylovora* is a bacterium and the causal agent of fire blight, a devastating disease of apples and pears. Fire blight originated in the Northeast United States but is now found worldwide and is a major disease for commercial farmers. As part of the disease process, *E. amylovora* grows on different plant tissues including the stigma of flowers, developing fruit, the plant vasculature and in cankers. In springtime, infected cankers generate ooze from over wintering *E. amylovora* that serves as inoculum for emerging blossoms. Different floral parts serve as bacterial propagation locals during disease establishment. *E. amylovora* is deposited on stigmatic surfaces (either by wind or visiting insects), amplifies and then is introduced into the nectary after a wetting event. Thereafter, bacterial growth occurs in the developing fruit with eventual invasion into the vascular system and subsequent dispersal in the plant. Endogenous virulence factors aid *E. amylovora* to evade and suppress host recognition and defense strategies to establish infection. Once it has gained entry, *E. amylovora* must acquire adequate nutrition to proliferate and establish disease. Importantly, colonized plant tissues present the bacterium with distinct nutrient environments requiring the bacterial to be metabolically nimble.

In apples the amino acids asparagine and aspartate serve as major nitrogen transport molecules. During springtime asparagine and aspartate are transported from the roots to actively growing tissues including young leaves and flower buds. The peak of asparagine and aspartate concentrations in xylem sap coincides with the development of flower clusters. Infection of flowers by *E. amylovora* initiates as flowers open soon thereafter as the bacteria deposit and propagate on stigmatic surfaces. Our research investigates the requirement of aspartate biosynthesis by *E. amylovora* for successful disease establishment.

The research project is a collaboration with Dr. Timothy McNellis and colleagues at the Dept. of Plant Pathology and Environmental Microbiology at the Pennsylvania State University and a continuation of work by Dr. Schultes during his sabbatical leave in the fall of 2021. Our aim is to isolate and biochemically characterize the gene(s) controlling the final step in aspartate synthesis and then to mutate these loci in *E. amylovora* and test if virulence on apple fruitlets is compromised. It turns out that in *Escherichia coli* two distinct enzymes, aspartate aminotransferase (AspC) and tyrosine aminotransferase (TyrB), exhibit complementarily dual functions and complete the last steps in both aspartate and tyrosine synthesis. The *E. amylovora* genome also contains orthologous genes *EaAspC* and *EaTyrB* that encode for similar enzymes as found in *E. coli*. The first step is to verify determine if EaAspC and EaTyrB function as their *E. coli* counterparts. The coding regions for both *EaAspC* and *EaTyrB* were cloned into an inducible expression vector, pQE80L, to generate plasmids *pEaAspC* and *pEaTyrB* for use in heterologous complementation experiments. A double mutant *E. coli* strain was generated by deleting the AspC and TyrB loci and replacing with *CamR* and *KanR* antibiotic resistance genes. As shown in figure 1 mutant *E. coli* strain alone requires the addition of aspartate(A) and tyrosine(T) for growth, however growth is restored if either pEaAspC or pEaTryB are present, indicating that the *E. amylovora* genes act similarly to those in *E. coli*. These results show that the EaAspC and EaTyrC function as their *E. coli* counterparts.

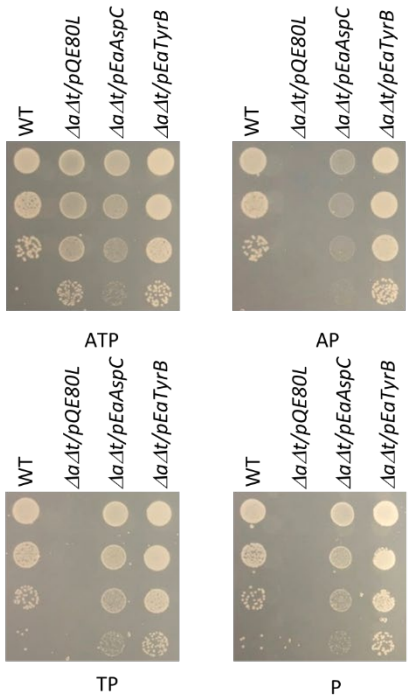


Fig 1. Functional analysis of *E. amylovora EaAspC and EaTyrB in E. coli ΔaspC/ΔtyrB* Wild type and mutant *E. coli* strains with vector control (pQE80L) or pEaAspC or pEaTyrB were grown on minimal media supplimented with aspartate (A), tyrosine (T) or phenylalanine (P).

The next step in our research is to verify the function of EaAspC and EaTyrB in *E. amylovora*. Here, *E. amylovora* strains deficient in both *EaAspC* and *EaTyrB* were generated using two independent mutational methods. The first method disrupts target loci by inserting plasmid (pKNOCK) sequence into the open reading frame by means of homologous recombination. The second mutational technique results in a deletion of target gene sequence and replacement with either antibiotic resistance genes CamR or KanR using the λ red protocol. As can be observed in Fig. 2 the double λ red derived *E. amylovora* mutant requires aspartate and tyrosine for growth, confirming that no other gene is functions for the terminal step in asparagine and tyrosine synthesis.

The last query in our research is to determine if loss of either *EaAspC*, *EaTyrB* or both genes effect the virulence in young apple fruitlets – a standard assay used to access virulence of *E. amylovora* strains. Here a series of young apple fruitlets were inoculated with 10^6 colony forming units of *E. amylovora* strains and monitored for disease symptoms over 6 days. The strains include a wild type. single mutant strains for *ΔaspC::CamR* or Δ*tyrB::KanR*; and two different double mutant strains carrying *ΔaspC::CamR ΔtyrB::KanR* or the pKNOCK alleles *aspC:Kn-CamR tyrB:Kn-KanR*. As shown in Fig 3 below all strains were able to form disease symptoms, indicating that aspartate and tyrosine, either as free amino acids or available from peptide breakdown, are available in developing apple fruit.

Impact: Comprehending how *Erwinia amylovora* utilizes the aspartate and tyrosine in disease establishment will contribute to devising new strategies for fire blight control.

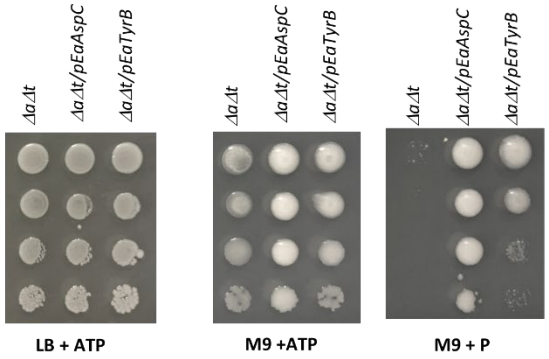


Fig 2. Amino acid requirements For growth of *E. amylovora ΔaspC ΔtyrB.Growth profiles of E. amylovora ΔaspC ΔtyrB with* vector control (pQE80L) or pEaAspC or pEaTyrB on rich media (LB), minimal media (M9) supplemented with aspartate

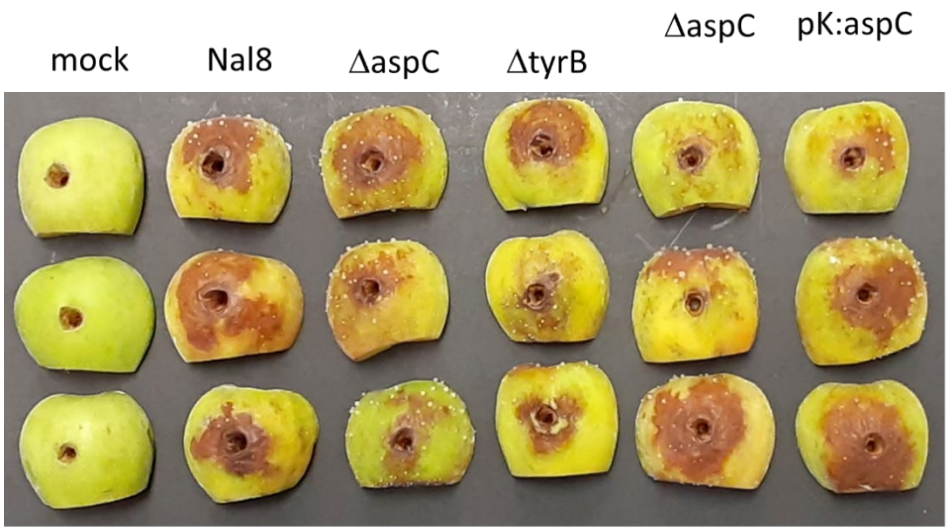


Fig 3. Apple fruitlet virulence assay for *E. amylovora aspC* and *tyrB* mutant strains. Three representative fruitlets were inoculated with no bacteria (mock solution only) or 10^6 CFU of wild type (Nal8); *ΔaspC::CamR*; *ΔtyrB::KanR*; *ΔaspC::CamR ΔtyrB::KanR* or pKNOCK alleles *aspC:Kn-CamR tyrB:Kn-KanR* and grown for 6 days at constant temperature. Disease symptoms include browning tissue and ooze droplet formation.

Forest Health Monitoring

Oak Wilt (Marra Lab)

Given its repeated occurrences in nearby parts of New York State, in Brooklyn and on Long Island, oak wilt remains an imminent threat to Connecticut's urban, suburban, and natural forests. Dr. Marra has assumed responsibility for monitoring for oak wilt in Connecticut, a devastating vascular wilt disease that can kill oaks in the red oak group (red oak, scarlet oak, black oak, pin oak, bear oak, in Connecticut) within a single season. Caused by the ascomycete fungus, *Bretziella fagacearum*, symptoms of the disease, characterized by rapid crown dieback and, in some cases, premature defoliation, can be easily confused with other biotic and abiotic factors; therefore proper and complete diagnosis of oak wilt must be completed in the laboratory, involving attempts to culture the fungus from properly collected material, as well as DNA extraction and PCR. Because the fungus spreads rapidly via root grafts and is easily vectored by native sap beetles, timely diagnosis and, should *B. fagacearum* be confirmed, regulatory intervention regarding removal and delimitation, are essential. Dr. Marra continues to educate the public on symptoms to be on the lookout for, through presentations to, and interactions with, landscape and tree-care professionals, tree wardens, and those enrolled in Master Gardener classes.

Impact: Oak wilt is a devastating disease that threatens Connecticut's abundant red oak stock, including red oak, black oak, pin oak, scarlet oak, and bear oak. Based on the trajectory of outbreaks in neighboring New York state, the disease is most likely to turn up in residential areas, which makes scouting and surveys futile. We are therefore dependent on the informed vigilance of tree-care professionals, which includes arborists, tree wardens, and other landscape managers. Also essential is

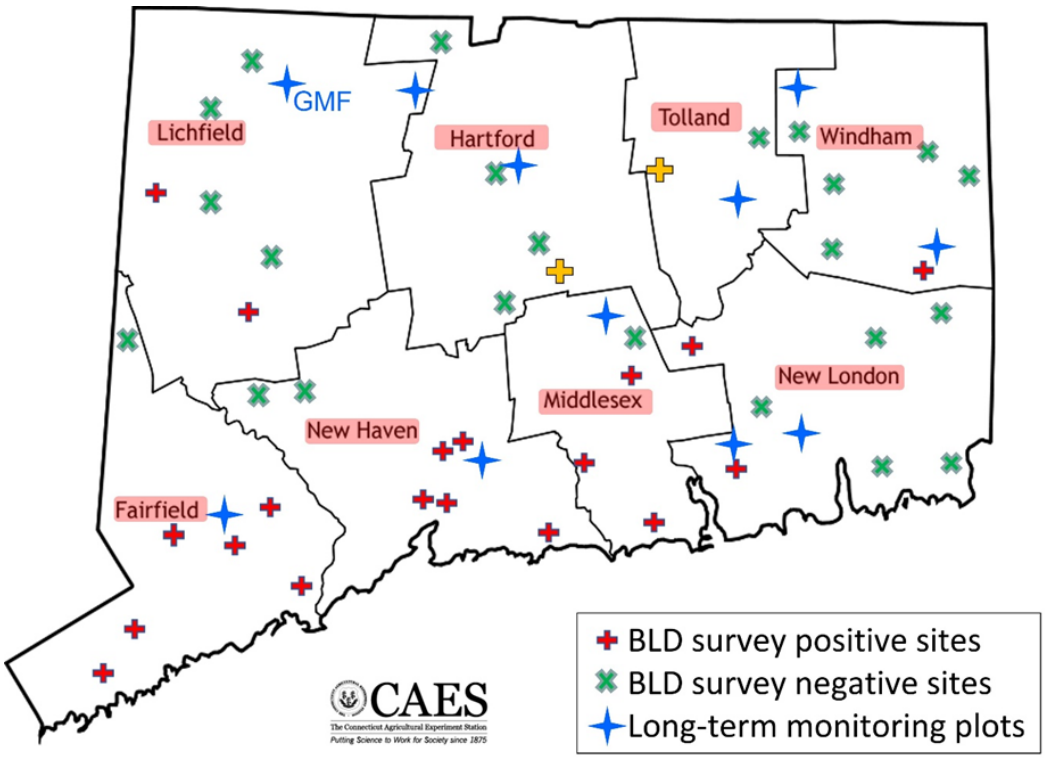
the ability of The CAES staff to act quickly in diagnosing and confirming the presence of *Br. fagacearum*, and communicating this to the state's DEEP, which will be responsible for developing a response protocol, such as those now established in New York, Minnesota, Wisconsin, and other states dealing with this lethal and easily spread disease.

Forest Health Monitoring

Beech Leaf Disease (Marra Lab)

Beech leaf disease (BLD) was first found in Connecticut in 2019 on American beech (*Fagus grandifolia*) in lower Fairfield County. By 2021, the disease, caused by the foliar nematode, *Litylenchus crenatae mccannii* (*Lcm*), was confirmed in all eight Connecticut counties. Dr. Marra continues to receive, and respond to, phone and email inquiries from CT stakeholders, including tree-care professionals. Through interviews with print, radio, and television media, press releases, and public presentations, Dr. Marra continues to educate the Connecticut public regarding this disease. Through a cooperative agreement with the USFS, Dr. Marra installed 11 long-term BLD monitoring plots in 2020; these plots conform to a design that has been implemented in states where BLD has been observed or where it is anticipated to occur. Distributed throughout the state in all 8 counties (Figure 2), these plots will continue to be measured annually following protocols standardized by the USFS, which is the recipient and user of these data.

In spring of 2022, the severity of BLD throughout the state exceeded all expectations, with large areas of understory beeches flushing no leaves due to aborted buds; what few leaves did flush were heavily symptomatic, predominately shrunken, curled, and heavily necrotic. Additionally, in 2022 BLD has been found in new states and more areas of other states, with the disease much more widely distributed in Litchfield, Hartford, Tolland, and Windham Counties, relative to 2021. These symptoms do not comport in severity with those reported by the areas of the continent – Ohio and Ontario, CA – that first observed BLD in 2012-2013. The severity has elicited an outpouring of public inquiries and concerns, nearly all of which have been directed to Dr. Marra, requiring many hours of time spent responding. Additionally, Dr. Marra was interviewed by various local media, which helped to educate the public about BLD, as did a video podcast, available on Youtube, featuring Dr. Marra and created for this purpose (https://youtu.be/Hl6yOXrsEzo).

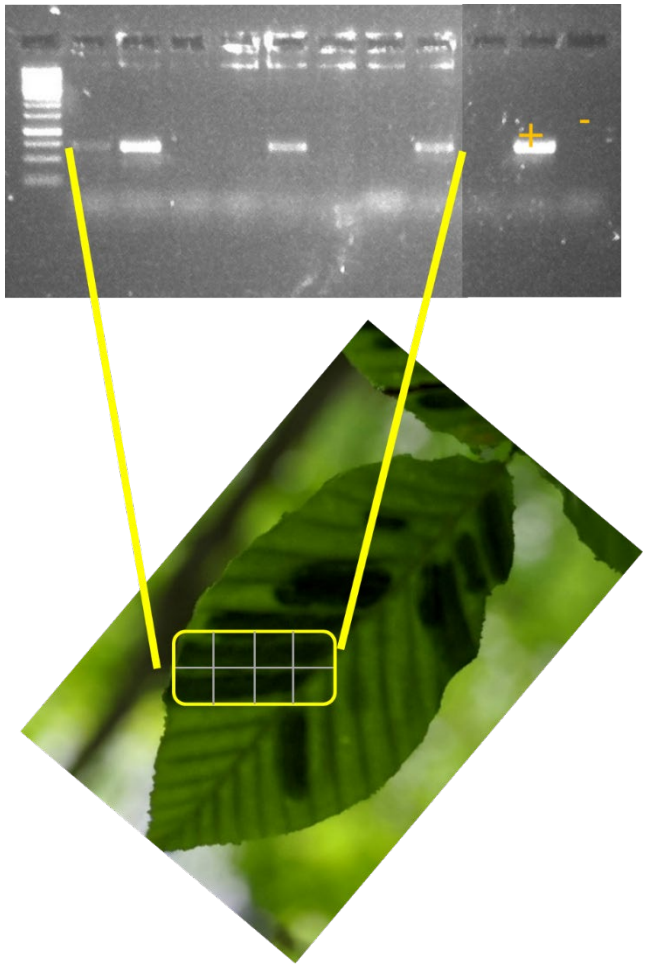


Long-term BLD monitoring plots, and 2020 survey sites, indicating where BLD was found and not found. The red "plus" signs indicate where BLD was found in 2020; the gold "plus" signs indicate where BLD was confirmed in August 2021.

One of thousands of beeches in CT forests showing severe impacts – aborted buds, branch and tip dieback – of beech leaf disease in spring of 2022. This 4" dbh mid-canopy beech was nearly completely unfoliated following bud-break; the majority of buds on this tree were dead. The few leaves that did emerge on this tree show advanced symptoms of BLD. West Rock Ridge State Park, June 2022.

"Advanced" symptoms of BLD, as observed in West Rock Ridge State Park in spring of 2022.

Since 2019, Dr. Marra has been an active and contributing member of the Beech Leaf Disease Working Group, comprising researchers in CT, OH, NY, NH, VA, WV, the USDA-ARS, and Ontario, Canada. This past year, Dr. Marra continued refining a rapid PCR diagnostic test that now targets a 350 bp portion of the mitochondrial cytochrome oxidase subunit 1 gene (CO-I) that has higher specificity than the previous assay to both *L. crenatae* subspecies, *mccannii* (N. America) and *crenatae* (Japan), permitting confirmation of the presence of the nematode using DNA extracted from 10 mg of leaf tissue. Ring-testing in collaborators' labs confirmed the specificity and sensitivity of the assay. The inability to find nematodes, in the form of juveniles or adults, in symptomatic tissue before early July, led earlier researchers to tentatively conclude that the nematode is not the cause of BLD, but more likely an opportunistic colonizer of necrotic tissue whose cause was yet to be determined. Dr. Marra used the CO-1 PCR assay method to reveal the random and patchy distribution of the nematode (eggs, presumably) in early-season symptomatic leaf tissue.



Symptomatic portions of leaves were divided into approximately equal pieces (10 mg), lyophilized, then processed for DNA using the Qiagen DNeasy Plant Pro kit, modified by first incubating tissue overnight at 56C in the kit's CD1 buffer amended with 50 mg Proteinase K. DNA extracts were then used as template in PCR reactions targeting the 350-bp CO-1 region as described above. The CO1 target was not found in asymptomatic portions of leaves (data not shown). This experiment was repeated several times to demonstrate the heterogeneous distribution of Lcm in symptomatic tissue.

The qPCR assay targeting this same CO-1 region, developed the previous year by Dr. Marra, proved essential to recently published research investigating the validity of an in-field detection method for identifying asymptomatic (early and in-season) infestations by the nematode using near-infrared spectroscopy and machine learning (Fearer et al. 2022).

For purposes of studying pathways of spread of the BLD nematode, Dr. Marra identified 16 candidate microsatellite loci using a whole-genome sequence obtained from the nematode the previous year. The goal this past year was to screen these loci for informative polymorphisms against BLD nematodes collected from as broad a distribution as possible. To that end, Dr. Marra obtained BLD symptomatic leaves from colleagues in Massachusetts, Maine, New York, Ohio, Pennsylvania, Rhode Island, and Virginia, optimally a mixture of leaves from numerous symptomatic trees from several sites, collected at the end of the 2021 season (September-October) in order to maximize the numbers of nematodes collected (nematode populations increase exponentially inside leaves over the course of the season). Nematodes were extracted from leaves by floating symptomatic portions in large trays of water, then concentrated via centrifugation, and stored at -20C. DNA was extracted from aliquots of approximately 10,000 nematodes, pooled from multiple trees from a single site or forest, using the Qiagen DNeasy Blood & Tissue kit, resulting in a screening population of 23 DNA samples. The 16 candidate microsatellite loci were then screened against these DNAs using PCR incorporating fluorescently labeled primers; amplicons were then separated by size at the Yale DNA sequencing facility. Eleven of the 16 loci were polymorphic among and within sites, while five loci were monomorphic across the entire screening population.

		Microsatellite Loci (bp)																																		
State	# sites	ata4		agc2		cttc1			tat2		gca1		ctg1		caa1						aca1		ttg1		tat3			agaa1		
CT	3		379	293		319	323	327		198	296	300		327			168	170			176		314		378	379		118		157
MA	2		379	293			323	327		198	296			327	160		168		177	182	176		314		378			118		157
ME	2	378	379	293	300		323	327		198	296			327			168				176	180	314		378			118		157
NY	7		379	293		319	323	327		198	296	300		327			168			182	176		314	317	378		381	118		157
OH	2		379	293		319	323		197	198	296			327			168				176		314		378			118		157
PA	3	378			300		323	327		198	296		324	327		165	168			182	176		314		378			118		157
RI	3	378	379	293	300		323	327		198	296	300		327			168				176		314		378			118		157
VA	1		379	293			323			198	296			327			168				176		314		378			118	154	

Alleles at each locus are indicated by amplicon size. Alleles highlighted in yellow are "private alleles"; those that were found only in one state or region. Five loci (aga1, ctca2, agg1, agc4, ttc2) were monomorphic among all 23 sites, and therefore are not shown here.

These data are preliminary, and likely do not represent all allelic diversity at these loci, due to the possibility of amplicon length bias in microsatellite PCR. The next stage of this research will involve testing the markers against DNAs extracted from individual nematodes. This will permit testing the hypothesis that high levels of homozygosity in individual nematodes reflects a genetic bottleneck, which often occurs with one or a few introductions of an exotic pathogen. Additionally, by genotyping cohorts from within single interveinal bands, we can test the hypothesis that Lcm undergoes parthenogenesis (females producing offspring without fertilization by sperm). We suspect this possibility because we have identified the bacterial endobiont, *Wolbachia* sp., in Lcm; *Wolbachia* spp., widespread in nematodes and arthropods, is known to effectuate parthenogenesis in females of some hosts.

After these data were obtained, three more candidate loci were identified that appear to be polymorphic in this screening population.

This past year, Dr. Marra has optimized the process of extracting DNA of suitable quality and quantity from single nematodes that can be used to amplify the entire set of microsatellite loci.

Disease Survey

During the year 2021-2022, Dr. Yonghao Li assisted by Ms. Katherine Dugas and Ms. Rose Hiskes diagnosed a wide range of fungal, bacterial, viral, nematode, and abiotic diseases on trees, shrubs, herbaceous ornamentals, lawn grasses, fruits, and vegetables.

Woody Ornamentals:

Since beech leaf disease was first detected in Connecticut 2019, the disease has been found in all counties of the State. Compared to last two years, more severe damages with distorted leaves and unopened dead leaf buds were observed on infected trees in the spring of 2022, which poses a threat to beech trees in both landscapes and forests. Between May and June in 2022, over 100 inquiries of problematic beech trees were handled by staff in the Plant Disease Information Office. Boxwood blight remains a major concern in landscapes and nurseries. Among 248 boxwood samples received, boxwood blight was confirmed on 47 samples. Other common problems on boxwood were winter injury, Volutella blight/canker, and Macrophoma leaf spot. Botryosphaeria canker was prevalent on oak, beech, cedar, hornbeam, and rhododendron. Trellis rust was problematic on pear trees and cause severe damages on certain varieties. Powdery mildew was found on dogwood, Japanese maple, lilac, serviceberry, and ninebark. An increased trend in Dutch elm disease was observed. Alternaria leaf spot resulted in severe early defoliation on privet in the summer. Rhizosphaera needlecast and Stigmina needlecast remained two major foliar diseases on spruce. Fungal leaf spot remained a major disease on mountain laurel bushes. Transplant shock and environmental stress resulted in severe diebacks of arborvitaes. Sudden fluctuations between severe cold and warmer winter temperatures caused severe winter injuries on rhododendron and jumpers.

Thin canopy resulted from beech leaf disease

Dark bands on leaves and dead leaf buds caused by beech leaf disease

Septoria leaf spot of maple

Powdery mildew of serviceberry

Dutch elm disease

Winter injury of rhododendron

Winter injury of juniper

Herbaceous Ornamentals:

Xanthomonas blight of geranium was detected in many greenhouses in the spring 2022 because of infected plugs in shipments from suppliers. Several dahlia plants from landscapes and propagation rooms were tested positive for Potyviruses. Southern blight caused by *Sclerotium rolfsii* was prevalent on hosta. A severe damage on Liatris caused by Rhizoctonia web blight was found in a nursery. Powdery mildew was problematic on begonia, heuchera, peony, beebalm, rudbeckia, and zinnia. Botrytis blight was found on phlox, hosta, dianthus, and impatiens. Bacteria leaf spot was problematic on Zinnia. Bacteria leaf spot was found on greenhouse-grown salvia, lavender, poinsettia, chrysanthemum, begonia, and heuchera.

Xanthomonas blight on geranium

Potyvirus on dahlia

Rhizoctonia web blight of Liatris

Vegetables and crops:

Septoria leaf spot remained a major disease in garden- and field-grown tomatoes. Fusarium wilt of tomato became prevalent in vegetable gardens. Many cases of herbicide injury were reported on various vegetable plants in gardens, especially on tomato plants. Bacterial leaf spot and Phytophthora blight remained major problems on peppers. Powdery mildew, anthracnose, and bacterial angular leaf spot were major disease problems on cucurbits. Verticillium wilt was a major disease on eggplant. White mold was problematic on garden- and field-grown garlics.

Herbicide injury on tomato

Bacterial leaf spot of pepper

Tree and Small Fruits:

Scab and Botryosphaeria black rot diseases were identified on quince. Black knot was prevalent on cherry, plum, and peach, and trees. Cedar-apple rust, scab, fire blight, frogeye leaf spot, and black rot were prevalent on apple trees. On pear trees, rust and Fabraea leaf spot were problematic. Leaf curl, scab, and brown rot continued to be major diseases on peach. Black rot, powdery mildew, downy mildew, and anthracnose were commonly found on grapevines. Phomopsis canker, Botryosphaeria canker, and mummy berry were major diseases on blueberry.

Quince scab

Botryosphaeria black rot of quince

Turf:
Brown patch, summer patch, red thread, pink patch, dollar spot, Pythium blight, anthracnose, Bipolaris leaf spot, powdery mildew, and rust were common lawn grass diseases. Slime mold and mushrooms in lawns raised residence's concerns.

Pink patch of turfgrass

Slime mold of turfgrass

Weeds:
In the spring 2022, abundant and high members of maple seedlings in lawns raised homeowner's questions if these weeds need to be treated with herbicides or not. Running bamboo and Japanese knotweed continued to be a topic of increasing public concerns because these weeds caused problems between neighbors. Poison ivy, poison hemlock, oriental bittersweet, Virginia creeper, horsenettle, garlic mustard, mugwort, mullein, spurge, Japanese stiltgrass, thistles, and sumac remained significant problems in residential properties and gardens. Crabgrass, annual blue grass, bermudagrass, bittercress, creeping bentgrass, common chickweed, mouseear chickweed, clover, ground ivy, yellow nutsedge, purslane, red sorrel, roughstalk bluegrass, wild garlic, and wild violets were major weed problems in lawns.

Maple seedlings in a lawn

Virginia creeper in a lawn

Impact: Information of disease survey in Connecticut landscapes, greenhouses, nurseries, vegetable fields, orchards, natural woodlots, forests, and home properties each year helps to monitor and assess the impact of these problems on the overall health of plants in the state. This information also assists in detecting new diseases or in identifying potentially important emerging diseases on specific plants, which can then be monitored in the years that follow.

SERVICE ACTIVITIES

Members of the Department of Plant Pathology and Ecology are involved in a wide range of service and public outreach activities. Some of these services involve presentations, publications, displays at meetings and other outreach events, tours of facilities, and interviews, in addition to being conducted in cooperation with other state agencies.

Seed Testing: In Cooperation with the Connecticut Department of Agriculture, Bureau of Regulation, and Inspection

Every year, official samples of vegetable, crop, and lawn grass seeds are collected by inspectors from the Bureau of Regulation and Inspection of the Connecticut Department of Agriculture and submitted to the Plant Disease Information Office at The Connecticut Agricultural Experiment Station, an official seed testing laboratory for Connecticut.

In 2021, a total of 318 official vegetable seed samples were collected by inspectors from the Bureau of Regulation and Inspection of the Connecticut Department of Agriculture for testing. Among them, only 315 samples were tested for seed germination rates because the other three samples did not have enough seeds for the test. Among the tested vegetable seed samples, two hundred fifty samples passed the germination test, but the other 65 samples did not meet their label claims and the Federal standard. Summarized by seed sources, one or more vegetable seed samples from all companies failed germination tests. Grouped by vegetable species, bean, beet, cantaloupe, cucumber, okra, pea, and squash samples had more samples that did not meet the claims than the other species. Seed samples were examined for prohibited noxious weed seeds and no vegetable samples contained noxious weed contaminants.

Impact: Results of seed tests conducted by Station staff are reported to the Seed Control Official of the CT Department of Agriculture who has the authority to stop the sale of products that do not meet label claims or contain noxious weeds. In the short term, this program protects state residents from purchasing inferior seed and ensures that seeds comply with the Connecticut Seed Law Regulations and the Federal Seed Act. The long-term benefit of the seed testing program is to minimize the unintentional introduction of noxious weed seeds that could potentially impact crops of economic importance and the state's ecosystem.

Samples for Analytical Chemistry and the Connecticut Department of Consumer Protection

During the year, Dr. Li examined eight samples from the Connecticut Department of Consumer Protection at the request of the Department of Analytical Chemistry at the Experiment Station.

Citizen Inquiries

Plant Disease Information Office

Dr. Li assisted by Ms. Katherine Dugas and Ms. Rose Hiskes answered 3,535 inquiries about plant health from Connecticut citizens, which was 6.3% higher than last year. Although most inquiries were on ornamentals, trees, and shrubs (70.5%), other categories, such as food crops (12.0%) and turf grasses (0.4%), were also well represented. A moderate percentage of inquiries fell into the miscellaneous category (6.1%), which included identification of various plants, weeds, and mushrooms, and information about pesticides and their relationships to health and environmental concerns. Most inquiries were from commercial growers and plant care professionals (34.1%) and Connecticut homeowners (59.5%). One percent of inquiries were from cooperative extension and 5.4% were from health departments, news, agricultural personnel, and others. A further breakdown of inquiries showed that 26.9% of the questions came in by phone, 20.1% came in by mail, 20.6% came as email, and 32.4% were brought in person. To respond inquiries, 1,860 letters and email messages with attached files of fact sheets were sent from the PDIO. Many citizens opted to download fact sheets posted on the CAES website in lieu of letters since this gave them instant access to the information of concern.

VALLEY LABORATORY

Scientists at the Valley Laboratory conduct research on insects, diseases, mycology, integrated pest management, soil nutrition, and weeds of concern to commercial agriculture and homeowners in Connecticut. The Valley Laboratory, located in Windsor, was originally established in 1921 to conduct tobacco research and has conducted a century of research and service to the State of Connecticut. While research on tobacco continues today, the research mission has expanded to reflect the diverse agriculture present in the State. Scientists and staff also diagnose insect and plant health problems, test soils for fertility, conduct outreach to growers and homeowners by speaking to professional and community groups, host informational meetings, and assist municipalities, state agencies, and students.

The Tobacco Experiment Station in the 1920s

Activities on the Farm

There were a total of 34 experimental plots at the Valley Laboratory Research Farm during the past year. Five Windsor-based scientists had 26 of these plots; three New Haven-based scientists were using 3 plots. Additional plots were maintained by the Farm Manager as rotation crops or for seed collection. Valley Laboratory scientists also conducted experiments in many plots off site, such as in growers' fields, the CAES Lockwood and Griswold farms and in State forests. Valley Laboratory Farm Manager James Preste kept the farm and equipment ready and in excellent shape. He expertly maintained the many field plots and addressed the specific needs of each scientist. He and his summer research assistants did an outstanding job maintaining the extensive ornamental garden in cooperation with the Connecticut Nursery and Landscape Association. Mr. Preste and Dr. LaMondia (until his retirement in April 1, 2022) coordinated the Valley Laboratory effort to comply with EPA Worker Protection Standards for Agricultural Pesticides and organized and conducted safety and pesticide training sessions for the staff.

RESEARCH ACTIVITIES

Hemlock Woolly Adelgid Research

Biological Control of Hemlock Woolly Adelgid

Eastern hemlock, *Tsuga canadensis*, is the sixth most common tree species, and the second most abundant conifer in Connecticut forests. Hemlocks are an important component of watershed forests that capture, filter, store and protect Connecticut's northern drinking water reservoirs. Eastern hemlocks are long-lived and are considered a foundation species as they have a strong influence on community structure, provide critical shelter, forage and habitat for many wildlife and avian species. The unique cool shade provided by hemlocks provide essential thermoregulation for native trout streams and are integral to many recreational areas in state lands, land trust, bird sanctuaries and public preserves.

The most serious current threats to eastern hemlock are the invasive non-native pests from Asia: the hemlock woolly adelgid, *Adelges tsugae* (HWA) and the elongate hemlock scale, *Fiorinia externa* (EHS). Both these pests periodically infest and cause serious damage to Connecticut hemlocks, the scale from the 1960s and HWA since 1985. Biological control with the introduced ladybeetle HWA predator, *Sasajiscymnus tsugae*, has been Connecticut's major strategy to mitigate HWA damage in our hemlock forests since 1995 and remains the only biological control agent for HWA available to the public due to the suitability of this ladybeetle for large scale commercial laboratory rearing. The only company successfully rearing *S. tsugae* for the public is Tree-Savers from Pennsylvania. The rearing methods for *S. tsugae* used by Tree-Savers are a direct amplification of the original research on the biology and life cycle of this species and the rearing methods developed by Dr. Cheah at the Valley Laboratory and are an example of technology transfer from original research to the commercial sector. Connecticut's experience using *S. tsugae* as the sole HWA biological control agent for 27 years has helped sustain the state's hemlock resource with minimal hemlock mortality. After the initial hemlock decline and mortality during the rapid spread of HWA in the 1990s, hemlocks have persisted in many Connecticut forests where *S. tsugae* was released in mass numbers (>162,000) from 1995-2001. These multi-year findings indicated the utility of biological control with *S. tsugae* as a tool to mitigate HWA damage in hemlock forests. Public interest and endorsement of biological control and rejection of chemical control are increasing, especially due to non-target pollinator concerns. As most of Connecticut's hemlocks occur on private lands, a new Connecticut collaborative program for biological control of HWA, launched by Dr. Cheah in 2020, was further expanded in 2021 and 2022, to publicize and educate the public on the availability of this biological control strategy, train and help with HWA scouting and optimal implementation of *S. tsugae*.

While Connecticut's HWA populations were previously greatly reduced by severe winters (2014-2016 and 2018), recent warm, mild winters (2020 and 2021) conversely resulted in high survival resulting in HWA rebound. HWA has also actively spread into Connecticut from other infested regions along the northern and western borders. Another warm winter in 2022 in central and southern Connecticut continued to fuel HWA spread and outbreaks. Moderate sub-zero minimum temperatures (-4 to -5°F) in mid-late January 2022 were experienced in northwest Connecticut where HWA winter mortality was the highest at high elevations but reduced along rivers and around bodies of water. Average HWA winter mortality was between 53-72% in northwestern Connecticut, reaching a maximum of 81% on top of Canaan Mountain in Norfolk and a minimum of 53% along the Farmington River. Central and eastern Connecticut had much less HWA winter mortality around 40% along the lower Housatonic River. It was therefore strategically important to continue to release *S. tsugae* into newly adelgid-infested hemlock areas in Connecticut to counteract the resurgence of HWA. Dr. Cheah continued scouting surveys and sampling for HWA resurgence around the state, identifying new forest infestations for biological control releases and alerting property owners. Surveys of hemlocks are also documenting the continued increased rapid spread of elongate hemlock scale (EHS) in northern forests. This spread of EHS in high densities has now reached upper elevations in northwest Connecticut where EHS was recently formerly negligible.

Elongate hemlock scale and hemlock woolly adelgid at a northern Connecticut site in 2022

Hemlock forests across Connecticut are mostly suffering from co-infestations of ongoing EHS and resurgent HWA.

In cooperation with town and park staff, Dr. Cheah helped the towns of Glastonbury and Woodbury implement *S. tsugae* beetles in their parks and preserves in May 2022 to mitigate HWA infestations and damage. Glastonbury addressed the emerging HWA infestations with targeted *S. tsugae* releases in Cotton Hollow Preserve, a hemlock ravine which drains into the Connecticut River. For the Town of Woodbury, this was the second year of their HWA biological control program which began with a release in Nonnewaug Falls in 2021. Woodbury was the first town in Connecticut to purchase and implement *S. tsugae* for HWA control in 2021, and in 2022, they expanded releases to two other town parks. Wickham Park, a popular private park with landscaped gardens in Manchester also initiated biological control of HWA in 2022. Three towns in Connecticut have now opted to pursue biological control to manage HWA outbreaks in their parks and open space: Woodbury, New Hartford and Glastonbury. Flanders Land Trust also initiated biological control of HWA at their most popular preserve, after previous training and outreach in 2021.


Cotton Hollow Preserve, Town of Glastonbury Open Space


Wickham Park, Manchester

State forests with hemlocks bordering the upper Farmington River, Barkhamsted, were found to have heavy infestations of HWA in 2021. The upper Farmington River is Connecticut's first National Wild and Scenic River and a premier trout fishing destination. Through a grant from the Farmington River Coordinating Committee (FRCC), Dr. Cheah strategically released 5,050 beetles on HWA infested hemlocks along the upper Farmington River in mid-May at the American Legion and Peoples State Forests, Barkhamsted, with the help of volunteers from the FRCC, Friends of the American Legion and Peoples State Forests (FALPS), and staff from the CT DEEP Forestry division:


Upper Farmington River watershed forests and release technique for *S. tsugae*


Biological control releases on adelgid-infested riverside hemlocks along the upper Farmington River in Barkhamsted in May 2022

Major releases of thousands of beetles were also implemented in May and June 2022 at a private high elevation forest and two private lake communities in Norfolk, one of the coldest parts of the state, which has been very recently aggressively invaded by HWA. Over 15,000 *S. tsugae* were released across Norfolk in 2022. Forestry interns found an overwintered *S. tsugae* feeding on HWA at a 2021 release site in interior remote Great Mountain Forest in June 2022, confirming overwintering survival at sub-zero temperatures.

Releasing *S. tsugae* at Great Mountain Forest, Tobey Pond and Doolittle Lake, Norfolk in 2022.

An additional >5,000 beetles were purchased and deployed by homeowners to protect their hemlocks in 16 towns throughout Connecticut: Bethlehem, Bolton, Canton, Chester, East Hartland, Goshen, Granby, Harwinton, New Hartford, Newtown, Thomaston, Thompson, Trumbull, Wethersfield, Winchester, and Woodbury.

As of June 30, 2022, this collaborative program had released over 28,000 *S. tsugae* throughout Connecticut in 21 towns in 2022. The total number of *S. tsugae* officially released in Connecticut exceeds 220,000 in >80 sites from 1995-2022. The total number is actually much higher due to private property homeowner releases. Homeowner releases of *S. tsugae* currently exceed 5,000 in 2022. It is estimated that >230,000 *S. tsugae* have been released throughout Connecticut since the first release in 1995.

Dr. Cheah also continues to address numerous enquiries on the invasive Mile-a-Minute (MAM) weed and provides outreach on the biological control program for MAM, which was implemented and monitored in collaboration with Donna Ellis from the University of Connecticut. Over 60,000 specialist herbivorous weevils, *Rhinoncomimus latipes*, which feed and reproduce only on MAM have been released in 27 Connecticut towns from 2009-2019. Dr. Cheah updates the annual map of Connecticut towns with confirmed MAM reports with Kristen Ponack from the Connecticut Invasive Plant Working Group (CIPWG).

Impacts:

- Development of this new collaborative Connecticut biological control program for HWA is very successful and is rapidly gaining popularity amongst the public. This is another example of technology transfer from the research findings of Dr. Cheah that biological control with *S. tsugae* can be a useful tool for all communities, state, private and municipal partners for managing HWA at a landscape level and in sensitive riparian environments without the use of chemicals for restoring and conserving eastern hemlock forests.
- Biological control also offers a safe and attractive alternative to homeowners seeking to protect landscape hemlocks on private properties and residential areas where chemical control is not desired. This strategy minimizes the need and application of annual prophylactic chemical treatments for HWA.
- Mature hemlock forests can be protected from salvage as increasingly important carbon dioxide sinks in a warming world and biological control with *S. tsugae* is an important tool for that.
- Connecticut has the longest running HWA biological control program in the USA at 27 years since 1995. Long term impacts of HWA biological control in Connecticut show that eastern hemlocks are a resilient tree species which can recover from biotic and abiotic stressors, which is important to the multiple and diverse avian, amphibian, fish and mammal species, which are dependent on the hemlock ecosystem
- Ecosystem benefits from biological control with *S. tsugae* include mitigating tree mortality in reservoir watershed forests, protecting private property landscapes, protecting forests in natural areas, preserving popular hiking and recreation trails in open space and land trusts, conservation of wildlife and avian habitats.

Insect Management

Efforts continue to assist Christmas tree growers to find effective strategies to manage armored scale pests. Reliance on dinotefuran, a systemic neonicotinoid, apparently is incompatible with important biocontrol agents (the parasitoid wasps *Encarsia citrina* and *Aphytis proclea*) for cryptomeria scale. Growers using foliar sprays of dinotefuran to manage cryptomeria scale exacerbate the problem, whereas growers not spraying only have elongate hemlock scales predominating, and in low populations, which is less damaging. A test of selective insecticides during the 2021 field season established that the control of scales with a single-spray program was inadequate, and so a conventional two-spray program with the insect growth regulator pyriproxyfen appears to be the best integrated scale management approach for growers. The insect pathogenic fungus *Metarhiziopsis microspora* was rediscovered infecting scales after one year's absence and has been reisolated. We are now exploring conditions in its culture on grain that may lead to efficient production of conidia.

Disease Management

So far, we have found at least five species of *Phytophthora* that cause root rots in Christmas trees. Bacteria antagonistic to the growth of *Phytophthora* spp. were found to be very common in soil, but these interactions between bacteria and *Phytophthora* were highly species specific. To be practically useful, such bacteria would have to undergo U.S. EPA registration. Therefore, tests are now being conducted with commercially available biocontrol bacteria and fungi to

determine whether they can provide a practical benefit for preventing phytophthora root rot in susceptible fir transplants. These trials are taking place in factorial design experiments investigating the interactions between incorporation of aged wood chips (colonized by fungi), sulfur, and gypsum. The gypsum incorporation is expected to elevate the level of calcium in soil solution, which has been shown to be beneficial for suppressing phytophthora in avocado and raspberry crops.

A grant supported by the Connecticut Christmas Tree Growers' Association in 2022 will determine whether ammonium sulfate or mono amino phosphate will provide the same benefits as controlled-release nursery fertilizer incorporated into soil around the roots at the time of planting bare-root transplants. This factorial experiment is also investigating whether incorporation of gypsum is tolerated by bare-root transplants. Rapid establishment and improved root growth is anticipated to reduce overall risk of loss from root diseases, as faster growth will reduce the number of years the trees.

Impacts:

- Christmas tree growers are implementing use of sulfur to improve the health of their true firs.

Weed Science

1. **Effect of Reflective Anti-transpirant, Elemental Sulfur, and Herbicides on Christmas Tree Growth and Establishment (continuing trial):**

The ability to produce Christmas trees in CT, especially fir trees, is threatened over the long-term by changes in our climate. Each year, growers experience an average loss of 5 to 30% of young trees -- likely due to the combined adverse effects of drought, heat stress, weed interference, and herbicide injury. Dr. Aulakh is conducting several field research trials to evaluate the role of anti-transpirant, sulfur application, and herbicides in improving Christmas tree survival, growth, and weed control.

Picture 1. Surround XP (reflective anti-transpirant) plots at the Kogut's Christmas tree farm in Enfield, CT.

Findings and Impacts: Christmas tree losses to drought, heat stress, and herbicide injury will be minimized. New preemergence (PRE) and postemergence (POST) herbicides have been identified with excellent Christmas tree safety and improved grassy and broadleaf weed efficacy. Herbicide research trials in 2021 and 2022 revealed excellent tolerance of tested Christmas trees to application of a pre-packaged mixture of atrazine + mesotrione + s-metolachlor (Lumax EZ at 4lb/a), applied PRE and to POST application of topramezone (Frequency at 16 fl.oz/a) and mesotrione (Tenacity at 15 fl oz/a) alone and as a tank-mixture with clopyralid (Stinger at 8 floz/a).

2. **Horsenettle control with woodchips and pre-and post-emergence herbicides in Fraser Fir (new trial):**

Horsenettle (*Solanum carolinenese*) is native to North America. It is a perennial, rhizomatous, broadleaf plant in the nightshade family, *Solanaceae*. Horsenettle interference has been increasing in Connecticut Christmas tree production. Frequency® (topramezone), a HPPD-inhibitor, is a new herbicide for preemergence and postemergence control of annual grasses and broadleaf weeds in Christmas trees. Topramezone® has been reported to provide excellent control (>90%) of

seedling horsenettle in corn. Similarly, woodchip mulch has shown multiple benefits such as improvement in Christmas tree quality and weed control. Most horsenettle seeds germinate well within 1-inch of the soil surface. Very few plants emerge from seeds at depths of 4-inches or greater. Therefore, mulching also appears to be a viable alternative to preemergence herbicides for horsenettle control and warrants testing in Connecticut Christmas tree plantations. Field experiments are being conducted to evaluate:

1) Horsenettle control with different rates of Atrazine, Sureguard, Lumax, and Tenacity applied PRE (preemergence); and Frequency® and Stinger® tank mixtures for applied POST (postemergence).
2) Different depths of woodchip mulch for seedling horsenettle control

Picture 2. Horsenettle control with Frequency herbicide at Koguts Christmas Tree Farm, Enfield, CT.

Findings and Impact: Horsenettle control was excellent with Tenacity PRE at 15 fl oz/a and Frequency POST at 16 fl oz/a. Addition of Stinger to Frequency herbicide did not improve horsenettle control over frequency alone. No injury was observed on Fraser fir from any herbicide treatment. Horsenettle control with woodchips was inconsistent, probably, due to horsenettle regrowth from rhizomes as well.

3. Evaluation of fall applied herbicides and application rates for Oriental bittersweet control (continuing):

Oriental bittersweet, a non-native woody vine, is becoming increasingly invasive in natural ecosystems and managed habitats. An experiment has been in progress since the fall 2020 at the Windsor Valley Laboratory to evaluate various herbicides and their application rates for the Oriental bittersweet control.

Picture 3. Oriental bittersweet research plots at the Windsor Valley Laboratory 2022. Pictures: nontreated control (left), glyphosate 4 qt/a (center), triclopyr 2 qt/a (right).

Findings and Impact: Excellent control of young Oriental bittersweet vines was achieved with single fall application of triclopyr (Garlon 3A at 2 qts/a) or triclopyr (Garlon 3A at 1 qt/a) plus glyphosate (Maddog at 2 qt/a). With glyphosate (4 qts/a) control of Oriental bittersweet was not satisfactory. This research will provide vegetation managers with effective herbicides and their application rates for managing Oriental bittersweet in natural areas, landscapes, and plantation crops such as Christmas trees.

4. Ornamental Crop Safety Trials (new trial):

Ornamental species as well as cultivars within a species differ widely in their tolerance to herbicides. Ornamental plant safety and weed control efficacy trials are being conducted in multiple ornamental species that include Euonymus, Gomphrena, Ornamental nightshade, Periwinkle, *Portulaccaria*, and many Christmas tree species. These studies will help in developing safe use practices for these new products and comparing their weed control efficacy and safety with the conventional preemergence herbicides.

Picture 4: Ornamental plant safety trials 2022 at Valley Lab Windsor, CT.

Findings and Impacts: The 2021 ornamental plant safety trials resulted in the discovery of many newer and safer chemical weed control options for Christmas Trees, Periwinkle, and Gomphrena. The 2022 trials are underway for crop safety in Euonymus, Portulaccaria, and Ornamental nightshade.

5. Evaluation of Different Types of Mulches for Mugwort Control (new trial):

Mugwort (*Artemisia vulgaris*) is a highly invasive, herbaceous to semi woody perennial, C_4 plant. It was introduced into the North America more than 400 years ago as a medicinal herb. Mugwort is a serious threat to the diversity of native flora, especially early successional species. Historically, mugwort invasion was confined to roadsides, floodplains and riparian areas, rights-of-way, and in turf and landscape settings. In the last two decades, mugwort has begun encroaching into new areas including annual row crops, hayfields, pastures, and turfgrass. Mugwort can be controlled with herbicides such as aminopyralid and glyphosate. However, there is a growing demand for non-chemical control for mugwort management. A field experiment has been initiated in the summer 2022 at Windsor Valley laboratory to evaluate the effectiveness of Clear and black plastic mulches and woodchips.

Picture 5: Mugwort research plots using different types of mulches at the Valley Laboratory, Windsor, CT.

Findings and Impacts: Nothing to report; field trial is underway since June 2022.

Plant Disease Research

Tobacco Disease Research

The Connecticut Agricultural Experiment Station Valley Laboratory was established in 1921 as the Tobacco Substation to combat tobacco problems and diseases such as wildfire, a devastating disease caused by a bacterial plant pathogen. Wildfire was eventually eliminated by incorporating plant resistance to this pathogen. Ever since, tobacco breeding to incorporate genetic plant resistance to plant pathogens has been used to successfully manage diseases with minimal environmental impact. Plant resistance is the most economical, environmentally responsible, and often most effective way to control diseases. The development of plant resistance to Tobacco Mosaic Virus (TMV) in the 1950's, tolerance to ozone damage (weather fleck) in the 1960's, resistance to black shank in the 1970's, and Fusarium wilt in the 1980's and early 1990's effectively controlled serious diseases which each threatened to seriously impact or even wipe out cigar wrapper tobacco production in the Connecticut River Valley.

There are currently a number of pathogens that still threaten the crop. Dr. LaMondia conducts an ongoing breeding program to develop resistance to: Fusarium oxysporum (causing Fusarium wilt); Globodera tabacum (the tobacco cyst nematode); tobacco mosaic virus, and Peronospora tabacina (blue mold) for both shade and broadleaf types. An inbred line, C9, was initially released in 1991 and is still being produced as a wilt and TMV resistant cultivar. A new hybrid with similar resistance profiles and increased uniformity was released as B1 and is in production. In 2011, a male-sterile F1 hybrid 'B2' highly resistant to Fusarium wilt, TMV and the TCN and with moderate resistance to blue mold and black root rot was released and subsequently licensed.

Black shank, caused by *Phytophthora nicotianae*, has re-emerged as a serious pathogen in Connecticut and we are working to develop a hybrid line with significant resistance to the pathogen. Our first candidate line, B3, was evaluated under field conditions in 2014 and 2015 and, while resistant, was found to be lacking in sufficient wrapper leaf quality. Additional crosses have been made and an inbred with very high levels of resistance is being used to produce hybrids that are being commercially evaluated. Black root rot, caused by the fungus *Thielaviopsis basicola,* has been damaging and increasing in impact in recent years with cool wet springs. We obtained sources of dark wrapper tobacco with high levels of black root rot resistance from cooperating scientists in Kentucky. A back-cross program was used to transfer resistance to CT broadleaf, and resistant plants were selected for broadleaf characteristics. Inbreds have been developed and have been used to develop hybrid lines with resistance to multiple pathogens. A number of these lines are being evaluated under commercial conditions and two (D1 and D2) have now been licensed with a company for commercial seed production. The hybrid cultivars that have been released have been developed as Low Converter (LC) cultivars to reduce the levels of nicotine conversion to nornicotine during the curing process. Nornicotine is an alkaloid that is responsible for adverse health effects. Brown spot, caused by an *Alternaria* fungus, can cause significant losses when ripe tobacco cannot be harvested on time due to rain. We have identified a source of resistance and are evaluating breeding lines under field conditions. We have also initiated breeding for resistance to target spot, bacterial wilt and tomato spotted wilt. Recent breeding objectives have incorporated Cuban types of germplasm into quality evaluations as well as efforts to develop shade type wrapper in field grown plants.

Impacts:

- C9 and B1 broadleaf tobacco carry resistance to Fusarium wilt and TMV. C9 has been widely grown since its release (>80% of acreage) and has prevented more than $5 million in losses each year since 1992. B1 is more uniform and is replacing C9 over time.
- The development of a male-sterile hybrid broadleaf cigar wrapper tobacco with resistance to most of the major pathogens, including Fusarium wilt, TMV, the TCN and blue mold, will allow sustainable production with reduced disease and much reduced pesticide inputs. Growing B2 eliminates the need for nematode management at over $500 per acre per year. New varieties recently released and in development are resistant to black root rot, for which there are no current management options.
- B1, B2 D1 and D2 have been released as new cultivars and licensed to a local seed company. Proceeds will help support further research on plant resistance. Adding resistance to black root rot and brown spot will further reduce plant losses to disease.

Boxwood Blight

Boxwood blight is a relatively recent, introduced disease in Connecticut. The fungus that causes boxwood blight, *Calonectria pseudonaviculata* (*C.ps*), forms leaf spot and stem lesions resulting in defoliation and dieback. The impact of the disease has been very high; boxwood losses in nurseries were estimated at over $5.5 million in Connecticut in the first two years since October 2011. While production nurseries have not experienced problems in Connecticut, boxwood blight has been widespread and damaging in landscapes in years with wet conditions conducive to disease.

Survival of *C. pseudonaviculata* conidia

Boxwood blight, caused by *Calonectria pseudonaviculata*, is a significant disease affecting both nursery production and landscape boxwood plantings. *C. pseudonaviculata* conidia are produced in clumps in an extracellular mucilaginous matrix. Local spread of the pathogen is by dispersal of conidia in water splash or direct contact dispersal, but the effects of relative humidity (RH) on survival and germination of dispersed conidia over time is unknown. Drs. LaMondia and Kodati investigated the effects of 15, 40, 80, and 100% RH on survival of individual conidia or conidia aggregated in clumps over time. Conidia were transferred to a dry glass surface and scored for the incidence of survival and percentage germination over 3, 6, and 9 days. Conidia in clumps had higher incidence of survival and percent germination than individual conidia. RH significantly and positively influenced germination, and survival, as measured by presence/absence of germination by individual conidia, but not by clumps of conidia. Individual conidia survived for at least 6 days at all RH tested. No germination was observed for any individual conidium exposed to 15% RH for 9 days, whereas conidia in clumps survived and germinated at all RH levels for at least 9 days. This study indicates that simply pruning or working in infected boxwoods under dry conditions may be insufficient to limit the spread of the pathogen and ultimately, disease. Further measures such as frequent disinfestation of tools with alcohol or fungicide application before or after possible spread of conidial clumps may be necessary.

Impact:

- This identification of boxwood blight spore survival will result in changes to best management practices and improved disease management strategies.

Development of the Boxwood Blight Resistance Evaluation Program

The breeding of disease-tolerant boxwood cultivars is important for reducing the incidence of boxwood blight in Connecticut while providing landscapers with cultivars that have desired traits. In order to better assess boxwood tolerance to blight among cultivars, Dr. LaMondia is collaborating with researchers across the United States to create a standard protocol for boxwood evaluations that can be conducted across institutions. This will include rating cultivars against previously tested plants to assign a scaling of 1 (most susceptible) to 5 (least susceptible). The evaluation program began in 2018 and has grown in subsequent years to include hundreds of selections from multiple breeding programs being assayed at the Valley Laboratory and at other institutions in the United States. These ratings will be used by plant breeders to assess tolerance and by nurseries to convey susceptibilities to consumers. We observed a very good range of responses in percent leaf infection, leaf and stem lesions per plant and percent defoliation. The very susceptible varieties such as *B. suffruticosa* were severely diseased and *B. suffruticosa* was eventually killed. There is significant potential for the development and release of blight resistant boxwood cultivars in the future.

Boxwood blight

Buxus spp., commonly called boxwood or box plants, had a value of about $141 million in 2019. The fungal pathogen that causes the boxwood blight, *Calonectria pseudonaviculata* (*Cps*) produces leaf spots and stem lesions that will be resulting in defoliation and die back of the boxwood plants. The management of blight disease on boxwood is heavily dependent on sanitation and protection with application of several chemical fungicides. There is a need for development of alternative/sustainable management methods for the boxwood blight. A study was initiated by Drs. Kodati and Lamondia to evaluate the efficacy of essential oils in management of boxwood blight and diaporthe leaf spot on common hop.

Impact:

- Reduces the frequency of chemical fungicides application
- Helps in development of green pesticides

Hop Research

New and Emerging Diseases of Hops in Connecticut

Hops research
Drs. Kodati and Lamondia continually monitoring the diseases and insects on hops for providing the information to the hop growers in CT. The most common diseases and pests were downy mildew, two-spotted spider mites, potato leaf hopper. Intensive scouting and timely application of pesticides is required for the control of diseases and pests. Previously, a new pathogen, *Diaporthe humulicola* was identified causing the disease on hop leaves and cone that are being grown in Valley Laboratory. They noticed *Diaporthe* spp. infected stems of hop plants in the growing season of 2020. Molecular and morphological tools being employed to confirm the species identify of the isolates that were collected hop stems. They are conducting studies to understand the diversity and epidemiology of *D. humulicola.*

Impact:

- Understanding the diversity and epidemiology of diaporthe leaf spot helps in development of management practices

Mycology Research
Dr. DeWei Li conducts research on fungal taxonomy, indoor molds of human health concern, fungal succession on water-damaged building materials, infiltration of fungi from outdoors into residences and mushroom cultivation as well as conducting some phytopathological studies.

Intercropping wine-cap mushrooms in Christmas trees: It used to be a three-year project started from January 2019 to develop a new intercrop, wine-cap mushroom for Christmas tree farms using woodchip mulch. Due to the pandemic, it was extended for one year at no cost to the NIFA. The project has dual purposes: 1) develop a new cash crop, wine-cap mushroom for Christmas tree farms; 2) the woodchip mulch will improve root health by controlling weeds and thus preventing damage from herbicides, maintaining cool, moist soil conditions, suppressing injurious root pathogenic nematodes, and adding organic matter into the soils. The cultivation was conducted at Valley Lab, Humming Grove Farm and Jones Family Farm. The wine-cap mushrooms had been successfully cultivated at all field plots in the three locations from early fall 2019 to spring 2021 (Figure 1). The cultivation produces mushrooms in both spring and fall. Wood chip mulch suppressed weeds effectively (Figure 2). However, due to the drought in April and in the spring in 2022, only a few mushrooms developed in the plots at three locations. It really held back the development of this project. Lack of rains in the spring becomes a major limiting factor. Further studies on this mushroom are necessary to mitigate the problem.

Impact: Wine Cap Mushroom (*Stropharia rugoso-annulata*) is an edible gourmet mushroom. This study is to help Christmas tree farmers to develop a new crop: wine cap mushrooms. It can be marketed as fresh, dried produce or snack type of product. Fresh wine cap mushrooms have been sold at $5.00/pb. Grocery stores and farmers' markets are potential venues for this produce. The new crop will increase their profit in the future. Woodchip mulch also suppressed the weeds.

Figure 1. wine-cap mushrooms.

Figure 2. Wood chips suppressing weeds (left). No wood chips (right).

Fungal taxonomic study. This collaborative study with James LaMondia, Neil Schultes, and mycologists from several countries: Brazil, Canada, China, Cuba, Mexico, has led to discovery of seven new fungal species: *Diaporthe sapindicola* (Figure 3), *Fusarium rosicola*, *Talaromyces nanjingensis*, *Vanakripa chinensis*, *Vesiculophora diversiseptata*, *Anapleurothecium clavatum* and *Podosporium simile* and one new genus, *Vesiculophora*. These new species and genera have been published in four papers. *Diaporthe sapindicola*, *Fusarium rosicola* are new diseases on *Sapindus mukorossi* and *Rosa chinensis*, respectively.

Impact: Discovering and describing new fungal species add very important information to fungal diversity in the world and for the studies, such as plant disease management, biological resources, biodiversity, fungal taxonomy, fungal ecology and fungal biology. Identification of fungal pathogens, which causes significant loss to farmers, is an important service to local economy, agriculture, CT farmers and other areas. These studies are imperative for identifying fungi and determine the causal agents. The newly described species supplement new information to fungal diversity, resources and conservation and utilization.

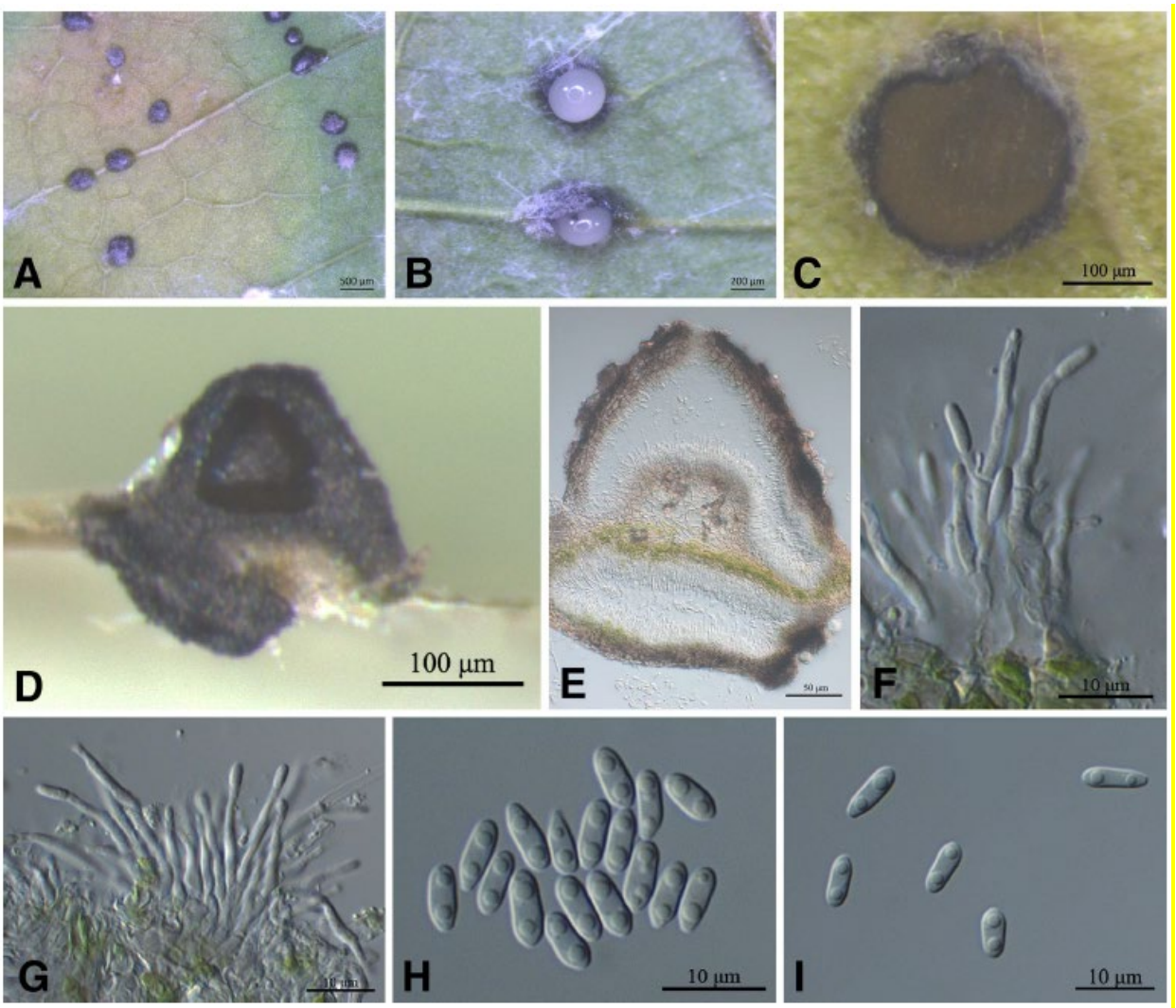


Figure 3. Morphology of *Diaporthe sapindicola* from *Sapindus mukorossi*. A, Pycnidia on the leaf lesion; B, conidial masses; C, transverse section of pycnidium; D and E, longitudinal section of pycnidium; F and G, conidiophores; H and I, alpha conidia.

Study on new plant diseases. A number of newly emerged diseases: *Diaporthe sapindicola* causes leaf spot of *Sapindus mukorossi*, *Diaporthe cercidis* causing leaf blotch of *Acer mono*, leaf spot caused by *Colletotrichum siamense* on *Salix matsudana*, *Fusarium rosicola* causing vascular wilt on *Rosa chinensis*, leaf spot on *Elaeagnus pungens* caused by *Epicoccum latusicollum*. These studies are a collaboration with several plant pathologists/mycologists/scientists at CAES and in China.

Impact: These newly emerged diseases are causing severe damage to the ornamental and landscape plants. Determination and identification of these pathogens are imperative for disease management and future studies to fully understand life cycles of the diseases for finding proper methods to manage these diseases.

VALLEY LABORATORY SERVICE ACTIVITIES

Requests for Information

A total of 4,177 inquiries were answered at the Valley Laboratory during the past year. Nearly half of these queries were answered by Ms. Rose Hiskes (26%) in the inquiry office (49% of these from the public sector) or by Dr. LaMondia (25% of total inquiries). The majority of inquiries answered by Ms. Hiskes concerned insects (23%), diseases (21%), pesticides (13%) or horticulture (6%). Most concerned landscape and nursery (48%), vegetable (7%) and structural entomology (8%). All scientists and many of the staff at the Valley Laboratory assist growers and homeowners.

All Valley Laboratory scientists contribute to the service effort. Scientists made 52 presentations to grower, professional and citizen groups (about 2,843 people), were interviewed 9 times and made 121 visits to commercial nurseries, greenhouses, farms, forests and landscapes to diagnose complex problems or conduct research projects. Dr. LaMondia maintains surveillance to notify the Connecticut River Valley growers about the presence and likely threat of tobacco blue mold disease in North America and inform about management options. His laboratory conducted 203 nematode diagnostic tests and conducts testing as an APHIS certified pinewood nematode export testing facility.

Soil Testing

A total of 4,174 soil tests were expertly performed by Ms. Diane Riddle during the past year. About 51% were performed for commercial growers and 49% for homeowners. Of the commercial samples submitted, 74% were for landscapers; 6% for tobacco growers; 3% for vegetable growers, 7% for municipalities, 3% for golf course superintendents; 0.2% for nursery growers; 1% for small fruit, 2% for Christmas tree growers, and 2% for research. Thirty-four tobacco seed germination tests were conducted.

Impact:

- Approximately 25% of soil samples tested did not require additional fertilizer. Reducing the over-application of fertilizers protects the environment.

The Gordon S. Taylor Conference Room

Many agricultural organizations used the conference room at the Valley Laboratory regularly for their meetings. During the previous year 10 different groups used the room on 27 occasions. The Conference Room was closed to the public due to the COVID-19 protocols until this spring. At present one group used it in spring.

Valley Laboratory Diagnostic Office: Insect, Disease and Plant Health Survey, 2021 – 2022

Ms. Rose Hiskes, working part-time at the Valley Lab, diagnosed a wide range of insect, disease, weed and plant health problems on herbaceous and woody ornamentals, lawns, vegetables, fruit and Christmas trees for homeowners, commercial businesses, other government agencies and nonprofits. Inquiries come in as phone calls, emails, mail or in-person as a walk-in or via the drop off bin outside.

Insects

Jumping worms, while not a true insect, have come into the diagnostic office more frequently this year. Garden clubs in particular are worried about their spring plant sales where members pot up the extra rudbeckias, daisies and anise hyssop to sell. Nurseries and mulch producers also need to beware of these worms. Moving soil in plants, mulch or compost is the way we are spreading these worms. They have an annual life cycle such that in the spring only small 2mm sized eggs sacs, called cocoons, are present. As larvae and adults these Asian worms quickly process the soil, removing organic matter and leaving a homogenized soil that does not support plant life as well. In particular the regeneration in forests that happens in the duff layer of fallen, decaying plant material is greatly reduced.

Pest control operators continue to bring in many flies which bother their customers. Psychodids, Sphaeroceridae, Sciaridae, Calliphoridae, Sarcophagidae and Muscidae are the most common families represented. These drain, small dung, bottle, face, house flies and fungus gnats lay their eggs in decaying organic matter so can be a problem in drains, under dishwashers or in garbage cans. Finding and cleaning up all the breeding sites usually results in sufficient control. Any houseplants should be watered only as much as the plant needs as fungus gnats can thrive in moist potting soil.

In mid-July an arborist brought in a sample of common lilac that had leaf buds totally destroyed. Under the microscope, minute eriophyids were found eating the young leaves in the buds. Rust mites, a form of eriophyid mite that feeds on developed leaves and causes a browning of the leaves is a problem more commonly seen on lilac. If a control is needed, thorough coverage of the affected foliage with Pyganic, Sevin or Avid when weather is favorable may manage the problem.

Diseases

Privet hedges suffered greatly this spring both from insects and a fungal leaf spot. Leaf spot symptoms were noticed on a hedge on June 23 but by July 5 that hedge was recovering and putting out new growth (Figure 1). In Diseases of Trees and Shrubs, it is mentioned that insects can move around the anthracnose pathogens that may be found on woody plants such as privet. Both an insecticide and a fungicide may be needed in the event that both an insect and fungal pathogen are present on privet.

Figure 1. Privet hedge with fungal leaf spot. © Rose Hiskes

Herbicides

Evergreen samples have come in this spring with what looks like herbicide damage. The curling, twisting new growth is easily mistaken for insect damage from some midges or the balsam twig aphid. However, over time no insect development has been seen. Herbicides were known to be applied to a neighboring property in one case.

A homeowner in Southern Connecticut had potted vegetables on their patio adjacent to the lawn (Figure 2). A 'grub application' was put down on May 31. The temperature was 86°F. Cool Power herbicide consisting of 2-4 D and Dicamba was applied along with Talstar. Dicamba can be a very volatile herbicide causing damage to sensitive plants as it drifts off target on air currents.

Figure 2. Wilted potted spinach.

Vertebrates

Voles will eat bark anytime of year, but when plant roots are frozen over the winter, they especially feed on bark. The ground cover junipers are especially fed on in this way. This past year a customer with a large, beautiful Japanese Umbrella Pine lost the tree to vole feeding over the winter (Figures 3, 4). If we have a cool, wet spring damage does not become evident until the first hot spell as the plants do not need their roots to provide water until then.

Figure 3. Vole feeding damage to base of umbrella pine.

Figure 4. Umbrella pine dead due to vole feeding on basal bark.

INFORMATION AND DIAGNOSTIC OFFICE TOTALS

1076 total inquiries answered. Dr. James LaMondia answered 1040 inquiries when Ms. Rose Hiskes was working in New Haven.

Sites

landscape	48 %
lawn	15 %
structural	8 %
vegetable	7 %
fruit	5 %

Problems

arthropod	23 %
disease	21 %
pesticide	13 %
cultural	10 %
horticulture	6 %

Impact:

- Accurate identification of pests of agricultural and human health significance has resulted in economic savings to commercial growers and homeowners, reduced human and environmental exposure to pesticides, and increased human safety.

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