THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

Record of the Year

2022-2023

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, 2023 were:

Governor Ned Lamont, President
Terry Jones, Vice President
Kumar Venkitanarayanan, Ph.D., Secretary
Jason C. White, Ph.D., Director
Commissioner Bryan Hurlburt
Erol Fikrig, Ph.D.
Joan Nichols
Frederick Cohan, Ph.D.

The Board of Control met on August 3, 2022, October 12, 2022, January 18, 2023, and April 19, 2023.

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, 2023.

ADMINISTRATION

Jason C. White, Ph.D., Director
Lindsay R. Triplett, Ph.D., Vice Director
Michael P. Last, Chief Financial Officer
Dianne F. Albertini
Vickie M. Bomba-Lewandoski
Kelly Fairbrother
Lisa L. Kaczenski
Joshua Tirado

ANALYTICAL CHEMISTRY

Christian O. Dimkpa, Ph.D., Department Head
Paul Aikpokpodion, Ph.D.
Michael A. Ammirata
Terri Arsenault
Anuja Bharadwaj, Ph.D.
Huu Trung Bui, Ph.D.
Meghan S. Cahill
Chaoyi Deng, Ph.D.
Brian D. Eitzer, Ph.D., Emeritus
Walter J. Krol, Ph.D., Emeritus
MaryJane Incorvia Mattina, Ph.D., Emeritus
Craig Musante
Raja Muthuramalingam, Ph.D.
Kitty Prapayotin-Riveros
John F. Ranciato
Carlos Tamez, Ph.D.
Sara Thomas, Ph.D.
Nassifatou Koko Tittikpina, Ph.D.
Shital Vaidya, Ph.D.
Yi Wang, Ph.D.
Jingyi Zhou, Ph.D.
Nubia Zuverza-Mena, Ph.D.

ENTOMOLOGY

Goudarz Molaei, Ph.D., Department Head
Philip M. Armstrong, Ph.D.
Tia M. Blevins
Douglas E. Brackney, Ph.D.
Angela B. Bransfield
Jamie L. Cantoni
Duncan W. Cozens
Dana E. Crandall
Mark H. Creighton
Katherine D. Dugas
Jeffrey M. Fengler
Zannatul Ferdous, Ph.D.
Andrea Gloria-Soria, Ph.D.

Rebecca Johnson, Ph.D.
Noelle Khalil
Megan A. Linske, Ph.D.
Sara L. Nason, Ph.D.
Tanya A. Petruff
Gale E. Ridge, Ph.D.
Claire E. Rutledge, Ph.D.
John J. Shepard
Victoria L. Smith, Ph.D.
Kirby C. Stafford III, Ph.D., Emeritus
Kimberly A. Stoner, Ph.D., 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.
Scott C. Williams, Ph.D., Department Head
Wael Abdelraheem, Ph.D.
Joseph P. Barsky
Gregory J. Bugbee
Zhihao Chen, Ph.D.
Jeremiah R. Foley, Ph.D.
Martin P. N. Gent, Ph.D., Emeritus
Susanna Keriö, Ph.D.
Jacquelyn LaReau
Abigail A. Maynard, Ph.D., Emeritus
Sara L. Nason, Ph.D.
Joseph J. Pignatello, Ph.D., Emeritus
Brij L. Sawhney, Ph.D., Emeritus
Itamar Shabtai, Ph.D.
Summer Stebbins
Blaire T. Steven, Ph.D.
Charles R. Vossbrinck, Ph.D., Emeritus
Paul E. Waggoner, Ph.D., Emeritus
Zhengyang Wang, Ph.D.
Elisabeth B. Ward
Jeffrey S. Ward, Ph.D., Emeritus
Leigh J. Whittinghill, Ph.D.

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
Lindsay R. Triplett, Ph.D., Vice Director, Department Head
Sandra L. Anagnostakis, Ph.D., Emeritus
Adam Argraves
Donald E. Aylor, Ph.D., Emeritus
Washington L. da Silva, Ph.D.
Sharon M. Douglas, Ph.D., Emeritus
Wade H. Elmer, Ph.D., Emeritus
Francis J. Ferrandino, Ph.D., Emeritus
Regan B. Huntley
Yonghao Li, Ph.D.
Robert E. Marra, Ph.D.
Neil A. McHale, Ph.D., Emeritus
Felicia Millett
Joseph Liquori
Ravikumar R. Patel, Ph.D.
Richard B. Peterson, Ph.D., Emeritus
Neil P. Schultes, Ph.D.
Stephen J. Taerum, Ph.D.
Quan Zeng, Ph.D.

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

Nassifatou Koko Tittikpina, Ph.D.

Nassifatou Koko Tittikpina joined the Station as an Assistant Agricultural Scientist II in January 2023. Dr. Tittikpina obtained a pharmaceutical doctor degree (PharmD) from the University of Lome (Togo) followed by a dual PhD in Analytical chemistry from the University of Lorraine (France) and in Natural Sciences from the University of Saarland (Germany) in 2017, under a Faculty For The Future Fellowship from the Schlumberger Foundation. Prior to arriving CAES, Dr. Tittikpina completed a postdoc at the University of Mississippi's National Center for Research on Natural Products in 2022. At CAES, Dr. Tittikpina Nassifa plays a dual role in the department of analytical chemistry as an analyst contributing to regulatory work and as a scientist conducting pertinent research. On the one hand, she is involved in the FDA-funded Laboratory Flexible Funding Model (LFFM) programs concerned with the analysis of human and animal foods for toxic/foreign substances, including heavy metals, mycotoxins, and pesticides. In that project, Nassifa is specifically responsible for methods development for organic compounds analysis and verifying or validating standard methods in a wide variety of matrixes, followed by analysis using HPLC/MS and GC/MS, for samples submitted by regulatory agencies. Currently, she is developing a method for the analysis of Vitamin B1 in animal feed using AOAC 2015.14. On the other hand, Nassifa conducts research that synergize with the regulatory work, including assessing the temporal and spatial dynamics of pesticides and mycotoxins accumulation in agricultural crops; detection of food fraud, untargeted analyses of contaminants in food, soil, sediment, drinking water, and sewage; and the transport and biotransformation of pollutants. Currently, Nassifa is investigating how polyaromatic hydrocarbons (PAHs) from wildfire smoke interfere with human food quality and safety through deposition on plant surfaces.

Kelsey E. Fisher, Ph.D.

Kelsey joined the Department of Entomology on January 3, 2023, as an Assistant Agricultural Scientist II. Kelsey worked as a Postdoctoral Research Associate at Iowa State University (ISU) under the guidance of Steven P. Bradbury from 2021–2022. She earned her PhD in Entomology from ISU in 2021, an MS in Entomology from the University of Delaware in 2015, and a BS in Biology from Widener University in 2013. Kelsey identifies as an insect movement ecologist, as her research focuses on discerning animal movement patterns and space use in fragmented landscapes to understand the movement and dispersal behavior of vagile insect species at various spatial scales. Kelsey employs multiple research methods in the field, greenhouse, and lab to address research questions related to the management of pest insects and the conservation of beneficial species, including radio telemetry, population genetics, stable isotope analysis, geospatial analyses, and spatial modeling. Most recently, Kelsey studied monarch butterfly movement in Midwest agroecosystems. Most notably, evidence from this work suggests milkweed and nectar resources be established within 50 m of established habitat to create a functionally connected landscape that facilitates monarch movement. Kelsey plans to build on her experience with monarchs to address research questions that provide management recommendations for other insects, including bumble bees and spotted lanternfly.

Hany Dweck, Ph.D.

Hany joined The CAES Department of Entomology as an Assistant Agricultural Scientist II in January 2023. Hany received his Ph.D. in Chemical Ecology from the Max Planck Institute for Chemical Ecology, Jena, Germany, in 2014. His research concerned the neuroecology of Drosophila. He aimed to identify natural odors that are highly significant to the fly, the receptors that detect them, and the neural circuits that drive the behaviors they elicit. He discovered one olfactory circuit that detects the strong repellent geosmin, which signifies the presence of toxic bacteria. As a result of his contribution and efforts, he received the prestigious Otto Hahn Medal of the Max Planck Society. Hany continued his research on Insect Chemoreception in the laboratory of Dr. John Carlson at Yale University, where he studied the molecular logic and evolution of taste coding, using Drosophila as a model system. Recently, he received a 5-year NIH K01 Award (2022–2027) to study molecular mechanisms of chemoreception in spotted wing Drosophila (SWD), which is now causing immense damage to fruit crops in much of the world, including Connecticut. Dr. Dweck is planning to continue his work on the chemical ecology of SWD, with the ultimate goal of developing new chemical and molecular strategies to control its damage.

Jeremiah R. Foley, Iv, Ph.D.

Jeremiah joined The CAES Department of Environmental Science and Forestry as an Assistant Scientist II in May 2023 in the newly formed Office of Aquatic Invasive Species (OAIS). Jeremiah received his master's and Ph.D. in Entomology at the University of Florida and Virginia Tech, respectively. For his graduate studies, Jeremiah worked on some of North America's most invasive animal species, the Formosan subterranean termite and the hemlock woolly adelgid. Additionally, throughout his graduate studies, Jeremiah worked at the USDA Invasive Plant Research Laboratory (IPRL) on a systems-based approach that integrates biological control, chemical control, and community restoration to determine aquatic ecosystem health and encourage ecosystem resiliency caused by invasive species.

At the CAES, Jeremiah will be carrying over the skills he has accumulated over the past decade to address the complex and multi-faceted problems of aquatic plant invasions in natural and human manipulated ecosystems. He aims to educate the public on aquatic invasive species (AIS) impact and management, to coordinate research across multiple scales (laboratory to large scale testing arenas) and inform land managers and municipalities on management efforts in the state as they relate to AIS. He will be working alongside GREG BUGBEE, SUMMER STEBBINS, and RILEY DOHERTY to coordinate and conduct regular surveys of the density and distribution of AIS throughout the state of Connecticut. The battle against AIS requires a multitude of approaches that include the use of chemical, physical, and biological treatments and the integration of each one of these tactics for each of the over 2000 lakes, ponds, and rivers throughout the state. As is common in the control of exotic invasive species, no one tactic is the "silver bullet". Jeremiah's research will aim to integrate these approaches by combining the strength of each tactic together.

Elisabeth B. Ward, Ph.D.

("Eli") joined The CAES Department of Environmental Science and Forestry as an Assistant Agricultural Scientist II in May 2023. Eli received her B.S. in Biology from Brown University and her M.S. and Ph.D. in Forest Ecosystem Ecology from The Forest School at the Yale School of the Environment. Eli's dissertation research examined how understory ericoid mycorrhizal shrubs (e.g., mountain laurel and blueberries) alter the effects of tree mycorrhizal associations on soil carbon and nitrogen dynamics. This work highlights the need to consider ericoid mycorrhizal shrubs alongside tree mycorrhizal associations to accurately project changes in forest soil carbon dynamics. More broadly, Eli's research focuses on how changes in aboveground-belowground linkages caused by forest disturbances and other factors of global change mediate shifts in plant community composition, forest development, and carbon dynamics. Her work has investigated the effects of a range of management practices and co-occurring stressors prevalent in Connecticut's forests. These include species invasions, urbanization, timber harvesting, forest restoration, and tree planting. These projects have spanned urban, suburban, and rural areas and have addressed questions on both the above- and below-ground impacts of land management and environmental change. At The CAES, Eli will study the effects of different management practices on forest resiliency under changing conditions. These projects will include examining the influence of deer browse, novel pests and pathogen outbreaks, and understory plant invasions on tree regeneration and forest carbon dynamics in managed and unmanaged forest stands.

Raquel Rocha, Ph.D.

Raquel joined The CAES Department of Plant Pathology and Ecology as an Assistant Agricultural Scientist II in February of 2023. She received her Ph.D. in Agronomy, specializing in Plant Pathology, from the University of Nebraska-Lincoln in 2019. There, her research focused on identifying molecular components necessary for the wheat and rice blast fungus to access and colonize plant cells to cause disease. In 2020, Dr. Rocha joined the University of Georgia as a Postdoctoral Researcher. There, she continued studying plantpathogen interactions by using root-knot nematodes as the main system to identify new proteins involved in nematode plant parasitism. At The CAES, her research will continue to investigate the molecular interactions between plant parasitic nematodes and hosts of interest to the state of Connecticut. Dr. Rocha moved to CT with her husband, Martônio, and their two dogs, Linus Pawling and Linnaeus. When not thinking about science and nematodes, Dr. Rocha enjoys reading comics while having coffee or ice cream.

Sandra E. Carney

Sandy retired in July of 2022 after many years as a Secretary in the Department of Plant Pathology and Ecology and then as the Secretary to the Director.

Joseph J. Pignatello, Ph.D.

Joseph J. Pignatello retired in 2022 from his position as Distinguished Scientist and Chief Scientist in the Department of Environmental Sciences at the New Haven campus after almost 38 years of service at CAES. He was appointed Chief Scientist and Department Head in 2013 and presided over a large, highly productive staff of diverse interests. During his tenure at CAES he also had appointments as Adjunct Professor in the Civil and Environmental Engineer Department at the University of Connecticut, Storrs, and later as Professor Adjunct in the Chemical and Environmental Engineering Department at Yale University where in each case he taught courses on environmental organic chemistry. Joe received a BA in Chemistry in 1971 from the University of Minnesota, Minneapolis and a PhD in Chemistry in 1977 from the University of California, Berkeley. Before coming to the CAES he had a postdoctoral appointment at the University of Minnesota. Joe has an international reputation for his work on the behavior of organic pollutants including sorption processes, reactions at carbonaceous surfaces, properties of natural organic matter and pyrogenic carbons, bioavailability of pollutants, and remediation chemistry, especially in advanced oxidation processes. He has published over 190 peer-reviewed papers and has obtained more than $6 million in competitive grant awards from the NSF, USDA, EPA, SERDP (DoD), and industrial sources over his career. His papers have been cited more than 22,000 times (Web of Science). He has an h-index of 68. He is an ISI (now Clarivate) Highly-Cited author in both Ecology/Environment and Engineering. According to a Stanford University survey based on career standard citation indices he ranks within the top 0.05% of all scientists in all fields. He is the principal inventor of three patents and co-inventor of a fourth, which is currently in provisional application stage. He is a member of the Connecticut Academy of Science and Engineering and a Fellow of the Soil Science Society of America. He served on the editorial boards of several journals. At CAES he mentored 36 postdoctoral researchers and co-mentored about 30 graduate students from local colleges and universities as well as visiting students from abroad.

The Connecticut Agricultural Experiment Station
112th Plant Science Day

Lockwood Farm
890 Evergreen Avenue, Hamden, CT 06518
Wednesday, August 3, 2022

PLANT SCIENCE DAY
2022

The weather on Plant Science Day 2022 was in the mid-80s. A total of 1156 people 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. Vickie Bomba-Lewandoski moderated the short talks and introduced the speakers.

All the short talks were very well attended:

SHORT TALKS:

Leigh Whittinghill, Ph.D.	Urban Agriculture for Food Security in Challenging Spaces
Walter Krol, Ph.D. and Terri Arsenault	Industrial Hemp: An Emerging Crop in Connecticut
Itamar Shabtai, Ph.D.	Soil Organic Carbon: A Key Component of Soil Health in a Changing Climate
Carlos Tamez	Laboratory Analyses of Processed Foods, Raw Agricultural Commodities and Animal Feed in Connecticut

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

DEMONSTRATION TENT:

Mark Creighton	Beekeeping Systems Used in Connecticut
Gregory J. Bugbee assisted by Summer Stebbins	Managing Weeds in Lakes and Ponds

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.

- **Nano-enabled Agriculture Research at CAES**. Investigators: Nubia Zuverza-Mena, Ph.D., Washington da Silva, Ph.D., Susanna Keriö, Ph.D., Milica Pavlicevic, Ph.D., Shital Vaidya, Ph.D., Yi Wang, Ph.D., Chaoyi Deng, Ph.D., Inès Karmous, Ph.D., Wade Elmer, PhD. (Emeritus), Christian Dimkpa, Ph.D., and Jason C. White, Ph.D.

- **Wild Bee Biodiversity in Connecticut**. Investigators: Tracy Zarrillo and Kimberly Stoner, Ph.D. (Emeritus), assisted by Morgan Lowry (Retired).

- **A New Environmentally-Friendly Phosphate Fertilizer: Delivery of Less Leachable Nutrients from Biochar to Plants**. Investigator: Philip Wang, Ph.D., Tyler Swanson, Yi Wang, Ph.D., Alex Waller, Wade Elmer, Ph.D. (Emeritus), and Joseph Pignatello, Ph.D. (Emeritus)

- **Mycorrhizae and Urban Tree Health**. Principal Investigator: Susanna E. Keriö, Ph.D. Co-Investigators: Nubia Zuverza-Mena, Ph.D., Wade H. Elmer, Ph.D. (Emeritus), Adriana (Arango-Velez) Puralewski, Ph.D., assisted by Joseph P. Barsky

- **Beech Leaf Disease in Connecticut**. Investigators: Robert E. Marra, Ph.D., assisted by Alexandra Farah

- **Armored Scale Pests of Christmas Trees.** Investigator**:** Richard S. Cowles, Ph.D.

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 Katherine Dugas, Rose Hiskes, Yonghao Li, Ph.D., Diane Riddle, and Gale Ridge, Ph.D.

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 Richard Cecarelli and his Research Technician Rollin Hannan as well as seasonal resource assistants Chris Carnale, Mary Consoli, and John DeFrancisco. Visitors were able to visit the following 70 field plots:

CHINESE CHESTNUT TREES	Sandra Anagnostakis, Ph.D. (Emeritus)
NUT ORCHARD	Sandra Anagnostakis, Ph.D. (Emeritus) assisted by Pamela Sletten
THE FIGHT AGAINST POTATO VIRUSES	Washington da Silva, Ph.D. and Gale Ridge, Ph.D.
FIGS IN SELF-WATERING POTS	Charles R. Vossbrinck, Ph.D. (Emeritus)
COMMERCIAL CHESTNUT CULTIVARS	Sandra Anagnostakis, Ph.D. (Emeritus) assisted by Pamela Sletten
COMMERCIAL CHESTNUT SEEDLINGS	
CONTROL OF BLIGHT ON AMERICAN CHESTNUTS	Sandra Anagnostakis, Ph.D.
REMOTE ACCESS WEATHER STATION	
SURFACE COATED SULFUR NANOMATERIALS SUPPRESS TOMATO FUSARIUM OXYSPORUM INFECTION AND INCREASE THE FRUIT YIELD	Yi Wang, Ph.D., Jason C. White, Ph.D., and Wade Elmer, Ph.D
GRAPEVINE DEMONSTRATION PLOT TABLE GRAPES	Washington da Silva, Ph.D. and Richard Cecarelli.
GRAPEVINE DEMONSTRATION PLOT CHARDONNAY WINE GRAPE	Washington da Silva, Ph.D. and Richard Cecarelli
GRAPEVINE DEMONSTRATION PLOT WINE GRAPES	Washington da Silva, Ph.D. and Richard Cecarelli
SEEDLINGS OF OLD SURVIVING AMERICAN CHESTNUTS	Sandra Anagnostakis, Ph.D.
WILD CHESTNUTS FROM TURKEY	Sandra Anagnostakis, Ph.D.
QUESTIONS AND ANSWERS TENT	Katherine Dugas, Rose Hiskes, Yonghao Li, Ph.D., Diane Riddle, and Gale E. Ridge, Ph.D.

TECHNICAL DEMONSTRATION TENT	
HAMDEN POLICE DEPARTMENT	
CROWN CASTLE CELLULAR TOWER	
THE BIG DIPPER (ICECREAM)	Harry Rowe
KIDS' KORNER	Andrea Gloria-Soria, Ph.D.
SELF-GUIDED ACTIVITY FOR ALL CHILDREN, INCLUDING GIRL SCOUTS	Terri Arsenault
BABY POOLS: LOW-COST CONTAINER FOR VEGETABLE PRODUCTION IN URBAN AGRICULTURE	Leigh Whittinghill, Ph.D.
FARM EQUIPMENT USED AT LOCKWOOD FARM	Richard Cecarelli
EXPERIMENT STATION ASSOCIATES	Skip Hobbs
PHOSPHOROUS TRAPPED BY MODIFIED BIOCHAR AND RECYCLED AS FERTILIZER USING ARBUSCULAR MYCORRHIZAL FUNGI	Tyler Swanson, Ph.D., Philip Wang, Ph.D., Wade Elmer, Ph.D., and Joe Pignatello, Ph.D.
THE MINISTRY OF MOLECULAR MAGIC	Michael Ammirata and Meghan Cahill
MICROBIOME ON PLANTS AND ITS ROLE IN PLANT DISEASE MANAGEMENT	Mohamed-Amine Hassani, Ph.D., Salma Mukhtar, Ph.D., Blaire Steven, Ph.D., and Quan Zeng, Ph.D.
INTERCROPPING WINE-CAP MUSHROOMS IN CHRISTMAS TREES	DeWei Li, Ph.D. assisted by Ethan Paine, Christine Grant, and John Yorder
REMOVAL OF POLLUTANTS FROM WATER AND SOIL BY CHEMICAL OXIDATION USING ACTIVATED CARBON AS A CATALYST	Wael Abdelraheem, Ph.D. and Joseph Pignatello, Ph.D.
COMBINING GREEN SYNTHESIS AND NANOTECHNOLOGY TOOLS FOR ENHANCED EFFICIENCY IN FUSARIUM VIRGULIFORME L. DISEASE SUPPRESSION	Inès Karmous, Ph.D., Shital Vaidya, Ph.D., Nubia Zuverza-Mena, Ph.D., Christian Dimkpa, Ph.D., Jason White Ph.D., and Wade H. Elmer, Ph.D. (Emeritus)
BIODEGRADABLE POLYMER NANOCOMPOSITES FOR CONTROLLED RELEASE AND TARGETED DELIVERY OF PHOSPHORUS DURING PLANT GROWTH	Shital Vaidya, Ph.D., Jaya Borgatta, Ph.D., Christian Dimkpa, Ph.D., Wade Elmer, Ph.D. (Emeritus), Howard Fairbrother, Ph.D., Leslie Sigmon, and Jason White, Ph.D.
A WORLD OF VIRUSES	Zannatul Ferdous, Ph.D. and Rebecca Johnson, Ph.D., assisted by Duncan Cozens
PREEMERGENCE HERBICIDE TOLERANCE TRIALS IN CUT FLOWERS	Jatinder S. Aulakh, Ph.D.

THE ROLE OF FE3O4 NANOPARTICLE SURFACE CHARGE ON DISEASE SUPPRESSION IN TOMATO PLANTS (SOLANUM LYCOPERSICUM)	Chaoyi Deng, Ph.D., Yi Wang, Ph.D., Christian Dimkpa, Ph.D., Wade Elmer, Ph.D. (Emeritus), Christopher Castillo, Juan Pablo Giraldo, Ph.D., Robert Hamers, Ph.D., and Jason White, Ph.D.
RESPONSE OF BARE-ROOT CHRISTMAS TREE TRANSPLANTS TO FERTILIZER AT PLANTING	Richard S. Cowles, Ph.D.
THE PAVILION AT LOCKWOOD FARM	
NATIVE WOODY SHRUBS	Jeffrey S. Ward, Ph.D., assisted by Joseph P. Barsky and Jessica Shanley
BIRD & BUTTERFLY GARDEN	Jeffrey Fengler and Lisa Kaczenski-Corsaro
THE PUBLIC HEALTH AND ENTOMOLOGY TENT:	
STATEWIDE MONITORING PROGRAM FOR MOSQUITO-BORNE VIRAL DISEASES IN CONNECTICUT	Philip Armstrong, Ph.D., John Shepard, Andrea Gloria-Soria, Ph.D., Angela Bransfield, Michael Misencik, and Tanya Petruff
IMPACTS OF FALL ACARICIDE APPLICATION ON SPRING BLACKLEGGED TICK ABUNDANCES	Scott C. Williams, Ph.D. & Megan Linske, Ph.D. assisted by Heidi Stuber, Jamie Cantoni, Hannah Litwak, Claire Keanna, and Alexa Garbiel
BACKAYRD HABITATS AND BLACKLEGGED TICK ASSOCIATIONS	Scott C. Williams, Ph.D. & Megan Linske, Ph.D. assisted by Heidi Stuber, Jamie Cantoni, Hannah Litwak, Claire Keanna, and Alexa Garbiel
MONITORING TICKS AND TICK-BORNE PATHOGENS TO BETTER GUIDE PUBLIC HEALTH ACTION IN CONNECTICUT	Goudarz Molaei, Ph.D. assisted by Noelle Khalil, Morgan Fitch and Kristy Lok
HOW DO PLANT PATHOGENS ENTER PLANTS?	Felicia Millett and Quan Zeng, Ph.D.
GROWING CANNABIS IN CONNECTICUT – CROP PRODUCTION AND PEST MANAGEMENT	Quan Zeng, Ph.D.
IF YOU PLANT IT, WILL THE BEES COME?	Tracy Zarrillo and Kimberly Stoner, Ph.D. (Emeritus)
INVASIVE AQUATIC PLANT PROGRAM	Gregory Bugbee and Summer Stebbins, assisted by Eva Ramey and Meara Burns
HEMP DEMONSTRATION PLOT	Terri Arsenault, Richard Cecarelli, Anuja Bharadwaj, Ph.D., Christian Dimkpa, Ph.D. and Jason C. White, Ph.D.
CHESTNUT SPECIES AND HYBRIDS	Sandra Anagnostakis, Ph.D. (Emeritus) assisted by Pamela Sletten
HEALTHY PLANTS – HEALTHY BUSINESS: SUPPORT OF THE GREEN INDUSTRY BY INSPECTION	Victoria Lynn Smith, Ph.D., assisted by Tia Blevins, Dana Crandall, Mark Creighton, Jeffrey Fengler, and Gerda Magana

BIOLOGICAL CONTROL OF HEMLOCK WOOLLY ADELGID	Carole Cheah, Ph.D.
THE ROCK	
ASIAN CHESTNUT GALL WASP ON CHESTNUT	Sandra Anagnostakis, Ph.D. (Emeritus) assisted by Pamela Sletten
HYBRID ELM TREES	Sandra Anagnostakis, Ph.D. (Emeritus) assisted by Pamela Sletten
ROCKY HILL AMERICAN CHESTUNUT TREES	Sandra Anagnostakis, Ph.D. (Emeritus) assisted by Pamela Sletten
GRAPEVINE DEMONSTRATION PLOT: HYBRID AND VINIFERA GRAPE CULTIVARS	Washington da Silva, Ph.D. and Richard Cecarelli
CONNECTICUT FARM BUREAU ASSOCIATION	Joan Nichols
US DEPT. OF AGRICULTURE, ANIMAL AND PLANT HEALTH INSPECTION SERVICE, PLANT PROTECTION AND QUARANTINE (APHIS-PPQ)	Erica Willey
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.	Nate Heiden
THE CONNECTICUT TREE PROTECTIVE ASSOCIATION	Cathy Dvorsky
THE CONNECTICUT INVASIVE PLANT WORKING GROUP	Rose Hiskes
THE CONNECTICUT DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION-PESTICIDE MANAGEMENT PROGRAM	Zachary Donais
CT DEEP FORESTRY- PRIVATE AND MUNICIPAL LANDS	Frank Cervo
US DEPARTMENT OF LABOR, WAGE AND HOUR DIVISION	Heather Callahan

THE CONNECTICUT DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION-WILDLIFE	Paul Benjunas
UNIVERSITY OF CONNECTICUT IPM TEAM	Shuresh Ghimire
CONNECTICUT PROFESSIONAL TIMBER PRODUCERS ASSOCIATION	Joan Nichols
UNITED STATES DEPARTMENT OF LABOR-OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)	Marianne Bonito
THE CONNECTICUT DEPARTMENT OF LABOR'S DIVISION OF OCCUPATIONAL SAFETY AND HEALTH (CONN-OSHA)	Catherine Zinsser
BONSAI SOCIETY OF GREATER NEW HAVEN	Alexander J. Amendola
MASTER GARDENERS, UNIVERSITY OF CONNECTICUT (UCONN)	Eric Larson

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 2022 CT Century Farm Award is Fairholm Farm, Woodstock, CT.

CENTURY FARM AWARD

Fairholm Farm
Woodstock, 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:

In 1920, Ethal and Estella Barrett purchased Fairholm Farm in Woodstock. Fairholm means sunny hillsides surrounded by streams. Ethal worked the farm after having served in the army during World War I. Ethal, Estella, and their three children, Barbara, George, and Doris worked together to make and sell dairy products that they marketed locally and in surrounding towns. In this way, the family survived the hardships of the Great Depression. Ethal passed away when George was sixteen. George completed high school and returned to working and growing the farm. Barbara and Doris went on to other careers but always found time to help out on the farm whenever they were needed. Although none of the original barns remain, the original 1812 farmhouse still stands and is where the fifth generation now lives.

Fairholm Farm currently raises and milks 400 Holstein cows using a modern robotic system and recently added a small retail store as well as an online store where they sell their own pork, beef, and cow's milk soap, in addition to honey and maple syrup. A Community-Supported Agriculture (CSA) program was started in 2021 and the farm is opened for visitors and educational opportunities such as four different Farm Camp programs for children and Hay Wagon Farm Tours to educate the public about how their food is produced.

At 11:15 a.m., Director Jason C. White introduced Katie S. Dykes, Commissioner of The Connecticut Department of Energy and Environmental Protection (CT DEEP), as the Samuel W. Johnson Memorial Lecturer.

EVENTS HELD AT THE STATION

Forest Health Monitoring Workshop 2023

On March 7, 2023, Victoria Smith, Ph.D. organized and participated in the annual CAES Forest Health Monitoring Workshop held in person at Jones Auditorium and on Zoom.

9:00-9:15	Vicki Smith	Welcome and Introductions
9:15-9:30	Joseph P. Barsky	2022 Acorn Mast Survey Results
9:30-10:00	Jeff Ward	Slash Walls and Beyond
10:00-10:30	Susanna Kerio	Urban Tree Health Challenges and Urban Maple Conditions in New Haven
10:30-10:45	BREAK	
10:45-11:15	Amanda Bunce	Adaptive Silviculture Experiment: Some Progress, Some Results, Some Chipmunks
11:15-11:45	Bob Marra	Beech Leaf Disease Update
11:45-12:15	Carole Cheah	Collaborations to Protect Hemlocks in CT
12:15-1:00	BROWN BAG LUNCH	
1:00-1:30	Tom Worthley	Turning Problems into Opportunities
1:30-2:00	Claire Rutledge	The Impact of EAB Biological Control Agents on Ash Forest Structure in CT
2:00-2:30	Vicki Smith	Alphabet Soup: LDD and SLF
2:30	Everyone	Discussion and Wrap Up

Spotted Lanternfly Symposium

On April 20, 2023, a symposium on Spotted Lanternfly (SLF), a newly invasive pest in Connecticut was sponsored by a CAES Board of Control grant to Dr. Claire Rutledge, and by the Connecticut Farm Wine Development Council. The

speakers included Dr. Melody Keena of the Northeastern Forest Research Station USDA, FS speaking on SLF biology. Dr Victoria Smith, State Entomologist CEAS, and Erica Willey APHIS PPQ, speaking on the regulatory status of SLF in CT and its current distribution in Connecticut. Dr. Flor Acevado of Pennsylvania State University speaking on SLF management in vineyards. Nicole Carrier of APHIS PPQ shared information on a newly invasive beetle, the grape vine borer, Xylotrechus pyrrhoderus,(Coleoptera: Cerambycidae). This potential pest has been detected in central Massachusetts. At the end of the morning there was a panel discussion held with all the speakers and Jamie Jones of Jones Family Farm of Shelton. There were 35 attendees, and CEU's were awarded to 29 participants from Connecticut Department of Energy and Environmental Protection. The symposium was greatly facilitated by help from Washington da Silva, Ph.D. of the CAES Plant Pathology Department, Niklas Lowe, a durational worker supported by a CAES BOC grant, and Kelly Fairbrother.

The CAES Vector-borne Disease Symposium

On May 10, 2023, The Department of Entomology and Center for Vector Biology and Zoonotic Diseases hosted the Vector-borne Disease Symposium in Jones Auditorium assisted by Megan Linske, Ph.D., Rebecca Johnson, Ph.D., and Zannatul Ferdous, Ph.D.

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 Plant Health Fellows Internship Program

From June 5th through August 3rd 2023, Lindsay Triplett, Ph.D. coordinated the USDA-funded SCSU/CAES Plant Health Fellows internship program for its sixth 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 thirteen panelists from industry, federal agencies, and universities in weekly career panels.focusing on different types of plant health careers.

The International Festival of Arts and Ideas 2023

On June 16 and 23, 2023, the Station participated in the International Festival of Arts and Ideas. Goudarz Molaei, Ph.D. 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. Philip Armstrong, Ph.D. spoke to visitors about the mosquito trapping and testing program. Katherine Dugas and Gale Ridge, Ph.D. spoke to visitors about their work at the CAES Insect Information Office; and Yonghao Li, Ph.D. talked about the Plant Disease Information Office and disease diagnosis to the tour groups. Lindsay Triplett, Ph.D. twice gave a presentation titled "CAES Then and Now" to members of the public. 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, Phil Anderson, Claire Rutledge, Washington da Silva, Gale Ridge, and Yonghao Li (24 adult) (June 16) and (24 adults) (June 23).

The Diagnosis and Management of Plant Diseases in Ornamental Greenhouses Workshop

On June 19, 2023, Yonghao Li, Ph.D. co-sponsored The Diagnosis and Management of Plant Diseases in Ornamental Greenhouses Workshop with Felicia Millett from CAES and Leanne Pundt and Rosa Raudales from UCONN Extension, which was held in Jones Auditorium at CAES New Haven campus. Fifty-five growers, professionals, and managers attended the workshop.

EVENTS HELD AT LOCKWOOD FARM

The 2022 Connecticut-FFA Forestry Career Development Event

On November 10, the Department of Environmental Science and Forestry hosted the Connecticut FFA-Forestry Career Development Event at Lockwood Farm Pavilion. The event included several components and evaluated students' individual knowledge in the following areas: tree identification, mensuration, equipment, a compass practicum, and a general knowledge exam. In addition, a team event included a timber stand improvement scenario. Forty-eight students from 12 high school agriscience programs in Connecticut participated in the event this year. The winning team this year attend the E. O. Smith High School in Storrs and will represent Connecticut at the National FFA Convention in 2023. The

E. O. Smith team placed 10th nationally at the 2022 National FFA Convention. The CAES would also like to thank and recognize Frank Cervo of CT-DEEP, Eric Hansen of Ferrucci and Walicki, LLC, and George Lyman for their participation and assistance with the event. Scott Williams, Ph.D. and Joseph P. Barsky of the Department of Environmental Science and Forestry and Megan Linske, Ph.D. of the Department of Entomology helped organize and oversee the event.

EVENTS HELD AT THE VALLEY LABORATORY

Tobacco Field Day

Twenty-five people attended the Connecticut Agricultural Experiment Station Valley Laboratory's Tobacco Field Day held at the Valley Laboratory on August 24, 2022. Dewei Li, Ph.D. welcomed growers. Tours of field plots were conducted; Jim Lamondia, Ph.D. spoke about target spot management and fungicide trials, breeding for resistance to multiple pathogens and new varieties under development, Fusarium wilt resistance, PVY and tobacco ringspot viruses, and with MR. JIM PRESTE discussed reduced tillage pros and cons and cover cropping. Jim Hyde of USDA NRCS and Julie Fine contributed to the discussion of reduced tillage and soil quality. Pete Kisselburgh (Arthur Carroll Insurance) answered questions about risk management in tobacco and the tobacco insurance program. Jim Preste, Michelle Salvas and Ethan Paine assisted with much of the behind the scenes work for the meeting. The meeting qualified for pesticide applicator re-certification credit in Connecticut and Massachusetts.

Tobacco Research Meeting

Sixty-five people attended the Connecticut Agricultural Experiment Station's annual Tobacco Research Meeting held at the East Windsor Scout Hall on February 22, 2023. This event was organized by Jim Lamondia, Ph.D. DeWei Li, Ph.D. welcomed growers and spoke about recent developments at the Experiment Station. Dr. Srikanth Kodati was introduced as the new UConn Extension IPM and Pesticide coordinator. Jatinder Aulakh, Ph.D. spoke about an invasive weed threat to tobacco production, and Christina Berger of the DEEP spoke about Worker Protection Standard updates. Jim Lamondia, Ph.D. spoke about tobacco breeding and disease management in wrapper tobaccos and Low Converter varieties of Connecticut broadleaf. He also spoke about reduced tillage effects on

soils and tobacco plantings. Colleen Kisselburgh (Arthur Carroll Insurance) discussed risk management in tobacco and the tobacco insurance program. Jim Preste, Ethan Paine and Michelle Salvas assisted with much of the behind the scenes work for the meeting. The meeting qualified for pesticide applicator re-certification credit in Connecticut and Massachusetts and 48 persons received credit.

THE STATION IN THE COMMUNITY

On July 2, 2022, Quan Zeng, Ph.D. attended the 4th International Erwinia Workshop (IEW 2022) in Assisi, Italy and delivered an oral presentation entitled "Expression of the Type III Secretion System Genes in Epiphytic Erwinia amylovora Cells on Apple Stigmas Benefits Endophytic Infection at the Hypanthium" (70 adults).

On July 9, 2022, Gregory Bugbee gave a talk titled "Managing Nuisance Aquatic Vegetation in Highland Lake" at the annual meeting of the Highland Lake Watershed Association at Little Red barn Brewers in Winsted (100 attendees); with Summer Stebbins, gave an Invasive Aquatic Plant Seminar to a Limnology class at Western Connecticut State University (20 attendees) (July 12); gave a talk titled "Controlling Variable Watermilfoil with ProcellaCOR" at the annual meeting of the Crystal Lake Protective Association at the Ellington Town Beach (50 attendees) (July 20); gave a talk titled "Aquatic Vegetation Update – Bashan Lake" at the annual meeting of the Bashan Lake Association at the East Haddam Grange (75 attendees) (July 22).

From August 28–September 2, 2022, Lindsay Triplett, Ph.D. served as one of two US organizers of the 12th Japan-US Seminar on Plant Pathology in Ithaca, NY, an international conference supporting Japanese and American scientific cooperation in plant pathology since 1966. Attendees represented 17 US and 15 Japanese universities, where she gave an oral presentation "How predators remodel the phytobiome for plant health" (91 adults) (August 29)

September 13-15, 2022, Chaoyi Deng, Ph.D., Christian Dimkpa, Ph.D. and Jason White, Ph.D. attended the National Science Foundation Center for Sustainable Nanotechnology (CSN) All-hands meeting in Atlanta, GA in which DR. DENG presented a poster on "The role of Fe3O4 nanoparticle surface charge on disease suppression in tomato plants (Solanum lycopersicum)" (~50 participants). Dr. White and Dr. Dimkpa joined other CSN faculty in discussions on work progress and future plans.

From November 15–17, 2022, Kitty Prapayotin-Riveros, Terri Arsenault, Meghan Cahill, Carlos Tamez, Ph.D**.**, and Chris Dimkpa, Ph.D. attended the Laboratory Flexible Funding Model (LFFM) CAP Grantee Meeting in St. Louis, MO**.** Kitty Prapayotin-Riveros presented State Experiences with ORA DX and provided the feedback the FDA to improve the data exchange system, along with participating in the Town Hall Q&A for ORA DX. Chris Dimkpa, Ph.D**.** presented Food Safety Analysis at CAES: Focus on Toxic Elements in Infant Foods; Terri Arsenault presented the poster on "Calibration, Measurement Uncertainty and Limits of Detection," and Carlos Tamez, Ph.D. presented the poster on "Analysis of Pesticides in the State of Connecticut."

On January 18, 2023, Yonghao Li, Ph.D. co-sponsored The Bedding Plants – Spring 2023 meeting with Leanne Pundt from UCONN, which was held at the UConn Litchfield County Extension Center, Torrington. Topics included "Recap 2022, Bedding Crop Diseases to Prepare for 2023" by Dr. Yonghao Li, CAES and "Update on Insect and Mite pests" by Leanne Pundt, UConn Extension. Twenty-seven growers and professionals attended the event.

From March 8-10, 2023, thirteen members of the Plant Pathology and Ecology Department participated in the Annual Meeting of the Northeastern Division of the American Phytopathological Society in Southbury, CT. Back row, Left-Right: Quan Zeng, Washington da Silva, Juliana Milagres, Ravikumar Patel, Neil Schultes, Yonghao Li, and Raja Muthu-

ramalingam. Front row: Renee Smith, Wade Elmer, Lindsay Triplett, and Felicia Mil-lett. In attendance but not pictured: are Robert Marra (conference co-organizer) and Raquel Rocha.

On March 17, 2023, Scott Williams, Ph.D., Megan Linske, Ph.D., and. Jamie Cantoni hosted a film crew from the CW's Mysteries Decoded with co-host Tracy Walder (far left), producer Lisa Lumar (second from left) and host Jennifer Marshall (third from left) on a private property in Lyme, CT to demonstrate tick sampling techniques and discuss the origins of Lyme disease.

On April 17, 18, and 20, Itamar Shabtai, Ph.D. and Joseph Barsky joined with NRCS staff at a soil sampling pit at White Memorial Foundation Forest in Morris, CT as part of a project evaluating dynamic soil properties.

On May 22-23, **Dr. Chris Dimkpa** and **Dr. Paul Aikpokpodion** visited Stony Brook University (SBU) Long Island under the auspices of the NSF-funded *PFI-TT: Advancing Nanocellulose-Enabled BioNanofertillizers for Agricultural Applications.* The project is implemented by Dr. Ben Hsaio for SBU (left in photo), and **Dr. Chris Dimkpa** for The CAES.

DONATIONS MADE TO THE COMMUNITY

Lockwood Farm

A total of 29,565 pounds of fresh produce grown at the Lockwood Farm were donated to various organizations in the community.

Valley Laboratory

A total of 6,025 lbs 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 DeWei Li, Ph.D. generated the fresh produce, and Jim Preste organized the distribution effort.

AWARDS AND RECOGNITION RECEIVED BY STATION STAFF

In August 2022, Susanna Keriö, Ph.D. was awarded a USDA Specialty Crop Block Grant to study Reduction and diagnosis of transplant shock in landscape trees in Connecticut nurse-ries and urban sites. $96,313.

From September 1, 2022 – August 31, 2027, Scott C. Williams, Ph.D. (CAES), Co-Pis: Megan A. Linske, Ph.D., Goudarz Molaei, Ph.D., and Doug E. Brackney, Ph.D. (CAES), Dr. Robert Smith, Dr. Susan Elias, and Mr. Charles Lubelczyk (Maine Medical Center Research Institute), and Dr. Maria Diuk-Wasser (Columbia University) will receive a $5,000,000 award from the Centers for Disease Control and Prevention for “Suppression of Host-Seeking Ixodes scapularis Abundances and Interruption of Pathogen Transmission Through Orally Delivered Systemic Acaricide Treatment of White-tailed Deer and Peromyscus spp.”.

In October 2022, Tracy Zarrillo received USDA NRCS Cooperative Agreement funding of $247,597 in collaboration with the University of Rhode Island for 3 years (2023-2025). The purpose will be to monitor wild native bees (both bumblebees and solitary bees) in Farm Bill conservation plantings in RI and CT; evaluate the efficacy of existing Farm Bill practices; and suggest practices to improve the program.

In October 2022, Leigh Whittinghill, Ph.D. was awarded a USDA Specialty Crop Block Grant to study The Effects of Management Practices on the Nutritional Quality of Cut-and-Come-Again Greens from Urban Farms in Connecticut. $58,494.69.

From 9/23/2022 – 9/22/2025, Megan Linske, Ph.D. (Co-PI) was awarded a subcontract for Banfield-Bio’s National Institutes of Health, Direct Phase II Small Business Innovation Research Award (1R44AI172565-01) titled “Polymeric

Matrix Loaded with Tick Repellent or Toxic Compositions for Incorporation into Fabrics or Granular Dispersal." $333,028.

From 9/23/2022 – 9/22/2025, Scott Williams, Ph.D. (PI-CAES) was awarded a subcontract for Banfield-Bio's National Institutes of Health, Direct Phase II Small Business Innovation Research Award (1R44AI172565-01) titled "Polymeric Matrix Loaded with Tick Repellent or Toxic Compositions for Incorporation into Fabrics or Granular Dispersal." $333,028.

In December 2022, Blaire Steven, Ph.D. and colleagues from the University of Connecticut and DEEP were selected for a Long Island Sound Sea Grant. The title of the successful proposal is "Testing the Effects of Vegetation on Saltmarsh Ecology, Services, and Restoration Success: From Microbial Ecology and Biogeochemistry to Wildlife Conservation." Total funding $909,478 with $94,486 to CAES, 2 years.

In December 2022, Nubia Zuverza-Mena, Ph.D. and Jason White, Ph.D. were granted USDA awards to fund two projects in which they participate as Co-PI and key personnel: "Manganese and iron-based nano-enabled agrochemicals for food security" and "Crop exposure to micro-nanoplastics and potential impact on human nutrition and health," each for ~$750,000 total.

On December 8, 2022, Andrea Gloria-Soria, Ph.D. received the Louis A. Magnarelli Post-Doctoral award established by The Board of Control of The Connecticut Agricultural Experiment Station.

In January 2023, Hany Dweck, Ph.D. has succeeded in transferring his 5-year NIH K01 Award to The CAES. The aim of this award is to study molecular mechanisms of chemoreception in spotted wing Drosophila, Drosophila suzukii, that are causing immense damage to fruit crops in much of the world, including Connecticut. 2/10/2022-1/31/2027. $616,120.

In January 2023, Washington Da Silva, Ph.D. was awarded a Specialty Crop Block Grant from the Connecticut Department of Agriculture titled "Functionalizing liposomes for controlled delivery of siRNAs to manage potato virus Y infections." $119,575.79.

In January 2023, Robert Marra, Ph.D. was awarded $450,000 from the Division of International Programs of the US Forest Service, for the proposal "Finding the origin of Litylenchus crenatae mccannii, the invasive nematode causing widespread decline of American beech," which he shares with Dr. Paulo Vieira (USDA-ARS).

On January 26, 2023, Carole Cheah, Ph.D., in partnership with Farmington River Watershed Association and McLeans Game Refuge, was awarded a 2023 grant for $24,000 by the Lower Farmington River and Salmon Brook Wild and Scenic Committee for a joint project to acquire and release Sasajiscymnus tsugae for biological control of HWA in the Lower Farmington River and Salmon Brook watershed.

In February 2023, Srikanth Kodati, Ph.D. received a $29,900 grant through The Horticulture Research Institute's grant program for the year 2023 to study "Copper-based nanoparticles in the management of boxwood blight."

In March of 2023, Dewei Li, Ph.D. was awarded with a Specialty Crop Block grant (USDA Agreement No. AM21SCBPCT1109) "Study of morel (Morchella sp.), a gourmet wild mushroom as an intercrop of Christmas trees." 2023-2024. $87,941 and received a one-year grant from Farmington River Coordinating Committee for "Fungal Diversity Study in the Upper Farmington River Watershed." $12,235

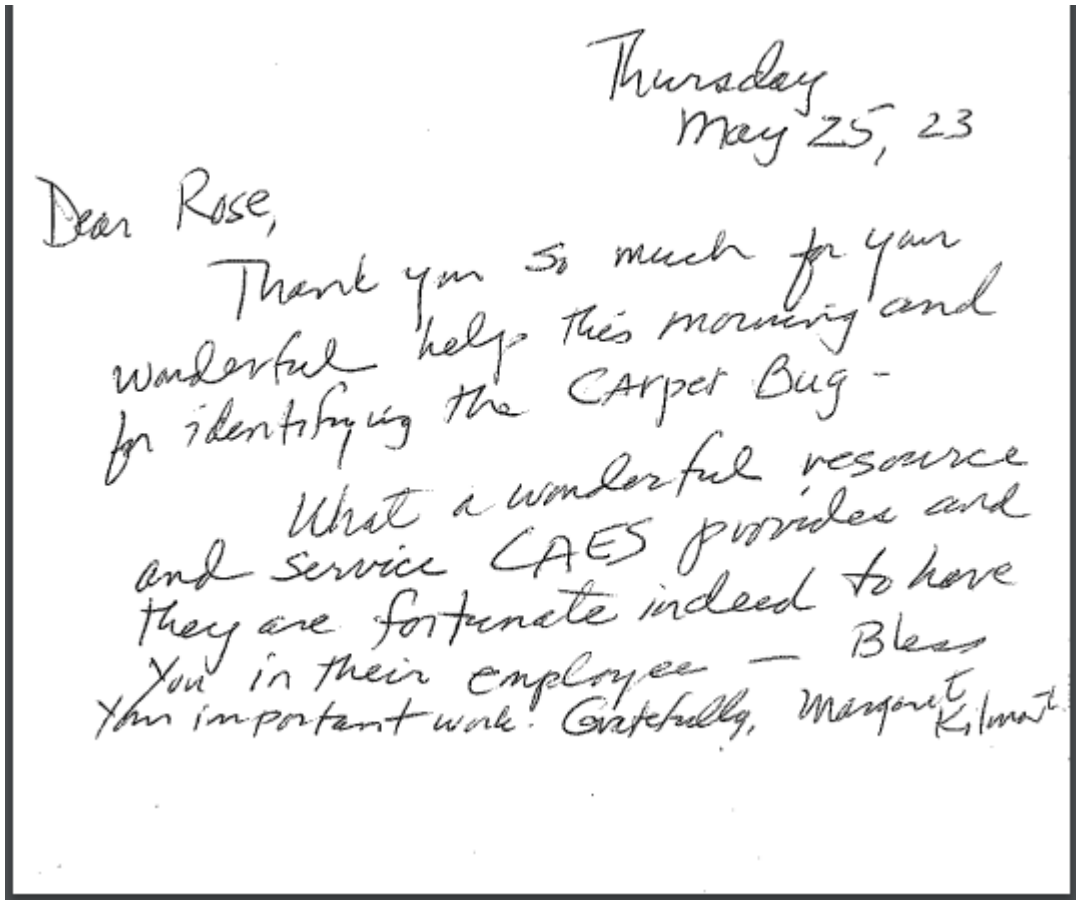
In April 2023, Jason White, Ph.D. was awarded from USDA NIFA AFRI for 4 years for "Nanoparticulate soil amendments for achieving Closer to Zero via metal(loid) encapsulation," Adeyemi, A., White, J. C., and Keller, A., $728,000 and, along with Nubia Zuverza-Mena, Ph.D., awarded for 3 years for "Crop exposure to micro-nanoplastics and potential impact on human nutrition and health", Demokritou, P., White, J. C., Zuverza-Mena, N., and Sadik, O., $752,000.

In May of 2023, Jason White was awarded from USDA NIFA AFRI for 4 years for "Nanoscale manganese and iron micronutrients to increase photosynthesis, crop yield and abiotic stress tolerance", Hernandez, J.A., White, J. C., Gardea-Torresdey, J.L., Zuverza-Mena, N., Craver, V. $750,000 and along with Blaire Steven, Ph.D., awarded from USDA NIFA AFRI for 4 years for "Calcium phosphate nanocomposites as a precise intelligent fertilizer to increase nutrient use efficiency and crop yield", Jaisi, D., White, J. C., Steven, B., Iafisco, M. $750,000.

THE PUBLIC SPEAKS

- On August 11, 2022, Steve Hurt wrote the following to Yonghao Li, "That solves the mystery and we appreciate the very quick reply, most helpful."
- On August 15, 2022, Christopher Harley wrote the following to Yonghao Li, "Thanks for your help and quick response. As always CAES is a valued resource."
- On September 14, 2022, Rob Vavasour wrote the following to Yonghao Li and Gale Ridge, "Thank you so much for quickly providing your expert advice on my Dawn Redwood problem earlier this afternoon. Always so lucky to have your expertise available on such short notice!"

- On October 3, 2022, Arlene Ghent wrote the following to Yonghao Li, “Thank you tremendously! I am so appreciative of your time, knowledge and caring assistance in helping me care for my tree (more) properly. I’m hoping it will survive this leaf disease; I will rely on your expertise along the way to monitor its condition with me.”
- On January 25, 2023, Anna Korkus, a Reference Librarian at the Avon Free Public Library, wrote the following to Yonghao Li, “Thank you for your wonderful and very informative presentation. We received many thank you messages and patrons enjoyed your very interesting lecture. Once again thank you!”
- On March 28, 2023 Ebony Williams wrote the following to Felicia Millett. “Thank you! I’m definitely interested in this article.”
- On March 28, 2023 Thomas DeSimone wrote the following to Felicia Millett. “Thank you very much for the informative analysis, Felicia!”
- On April 6, 2023, Daniel Hennessey wrote the following to Yonghao Li, “Thank you, excellent report and timely”
- On April 19, 2023, Robin Page wrote the following to Yonghao Li, “Thank you so much for this information AND your quick reply! You have saved me a lot of time, money, and hopefully plant lives!”
- On April 20, 2023, Enrene Tonder wrote the following to Yonghao Li, “Thank you for these suggestions, I will implement them. Thank you for this wonderful service you provide! It has given me both direction as to what to do and pace of mind that there is something to be done.”
- On April 23, 2023 Michelle Gilbert wrote the following to Felicia Millett. “Thank you in very much. I’m grateful for your help. I’ll try pruning early spring next year and hope to avoid the leaf tie-ers!”
- On April 27, 2023 Carolyn and Gary Decko wrote the following to Felicia Millett. “I appreciate your help in identifying this rather scary situation/plant! And such a beautiful creation. We’ll dispose of it promptly and monitor any other appearances. It’s been caught early, thank goodness, thanks to you! Have a great day!”
- On April 27, 2023 Ann Perkowski wrote the following to Felicia Millett. “Thank you very much for your advice and directions. So appreciated.”
- On May 5, 2023 Lasse Simonsen wrote the following to Felicia Millett. “Thank you very much, I appreciate that you are keeping me updated on this. Have a nice weekend!”
- On May 9, 2023, Elizabeth Morin wrote the following to Yonghao Li, “Thank you so much for such a quick reply and the good news. CAES is the best! Much appreciation”
- On May 11, 2023 Nancy Cook wrote the following to Felicia Millett. “Thanks so much. You are a great resource.”
- On May 22, 2023 Mark Hughes wrote the following to Felicia Millett. “Thanks for the quick and clear response. Very much appreciated.”



Thursday
May 25, 23

Dear Rose,

Thank you so much for your wonderful help this morning and for identifying the Carpet Bug -

What a wonderful resource and service CAES provides and they are fortunate indeed to have you in their employee - Bless your important work. Gratefully, Margaret Kilmartin

- On May, 25, 2023 Margaret Kilmartin wrote the following to Rose Hiskes: Dear Rose, Thank you so much for your wonderful help this morning and for identifying the carpet bug- What a wonderful resource and service CAES provides and they are fortunate indeed to have you in their employee- Bless your important work. Gratefully, Margaret Kilmartin"
- On June 5, 2023 Kathleen McFadden wrote the following to Felicia Millett. "Thank you for the quick response. Very helpful!"
- On June 7, 2023**,** Nassifatou Tittikpina, Ph.D. was invited by the Shepherd Glen Elementary School in Hamden to meet with 5th graders and share her experience and life as a scientist. The meeting was set up with Mrs. Powell, Suzanne and Carolyn Nielsen from the Shepherd Glen Elementary School, and Dr. Lindsay Triplett from the CAES. Dr. Tittikpina received letters of thanks from the students after the event. "Thank you so much for your time today and the impact you had on our students. Suzanne"

- On June 15, 2023 Susie Avitabile wrote the following to Felicia Millett. “It was such a treat to meet with you yesterday! Thank you for all of your help in diagnosing what ails my roses. I had such a good time watching you use your microscope and viewing the monitor. My husband had no idea what tools were used to gather info. I also told him about your hellebores and their amazing colors. Thank you for the printouts as well. I attacked my rose bush carefully bagging it all and also recovered the diseased canes I'd tossed into compost. My husband will probably use our mower as a tractor to help pull out roots. I'll cover the stump to be pulled out in hopes of minimizing mites in the air. I'm cautiously hopeful no other bushes have been infected. I shudder to imagine what a disaster I could have created without your help. Thank you so much.”
- On June 16, 2023 John Chunis wrote the following to Felicia Millett. “I want to thank you so much for all the help you have provided to me on this problem, it is greatly appreciated!”

- On June 20, 2023, Dan Swim, an arborist at SavATree, wrote the following to Yonghao Li, “Excellent and timely work as always. Thank you and your team for everything you do for the state of Connecticut.”

- From: Dan Swim, Savatree. Great information Rose. Now I'll be hunting pupal skins. Hopefully this cool Spring may have slowed them down. Thank you, you are a treasure. Best, Dan Swim
-
- From Ann B. Windsor. Rose, Thank you from the deepest wells of my being. During my years of service as a commission member, I've always found CT valley Agricultural Experiment Station as a reliable resource for information. May I reference your observations to my Conservation Commission members.
  In gratitude and appreciation, Ann B.

Best wishes for a good summer and thank you again for all you do.

Sincerely,
Martha Steenburgh
VP/Treasurer NHLT

05 June 2023

Dear Rose,

A belated thank you note for your very informative walk + talk at the Alfred Sabolcik Preserve. I'm glad there was such good participation and the feedback has been very positive - especially from the people from neighboring land trusts.

I learned a few new things and had other lessons imprinted more firmly on my brain.

Thanks also to Todd for his participation. I covet his belt tool holder!

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 Chemistry for the Special Issue "Functional Chitosan Biopolymers for Applications in Agriculture"
- Committee member of the ISO/TC 229/WG 3 on Health, Safety and Environmental Aspects of Nanotechnology
- Guest Editor for Environmental Pollution for the Special Issue "Interactions between micro/nano particles in the environment: Assessing the impact on soil and water ecosystems"

- Member of the Doctoral Dissertation Committee for candidate Ken Johnson, Department of Chemistry, Stony Brook University. August 2022
- 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.
- Co-Implementer of the Fertilizer Research and Responsible Implementation (FERARI) project funded by OCP and UM6P, Morocco.

YI WANG

- Member, American Chemical Society
- Member, Sustainable Nanotechnology Organization
- Guest Editor, MDPI Plants
- Member, Editorial Advisory Board of ACS Agricultural Science & Technology

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"

DOUG BRACKNEY

- Assistant Clinical Professor, Department of Epidemiology of Microbial Diseases, Yale School of Public Health
- Adjunct Associate Professor in the Department of Pathobiology and Veterinary Sciences, University of Connecticut

- Academic Editor, *PLoS Neglected Tropical Diseases*
- 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"

ANGELA B. BRANSFIELD

- Member, Beta Beta Beta Biological Honor Society (Upsilon Omicron chapter)
- Member, Phi Sigma Biological Honor Society (Gamma Rho chapter)
- Member, The Connecticut Biosafety Alliance Group
- Member,The American Biological Safety Association
- Diversity, Equity, and Inclusion Committee Member, The Connecticut Agricultural Experiment Station
- Health and Safety Committee Member, The Connecticut Agricultural Experiment Station
- Biosafety Committee Member, Yale University

HANY K. M. DWECK

- Assistant Scientist II, The Connecticut Agricultural Experiment Station
- Research Associate, Department of Molecular, cellular, and Developmental Biology, Yale University
- Editorial Board Member, *Insects*
- Review editor for *Frontier in Ecology and Evolution*, Section of Chemical Ecology
- External Reviewer for Annals of the Entomological Society of America, Comparative Biochemistry and Physiology, Part B, Chemical Senses, Cellular and Molecular Life Sciences, Chemecology, Communications Biology, eLife, French National Research Agency (ANR), Frontiers in Behavioral Neuroscience, Genetics, Journal of Chemical Ecology, Journal of Insect Physiology, Insects, International Journal of Biological Sciences, Micron, Molecular Biology and Evolution, Microscopy Research and Technique, PLoS ONE, Proceeding of the Royal Society B, Psyche, Scientific Reports
- Member Entomological Society of America

KELSEY E. FISHER

- Member, Multi-State Research Project NC1173 – Sustainable Solutions to Problems Affecting Bee Health
- Member, Multi-State Research Project NC246 – Ecology and Management of Arthropods in Corn
- Editorial Board Member: Agricultural and Environmental Letters, Northeast Naturalist
- External Reviewer: Ecology and Evolution, PLOS ONE, Journal of the Lepidopterist's Society
- Science Policy Fellow, Entomological Society of America
- Member, Entomological Society of America's Insect Loss Working Group

- Secretary, Ecological Society of America's Communication and Engagement Section
- Member of Professional Societies: Entomological Society of America, Ecological Society of America, The Wildlife Society, Society of Conservation Biology, Connecticut Entomological Society, and American Entomological Society

ANDREA GLORIA-SORIA

- Leadership Team, Northeast Regional Center for Excellence in Vector-Borne Diseases
- 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"
- Member Entomological Society of America
- Member Society for the Study of Evolution
- Diversity, Equity and Inclusion Committee Member, The Connecticut Agricultural Experiment Station

MEGAN A. LINSKE

- Postdoctoral Association Liaison, 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
- Member, The Northeast Regional Center of Excellence in Vector-Borne Diseases
- Past President, The Wildlife Society, Northeast Section
- President, 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
- Member, The Ecological Society of America
- Certified Ecologist, The Ecological Society of America
- Adjunct Faculty, Unity College Distance Education Program
- MS Committee Member for Sandra M. Zapata-Ramirez, Western Connecticut State University

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

- Member, Entomological Society of America
- Vice-President,(Board of Directors), The Connecticut Tree Protective Association

VICTORIA LYNN 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

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, Entomological Society of America
- Member, IUCN SSC Wild Bee Specialist Group
- 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
- Professional Certification Review Board, The Wildlife Society
- Executive Treasurer, Northeast Section of The Wildlife Society
- Member, The Wildlife Society
- Member, Entomological Society of America
- Associate Editor for the peer-reviewed journal, *Animals*
- Vice Chair, Town of Guilford Inland Wetlands Commission
- Vice Chair, Town of Guilford Land Acquisition Commission
- Commissioner, Town of Guilford Conservation 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
- Member, Connecticut Environmental Review Team

GREGORY J. BUGBEE

- Past President, Northeast Aquatic Plant Management Society
- Chair, Scholarship Committee, Northeast Aquatic Plant Management Society
- Panelist, Northeast Aquatic Nuisance Species Panel
- Member, United States Army Corps of Engineers, CT River Hydrilla Education & Outreach Working Group
- Member, United States Army Corps of Engineers, CT River Hydrilla Control Demonstration Project Working Group
- Member, Connecticut Invasive Plant Working Group
- Director, Clear Lake Improvement Association
- Member, North American Lake Management Society
- Member, Aquatic Plant Management Society

JEREMIAH R. FOLEY IV

- Member, Entomological Society of America
- Member, Aquatic Plant Management Society
- Member, North American Invasive Species Management Society

SUSANNA KERIÖ

- Secretary, Connecticut Urban Forest Council
- Secretary, Connecticut Tree Protective Examination Board
- Member, Forest Pathology Committee, American Phytopathological Society
- Member, Society of American Foresters
- Member, Yale Biosafety Committee
- Secretary, Connecticut Tree Protective Examination Board (Ex Officio)

SARA L. NASON

- Adjunct Assistant Research Scientist, Department of Plant Science and Landscape Architecture, University of Connecticut
- Website Manager, Best Practices for Non-Targeted Analysis Working Group
- Co-Chair, Stakeholder Outreach Committee, Best Practices 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 A. SHABTAI

- Member, Soil Health Subcommittee, Connecticut Council on Soil and Water Conservation
- Chair, Multi-State Research Project NC-1178, "Land use and management practice impacts on soil carbon and associated agroecosystems services"
- Adjunct Professor, Department of Natural Resources and the Environment, University of Connecticut, Storrs, CT
- Member, Review Panel for the Department of Energy's Environmental Molecular Sciences Laboratory User Access grants program

BLAIRE T. 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

ELISABETH B. WARD

- Member, State Coordinators Committee, Forest Ecosystem Monitoring Cooperative
- Member, Multi-state Beech Leaf Disease Working Group
- Member, Society of American Foresters
- Member, Ecological Society of America
- Member, American Geophysical Union

JEFFREY S. WARD (Emeritus)

- Executive Board, Connecticut Forest and Park Association
- Trustee, Great Mountain Forest
- Secretary, Connecticut Tree Protection Examination Board

LEIGH J. WHITTINGHIL

- Editorial Board, Journal of Living Architecture

- Member, Scientific Committee for the 2022 Urban Food System Symposium conference
- Member, Planning Committee, Connecticut Vegetable and Fruit Conference
- Member, Connecticut State Consulting Committee for Agricultural Science and Technology Education
- Member, Connecticut Council on Soil and Water Conservation
- Member, Soil Health Subcommittee, Connecticut Council on Soil and Water Conservation
- Scientist Mentor, CAES Postdoctoral Scholar Association
- Member, grant review panel, CT Department of Agriculture
- Member, grant review panel, USDA NIFA

DEPARTMENT OF PLANT PATHOLOGY AND ECOLOGY

LINDSAY R. TRIPLETT

- 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
- Gratis Faculty, University of Connecticut (UCONN)
- Member, Research Thesis Advisor, Southern Connecticut State University
- 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
- Scientific Member, Connecticut Farm Wine Development Council
- Member, Science/Education Committee, Connecticut Farm Wine Development Council
- Member, New England, New York, and Canada Tree Fruit Pest Working Group
- 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
- Member, Virology Committee, American Phytopathological Society

- Member, Tropical Plant Pathology Committee, American Phytopathological Society
- Chair, Working Group, American Phytopathological Society (APS) and the Brazilian Society of Plant Pathology (SBF)

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, Beech Leaf Disease Working Group
- Member, American Phytopathological Society
- Member, Northeastern Division, American Phytopathological Society (NED-APS)
- Member, Forest Pathology Committee, American Phytopathological Society
- Local Arrangements Co-Chair for Annual Meeting of the NED-APS
- Member, Society of American Foresters
- Member, International Society of Arboriculture
- Member, Connecticut Tree Protection Examining Board

FELICIA MILLETT

- Vice Chair, Proficiency Committee, National Plant Diagnostic Network
- NEIL P. SCHULTES
- Member of the Linnean society, London, UK
- President, Quinnipiac Chapter Sigma Xi, Hamden, CT
- Member, New England, New York and Canada Tree Fruit Pest Working Group
- Gratis Faculty, University of Connecticut

QUAN ZENG

- Senior Editor, Phytopathology
- Editor, Microbiology Spectrum
- 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 (2) and University of Wisconsin-Milwaukee (1)
- Gratis faculty, 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)
- Mycological Society of America
- American Phytopathological Society
- International Association for Aerobiology
- Pan-America Aerobiology Association
- International Mycological Association

JATINDER AULAKH

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

CAROLE CHEAH

- Nearctic regional section of IOBC (International Organization for BioControl of Noxious Animals and Plants)
- 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

- 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.

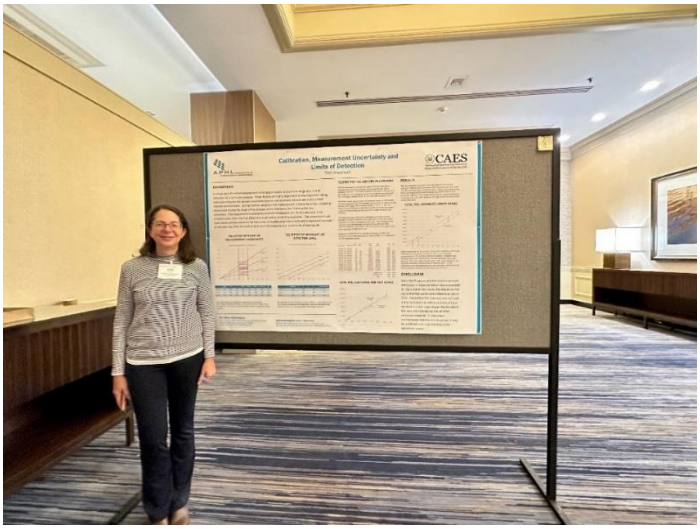
ARMSTRONG, PHILIP M.

- was interviewed by Patch Media about the current mosquito season and the projected risk for West Nile virus transmission this year (July 20), and by WTIC, Fox 61, and NBC Connecticut about the first detections of West Nile virus from mosquito pools in Connecticut (July 26-27)
- was interviewed by the New London Day about the current mosquito season and the risk of EEE virus (August 18); by the Record Journal about West Nile virus transmission in 2022 (August 24); and by Estuary Magazine about mosquitoes and mosquito-borne diseases affecting the Connecticut River valley (August 26).
- was interviewed by Fox 61 about human cases of West Nile virus infection in Connecticut (September 23).
- gave a poster presentation titled "Genetic characterization and vector competence of a regional variant of Brazoran virus from Florida" at the Annual Meeting of the American Society of Tropical Medicine and Hygiene in Seattle, WA (October 30–November 3).

- provided updates on mosquito surveillance and control during the CAES meeting with Yale University, Western Connecticut State University, and the Connecticut Department of Public Health on March 27, 2023
- along with Goudarz Molaei, Ph.D., Noelle Khalil, and Angela Bransfield, hosted a group of Yale Emergency and Wilderness Medicine residents and discussed tick and mosquito surveillance programs at the CAES and provided them with a tour of tick and mosquito laboratories as well as the BSL3 laboratory (April 19)
- was interviewed by a reporter from WTIC about the state mosquito monitoring program (May 31)
- spoke to visitors about the mosquito trapping and testing program as a part of the New Haven Festival of Arts and Ideas (June 16 and 23)

ARSENAULT, TERRI

- Spoke at the UCONN Cannabis symposium about optimizing testing for cannabinoids on March 16, 2023. The talk discussed how field sampling and laboratory handling affect the measurement uncertainty associated with test reports.
- Attended the annual meeting for the multi-state Hatch grant for industrial hemp (S1084) February 8-10, 2023 in Fort Collins Colorado, and met with stakeholders concerning research needs.
- Attended the New England Cannabis Research and Education Conference at Eastern CT State University in Storrs CT on October 21, 2022. and presented on compliance testing of *Cannabis sativa* samples.



- Attended the Laboratory Flexible Funding Model (LFFM) CAP Grantee Meeting in St. Louis, MO, during November 15–17, 2022 and presented a poster on "Calibration, Measurement Uncertainty and Limits of Detection".

AULAKH, JATINDER S.

- talked about weed management at the Connecticut Christmas Tree Growers twilight meeting at Totoket Tree Farm in Branford, CT (~50 attendees) (July 19); and submitted an article titled, "Horsenettle (Solanum carolinense L.) Control in Christmas Trees" to the Real Tree Line Magazine of the Connecticut Christmas Tree Growers Association (July 26).
- presented a poster titled "Preemergence Herbicide Tolerance Trials in Herbaceous Cut Flowers" at the 112th Plant Science Day (43 attendees) in Hamden, CT (August 3); gave a research demonstration field tour to a Christmas Tree Nursery Producer, Larry Downy, from Quebec, Canada (August 26); and talked about weed management at the annual fall meeting of the Connecticut Christmas Tree Growers Association at Dumas Christmas Tree Farm in Durham, CT (~60 attendees) (August 27).
- presented a talk on "Christmas tree tolerance and weed control with topramezone herbicide" at the Exotic Conifer Association meeting in Hatley, Quebec, Canada (September 23); and attended the Quebec, New Hampshire, Vermont Christmas tree growers annual meeting in Hatley, Canada (September 24).
- had Zoom meeting with Dr. Wang Huanzhong, Associate professor at UCONN, on a grant collaboration (October 26); and attended the Connecticut Invasive Plant Council virtual meeting (October 19) (8 attendees); and attended the Northeastern Invasive Plant Council virtual meeting (October 20) (23 attendees); had Zoom meeting with Dr. Vipan Kumar, Assistant professor at KSU, on a collaborative research project to determine the molecular and physiological mechanisms of herbicide resistance in Palmer amaranth biotype from Connecticut (October 16).
- published a manuscript titled "Asiatic Dayflower (Commelina communis) Control in Douglas Fir" in the Invasive Plant Science and Management Journal (January 9); presented a talk at the Vermont–New Hampshire Christmas tree growers meeting in Barre, Vermont (January 24)
- submitted two factsheets titled "Postemergence Herbicide Tank-mixes for Summer Weed Management" and "Wild Buckwheat Identification and Management in Christmas Trees" for publication in the Real Tree Line Journal (March 16) attended the Northeastern Invasive Plant Council zoom meeting (March 30).
- gave a research plot demonstration on Frequency (topramezone) and Tenacity (mesotrione) herbicides crop safety and weed efficacy at the twilight meeting of the Connecticut Christmas Tree Growers Association (June 14).

BARSKY, JOSEPH P.

- attended the Connecticut Tree Protective Association Summer Meeting in Farmington (July 21)
- attended the quarterly meeting of the New England Society of American Foresters Executive Committee (September 14); served as a judge at the 2022 Regional Agriscience Fair at the Big E (September 16); interviewed by Brian Hallenbeck of The Day about the importance of oak acorns for forest ecology, "Deer could be hungrier than usual this fall" (September 23); co-lead an interpretive biodiversity hike at Sleeping Giant State Park (September 24); conducted a vegetation survey for the Guilford Land Conservation Trust (September 26); interviewed by Robert Miller of Hearst Media Group regarding the importance of acorns for forest ecology

(September 27).

- organized and coordinated the Standard First Aid/Adult CPR/ AED training session at CAES (24 CAES employees attended) (October 4).
- Was interviewed by Jennifer Ahrens of Connecticut Public Radio about the importance of oak acorns for forest ecology in an article titled “Connecticut's depleted acorn crop will have wide-reaching impact” (November 8), Partici-pated in the Yankee Division of the Society of American Foresters Fall Field Meeting on Old Growth Forest Dynamics (November 16).
- attended a virtual meeting with staff from the Connecticut Natural Resources Conservation Service to discuss future soil sampling and characterization efforts (December 6); served as an invited panelist in an online webinar titled “Dogs on Land Trust Properties” hosted by Flanders Nature Center, Woodbury, CT (10 attendees) (December 7); participated in the quarterly meeting of the New England Society of American Foresters Executive Committee (December 14); met with Connor Hogan, Director of McLean Game Refuge to discuss collaborative research on the use of slash walls to limit herbivory impacts to native regeneration by white-tailed deer (December 21).
- participated in the quarterly Executive Committee meeting of the New England Society of American Foresters (January 11); attended and assisted with staffing the CAES booth at the Connecticut Tree Protective Association Annual Winter Meeting (400 attendees) (January 19).
- participated in a Zoom call with staff from the Department of Microbiology at the University of Massachusetts on the influence of acorn abundance on mouse populations and tick-borne pathogen presence (February 10); offered a walk-and-talk presentation to the Active Adventures on “Forest History in Connecticut” (February 21); participated in the quarterly meeting of the Connecticut State Consulting Committee for Agricultural Science and Technology Education and shared an update on recent CAES initiatives (February 23)
- presented “2022 Acorn Mast Survey Results” during the 2023 Forest Health Workshop at The CAES (50 attendees) (March 7); presented “Invasive Species and Climate Change” for the Youth and Climate Series, sponsored by NY and CT Audubon Societies (26 students and 6 teachers attended) (March 9); moderated silvicultural session and participated in executive committee meetings at the New England Society of American Foresters Annual Meeting in Nashua, NH (March 13-16); participated in virtual meeting to discuss collaborative research with University of Massachusetts resource professionals involving acorn mast abundance and Lyme disease incidence rates (March 20); met with Connor Hogan of McLean Game Refuge to discuss collaborative forest research on slash walls in Goshen, CT (March 29); participated in the Region 12 Agricultural Science and Technology Education Compliance Review (March 30-31).
- resented “Native Trees and Shrubs” to the Spring Glen Garden Club at Lockwood Farm (10 attendees) (April 10); along with DR. JEFFREY WARD, participated in the Forest Ecosystem Monitoring Cooperative State Partnership Virtual Conference Call (8 participants) (April 21); collaborated with soil scientists from the USDA-NRCS in Morris on a forest soil carbon study (April 17-21); demonstrated forestry sampling techniques to high school students from The Sound School at CAES, New Haven (10 students, 2 adults) (April 24).

- attended the Forest Ecosystem Monitoring Cooperative (FEMC) Forest Health Monitoring workshop at University of Vermont (June 5-6); participated in the New England Society of American Foresters Quarterly Board of Directors Meeting via Zoom (June 14).

BHARADWAJ, ANUJA

- Attended the New England Cannabis Research and Education Conference at Eastern CT State University in Storrs, CT on October 22, 2022. Dr. Bharadwaj gave a presentation titled "Analysis of Cannabis Products".
- Was an invited speaker at the 61st Eastern Analytical Symposium, Plainsboro, New Jersey held from November 14-16, 2022. Dr. Bharadwaj presented on "Compliance Testing of Cannabis sativa L. for Delta-9 THC and CBD using Gas Chromatography with Flame Ionization Detection and Liquid Chromatography with UV detection."
- Presented at the CAES seminar series on 4th January 2023. The presentation was on the compliance testing of *Cannabis sativa*.
- Represented the Station at the Ag Day at the Capitol in Hartford on March 22, 2023. Anuja staffed the CAES booth together with another Station colleague, Greg Bugbee responded to research and outreach questions about the Station from attendees.

- Served as one of the judges in the 12th annual Quinnipiac chapter of Sigma Xi student research conference at Quinnipiac University, Hamden, CT on April 26, 2023. Approximately 75 attendees were present.

BLEVINS, TIA M.

- attended the summer meeting of the Connecticut Tree Protective Association (CPTA) held in Farmington (July 21), and the summer symposium of the Connecticut Nursery and Landscape Association (CNLA) held at Prides Corner Farms in Lebanon (July 27).
- participated in a quarterly web conference with the regional USDAAPHIS-PPQ Export Certification Specialist to discuss phytosanitary certificate issuance and the Convention on International Trade in Endangered Species of wild fauna and flora (CITES) (August 18).
- participated in a three-part Invasive Insects webinar with UMass Extension which included topics on pest risk and climate change, spotted lanternfly updates, scouting techniques, biocontrol, and management in the landscape and vineyards, and beech leaf disease (January 25; February 8 and 22); participated in the virtual Spotted Lanternfly Summit presented by Pennsylvania Department of Agriculture (March 1–2); participated in USDA's webinar for Phytophthora ramorum (March 8–9); participated in USDA's United States-Canada Greenhouse-Grown Plant Certification Program webinar (March 28).
- participated in a pre-flight season webinar with the USFS Forest Health Assessment & Applied Sciences Team (FHAAST) which covered an overview of training materials, digital mobile sketch mapper tablet functions, and content of ArcGIS online services (May 17).

BRACKNEY, DOUG, PH.D.

- Gave an interview to Tamara Karsten of the Researcher App about the role of multiple blood meals in increasing the vectorial capacity of arbovirus infected mosquitoes. (*July 7, 2022*).
- Presented poster at the Keystone Symposium: Vector Biology: Emerging Concepts and Novel Technologies titled "Entry inhibitor peptides targeting viral fusion to block arbovirus infection of mosquitoes." (*February 13-16, 2023*).
- Gave an invited lecture at Colorado State University titled "Barriers to arbovirus infection of mosquitoes: from microbiota to hemocytes and everything in between." (*~40 attendees*) (*February 17, 2023*).
- 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*) (O*ctober 17, 2022*).
- Presented poster at the American Society of Tropical Medicine and Hygiene annual meeting titled "Microbiome presence and composition alter mosquito susceptibility to arboviruses: an axenic model." (*October 30 - November 3, 2022*)
- Gave a presentation at the 1st annual Yale Vector-borne and Zoonotic Diseases Symposium titled "Using axenic mosquitoes to interrogate mosquito-virus-microbiota interactions" (*~50 attendees*) (*January 20, 2023*).

  Gave a presentation at the CAES post-doctoral associations workshop titled "12 Rules to preparing and delivering and professional presentation." (*~20 attendees*) (*January 27, 2023*)

BRANSFIELD, ANGELA B.

- participated in the Federal Select Agent Program's Responsible Official webinar, The Future of FSAP Inspections; Preparing for a Successful Inspection Experience (July 20) and participated via Zoom in Yale's Biosafety Committee meeting (July 21).
- participated in the Federal Select Agent Program's Responsible Official webinar, "*Entity Scoring Process/Risk Tool/Complexity Score; eFSAP Information System User Discussion*" (August 17).
- participated in a CAES Health and Safety Committee meeting (September 2); participated via Zoom in Yale's Biosafety Committee meeting (September 15); and participated in the Federal Select Agent Program's Responsible Official webinar Forms Overview and Updates; Security, Section 11 Requirements (September 21).
- participated via Zoom in Yale's Biosafety Committee meeting (November 17).
- participated via Zoom in Yale's Biosafety Committee meeting (December 15); and participated in a CAES Health and Safety Committee meeting (December 20).
- participated via Zoom in Yale's Biosafety Committee meeting (January 19); attended the 1st Annual Yale Vector-borne and Zoonotic Diseases Symposium (January 20); and met with members of the New Haven Fire Department to discuss and answer questions relating to the BSL3 Laboratory (January 27).
- gave a presentation on biosafety, biosecurity, and incident response for the annual BSL3 laboratory training (February 16).
- participated via Zoom in Yale's Biosafety Committee meetings (March 23 and 27), and participated in a CAES Health and Safety Committee meeting (March 24).
- participated via Zoom in Yale University's Biosafety Committee meeting (April 20); participated in a CAES DEI Disability and Accessibility subcommittee meeting (April 20).
- participated in a CAES DEI Committee meeting (May 9); participated via Zoom in Yale University's Biosafety Committee meeting (May 18); and participated in the Federal Select Agent Program's Responsible Official webinar BSL-3/ ABSL-3 Verification Process and Requirements; BSL-4/ABSL-4 Laboratory Verification Policy (May 18).
- participated in a CAES DEI Parental Rights subcommittee meeting (June 13); participated in the Federal Select Agent Program's Responsible Official webinar "SARS-CoV/SARS-CoV-2 Chimeric Viruses Guidance Overview; APHIS/CDC Forms 3 and 4" (June 29); participated in a CAES Health and Safety Committee meeting (June 30); and met with members of Yale EHS to discuss CAES's Select Agent program and to provide a tour of the BSL3 laboratory (June 30).

BUGBEE, GREGORY J.

- gave a talk titled "Managing Nuisance Aquatic Vegetation in Highland Lake" at the annual meeting of the Highland Lake Watershed Association at Little Red barn Brewers in Winsted (100 attendees) (July 9); with MS. SUMMER STEBBINS, gave an Invasive Aquatic Plant Seminar to a Limnology class at Western Connecticut State University (20 attendees) (July 12); gave a talk titled "Controlling Variable Watermilfoil with ProcellaCOR" at the annual

meeting of the Crystal Lake Protective Association at the Ellington Town Beach (50 attendees) (July 20); gave a talk titled "Aquatic Vegetation Update – Bashan Lake" at the annual meeting of the Bashan Lake Association at the East Haddam Grange (75 attendees) (July 22).

- gave invited lecture titled "The effects of grass carp on Lake Waubeeka" at the Lake Waubeeka Association annual meeting (approx. 150 attendees) (August 14); participated in the United States Army Corp of Engineers Connecticut River hydrilla management demonstration project meeting (August 17); as a panelist, participated in the summer meeting of the Northeast Aquatic Nuisance Species Panel summer meeting (August 24); with **MS. SUMMER STEBBINS** gave a virtual talk titled "Connecticut River Hydrilla Update" to the Connecticut River Management Working Group (15 attendees) (August 25); interviewed by Linda Edgerton of the Weed Science Society of America on hydrilla in the Connecticut River (August 31).
- as Past President and Chair of the Scholarship Committee, attend-ed a virtual meeting of the Board of Directors of the Northeast Aquatic Plant Management Soci-ety (September 8); with SUMMER STEBBINS attended a virtual meeting of the United States Army Corps of Engineers CT River hydrilla control work group (September 12); judged the Fu-ture Farmers of America Science Fair at the Big E in West Springfield, MA (September 16); gave a talk titled "Improving Soil in the Home Garden" to the Garden Club of Cheshire at the Cheshire Senior Center (50 attendees) (September 21); gave a virtual presentation on "Biodiversity" to the Federated Garden Club Environmental School (50 attendees) (September 23); gave a talk titled "Container Gardening Indoors and Out" to the Long Hill Garden Club at the Trumbull Public Library (50 attendees) (September 26).
- participated in a United States Geological Survey virtual meeting on creating a national database of aquatic invasive species, where they are located, and the environments where there are favored (October 13); spoke at a virtual meeting of the West Lake Association (Guilford) on CAES IAPP 2022 Aquatic Plant Survey Results. (approx. 10 attendees) (October 21); with MS. SUMMER STEBBINS gave an update on hydrilla in the Connecticut River to the Connecticut River Hydrilla Workgroup (approx. 25 attendees) (October 25); with MS. SUMMER STEBBINS gave a talk titled "Pachaug Pond Aquatic Plant Update 2022" to the Pachaug Pond Weed Control Authority at the Griswold Town Hall (approx. 20 attendees) (October 26); gave a workshop titled "Invasive Aquatic Plants in Connecticut's Lakes, Ponds, and Rivers" at the Connecticut Association of Conservation and Inland Wetland Commissions Conference in North Haven (approx. 50 attendees) (October 29).
- presented the invited lecture titled "Hydrilla invades the Con-necticut river" at the virtual Connecticut Invasive Pant Working Group Symposium (200 attendees) (November 3), with MS. SUMMER STEBBINS presented a seminar on "Invasive aquatic plants" as part of watershed inspector training at CTDPH headquarters in Hartford (80 attendees) (November 8); also with MS. SUMMER STEBBINS presented a lecture titled "A novel strain of Hydrilla invades the northeast" at the North American Lake Management Society Conference in Minneapolis, Minnesota (50 attendees) (November 16); gave a virtual update on invasive aquatic plants in Connecticut to the annual meeting of the Northeast Aquatic Nuisance Species Panel (30 attendees) (November 30); and gave an invited lecture titled "Invasive aquatic plants – Our lakes in peril" at the Guilford Public Library (50 attendees) (November 30).

- chaired a virtual meeting of the Northeast Aquatic Plant Management Society Scholarship Committee (December 8); gave a virtual lecture titled "Grass Carp in Connecticut Lakes – Somethings Fishy Going on Here" as part of the Connecticut Federation of Lakes Fall Seminar Series (75 attendees) (December 12); with MS. SUMMER STEBBINS participated in a virtual meeting of the United States Army Corps of Engineers Connecticut River Hydrilla Task Force (December 21).
- gave a lecture titled "Grass Carp in Connecticut Lakes – Something Fishy is Going on Here" at the Northeast Aquatic Plant Management Society Conference in Hyannis, MA (150 attendees) (January 11); with MS. SUMMER STEBBINS, represented The CAES at a meeting of the United States Army Corp of Engineers Connecticut River Hydrilla Task Force (January 13); as Past President and Chairman of the Scholarship Committee, participated in the Northeast Aquatic Plant Management Society meeting of the Board of Directors (January 19).
- participated in a meeting of the Connecticut Invasive Working Group Steering Committee (February 7); presented a virtual lecture titled "Green Pond Aquatic Plant Survey 2022" to the Green Pond Ecological Society (~10 attendees) (February 8); presented a seminar on "Composting" to the Milford Garden Club at the DAR Chapter House (approx. 30 attendees) (February 14); staffed the Connecticut Invasive Working Group display at the Hartford Flower Show (February 23).
- with MS. SUMMER STEBBINS and MS. RILEY DOHERTY hosted a meeting with Dr. Berk Calli from Worcester Polytechnic Institute and Dr. Taskin Padir from Northeastern University on using robotics to manage aquatic plants (March 3); gave a talk on "Composting' to the Wethersfield Garden Club at the Solomon Wells House. (40 attendees) (March 6); with MS. SUMMER STEBBINS, gave a workshop on invasive aquatic plants at the annual meeting of the Connecticut Association of Wetland Scientists at the Eversource headquarters in Berlin. (200 attendees) (March 9); with MS. SUMMER STEBBINS, gave a soil testing workshop to a group of seven, young, homeschooled students (March 13); interviewed on soil contamination by Teresa Barger of Connecticut Magazine (March 20); gave a seminar titled "Container Gardening Indoors and Out" to the Simsbury Garden Club at the Simsbury Library (40 attendees) (March 21); gave a seminar titled "Container Gardening Indoors and Out" at the Waterbury Senior Center (40 attendees) (March 21); with MS. SUMMER STEBBINS, staffed the CAES table at Ag Day at the Capitol in Hartford (March 22); with MS. SUMMER STEBBINS and MS. RILEY DOHERTY, hosted a United States Army Corps of Engineers meeting for government officials at the CAES Windsor auditorium and spoke on "Hydrilla in the Connecticut River" (30 attendees) (March 30).
- gave a soil testing demonstration to students from Options Employment & Educational Services (6 students) (April 4); with MS. SUMMER STEBBINS and MS. RILEY DOHERTY, gave a seminar on Connecticut's Invasive Aquatic Plants at Three Rivers Community College in Norwich (30 attendees) (April 5); with MS. SUMMER STEBBINS and MS. RILEY DOHERTY, presented a lecture on "Hydrilla in the Connecticut River" to the Essex Harbor Management Commission at the Essex Town Hall (12 attendees) (April 27); with MS. SUMMER STEBBINS and MS. RILEY DOHERTY, hosted the annual meeting of the Connecticut Federation of Lakes and presented lecture titled "Invasive Plants in Connecticut Lakes and Ponds" in Jones Auditorium, New Haven, CT

(40 attendees) (April 29).

- provided a virtual update on “Invasive Aquatic Plants in Connecticut” at the semiannual meeting of the Northeast Aquatic Nuisance Species Panel (20 attendees) (May 24).
- spoke on “Hydrilla in the Connecticut River” at a virtual meeting of the Connecticut River Conservancy (20 attendees) (June 20); gave a talk entitled “Aquatic Plant Management Options for Great Hill Pond, Portland CT” at a stakeholders meeting at the Portland Public Library (75 attendees) (June 20); along with the United States Army Corp of Engineers presented a talk entitled “Connecticut River Hydrilla Research and Demonstration Project” at the Middletown Town Hall (30 attendees) (June 29).

CANTONI, JAMIE L.

- joined Megan Linske, Ph.D., and Scott Williams, Ph.D. (Department of Environmental Science and Forestry) in a Zoom call with collaborators from Dartmouth College to discuss updates pertaining to a study concerning tick abundance and pathogen prevalence using collective data from across the northeastern U.S. (December 12).
- participated in a Zoom call with collaborators from Dartmouth College to discuss updates regarding a Northeast-wide tick monitoring and infection prevalence project (January 17); attended and staffed the CAES booth at the annual CTPA meeting at the Aqua Turf (January 19); and attended a virtual meeting “Vector Day 2023” organized by the CDC (January 25).
- articipated in a Zoom call with Lisa Lumar and Brandon Gilbrech of the CW television program “Mysteries Decoded” about filming an episode on the origin of Lyme disease and other tick-borne diseases (February 16 and 24); and attended and staffed the CAES informational booth at the Annual Connecticut Flower and Garden Show at the Connecticut Convention Center in Hartford, CT (February 23).
- participated in a Zoom call with Ms. Shashika Lamahewa from the University of Connecticut to discuss updates to an invasive shrub cover study using drone assisted modeling (March 2); participated in an interview discussing ticks and Lyme disease for an episode on the CW Network Mysteries Decoded (March 17); and with MS. NOELLE KHALIL presented a talk titled “What’s that Tick?! Basic Identification of Commonly Encountered Tick Species in Connecticut” and assisted in hands-on tick identification at the Medical Entomology Workshop held for Connecticut’s public health officials (March 28)
- participated in the Girl Scouts of Connecticut’s STEMagination event held at Naugatuck Valley Community College in Waterbury, and spoke with groups of young future leaders and chaperones about careers in science and presented information pertaining to the Active Tick Surveillance Program and ongoing tick management projects (April 21); hosted, along with DR. KELSEY FISHER, MS. KATHERINE DUGAS, and MS. FELICIA MILLETT, hands-on demonstrations and activities involving ticks, Madagascar hissing cockroaches, butterflies, and nematodes for elementary school students and teachers for St. Thomas’s Day School annual STEAM event (April 26).

CHEAH, CAROLE A.

- Gave a talk on hemlock woolly adelgid and biological control opportunities with Sasajiscymnus tsugae to staff at McLeans Game Refuge, Simsbury and went on a tour to assess their hemlocks for HWA damage (6 attendees) (July 14); guided and released S. tsugae to mitigate HWA infestations at the Helen Butler Riverfront Trail, Town of New Hartford with volunteers from the New Hartford Land Trust (4 attendees) (July 22).
- Along with Megan Linske, Ph.D., participated in an exploratory virtual call with Dartmouth College to discuss climate-related impacts on tick populations throughout the Northeast (October 3); and attended the Tick-borne Disease Working Group virtual meeting (October 4).
- gave a zoom presentation on 10 years of biological control of mile-a-minute weed at the virtual Connecticut Invasive Plant Working Group (CIPWG) Symposium "Strategies for Managing Invasive Plants" (49 attendees) (November 3); and gave an evening presentation on collaborations in biological control of hemlock woolly ad-elgid at the Environmental Research Symposium hosted by Flanders Land Trust and the Taft School, at Taft School in Watertown (152 attendees) (November 3).
- gave an overview of biological control of HWA to members of Hartland Land Trust (6 attendees) (February 2) and of East Granby Land Trust (4 attendees) (February 8) and toured the land trust properties with them to assess the hemlocks
- ave a presentation on collaborations to protect hemlocks in Connecticut for the Forest Health Monitoring Workshop at The CAES, New Haven (68 attendees) (March 7); was interviewed by Heather Thomson, Interim Executive Director, for the Great Mountain Forest April 2023 Newsletter (March 23).
- assessed the 2021 Sasajiscymnus tsugae release site at Platt Farm Preserve, with Southbury Land Trust members (5 attendees) (May 1); assessed HWA on hemlocks at the Bent of the River Audubon Preserve in Southbury with staff (3 attendees) (May 1); gave a Zoom overview of HWA biological control strategy in 2023 to the Resource Protection Committee of the Lower Farmington and Salmon Brook Wild and Scenic Committee (LFRSBWS) (8 attendees) (May 4); guided S. tsugae releases for HWA biological control with a Southbury Conservation Commission member at town open space, Platt Park and Janie Pierce Conservation Area on (May 18); gave an overview of the CT HWA biological control program and collaborations to protect hemlocks in Connecticut to Bent of the River Audubon Preserve staff and forestry interns (6 attendees), then guided the biocontrol releases (May 18); staffed a booth on the CT HWA biological control program at the 60th Anniversary Festival of Flanders Land Trust, at the Van Vleck Preserve, Woodbury (May 21); as part of the federally funded 2023 HWA biological control program of the Lower Farmington and Salmon Brook Wild and Scenic: released S. tsugae at Nassahegon State Forest and the State Fish Hatchery in Burlington with a DEEP forester and volunteer (May 22); guided private S. tsugae releases at Hartland Pond (May 23); gave an overview of the HWA program to staff of the Nature Center at North West Park, Town of Windsor (3 attendees) and guided S. tsugae releases there (May 24); released at Enders State Forest, Granby with a CT DEEP forester and staff (May 25); gave an overview of the HWA biocontrol program to CT state park staff and

a volunteer from Simsbury Land Trust (6 attendees) then guided releases at Stratton Brook State Park and Tanager Hill, Simsbury Land Trust, (May 26); gave an overview of the HWA biocontrol program to members of the East Granby Land Trust, Wintonbury Land Trust and LFRSBWS members (6 attendees) then guided releases at two East Granby hemlock properties (May 30); gave an overview of the HWA biocontrol program to members of the Traprock Ridge Land Conservancy, members of Trees for Bloomfield and citizens of Bloomfield (10 attendees) then guided releases at Farmington River Park, Bloomfield, and Windsor Wildlife Management Area (May 31).

- as part of 2023 federal funding for HWA biological control along the Lower Farmington by the Lower Farmington River Salmon Brook Wild and Scenic Committee, implemented additional S. tsugae releases for HWA biological control Town of Windsor's Northwest Park (June 2); released S. tsugae to control HWA at state lands in Avon for water access and at the State Fish Hatchery on Bradley Brook, Burlington, (June 5); with state foresters, released along the west Branch of Salmon Brook, Tunxis State Forest, in Hartland, (June 7); gave an overview of the HWA biocontrol program in CT to forestry interns at McLean Game Refuge, Simsbury and guided releases there (5 attendees) (June 8); released S. tsugae along the Farmington River at Nepaug State Forest in New Hartford, Stratton Brook State Park, Simsbury and at the Town of Bloomfield's Farmington River Park (June 9).

COWLES, RICHARD S.

- presented "Insect and disease management" at the Massachusetts Christmas Tree Growers' Association field meeting in Huntington, MA (40 attendees) (July 16). He presented "Insect management" at the CCTGA twilight meeting, North Branford (40 attendees) (July 19).
- displayed the Barn Exhibit "Management of Armored Scales in Christmas Trees" at Plant Science Day in Hamden (August 3). He presented "Insect and disease management" at the Massachusetts Christmas Tree Growers' Association field meeting, Hancock, MA, (60 attendees) (August 20). He presented "Insect management" at the CCTGA summer meeting, Durham (60 attendees) (August 27).
- presented a talk "Update on armored scale management" to the Exotic Conifer Association meeting in Hatley, Quebec (~30 attendees) (September 23).
- presented "New invasive tree pests" for the Hartford Tree Commission via Zoom (October 5) (20 participants). He discussed "A synthesis of the 'wolf in sheep's clothing' phenomenon" for the Biology Department seminar at ECSU, Willimantic (October 14) (30 participants), and again for the Connecticut Entomological Society via Zoom (October 21) (20 participants); presented "Management options for beech leaf disease," at the Connecticut Urban Forest Council's 2022 Annual Forest Forum, Milldale, CT, (October 26) (25 participants); and discussed "Exotic pests and their impact on agriculture," to two Cornell Clubs meeting at Jones Family Farm, Shelton (October 29) (15 participants).
- presented "Climate change science and its impacts on rose culture" for the Connecticut Rose Society, (20 participants) (November 6). He discussed "Facts and fallacies of organic agriculture" at the Waterbury Senior Center (25 partici-pants) (November 7). He discussed "Pesticide resistance: theory and practice" to the Con-

necticut Environmental Council in Woodbridge (120 participants) (November 29).

- presented "Soil dwelling insect pests of strawberries" for the New England Vegetable and Berry Growers Conference, Manchester, NH (80 participants) (December 13).
- presented "Neonicotinoid Alternatives" for the Connecticut Greenhouse Growers Association, Somers, (40 participants) (January 4); spoke to the Manchester Garden Club about "Spotted Lanternfly and Beech Leaf Disease" (25 participants) (January 9); with Bob Marra presented "Beech Leaf Disease Biology and Management" at the CT Tree Protective Association meeting in Plantsville, (770 participants) (January 19); gave a lecture on "Climate change and phytophthora" to the CT Hardy Plant Society, (20 participants) (January 25); presented "Armored Scale Biology and Management," to the Avery County, NC, Christmas tree growers via Zoom (30 participants) (January 27).
- presented "Pest management for initial establishment of Christmas trees" for the Michigan State University Christmas Tree Management Web Series, (60 participants) (February 9). He spoke to Quebéc Christmas tree growers about "Conifer root aphid and balsam woolly adelgid management" (40 participants) (February 17). Presented "Beech leaf disease and life without neonics" to the Connecticut Grounds Keepers Association in Plantsville (475 participants) (February 21). He lectured on "Neonics, bees, and neonicotinoid alternatives" to the University of Massachusetts pesticide applicators virtual course series (167 participants) (February 22). He presented "Armored scale biology and management" to the North Carolina Christmas tree growers via Zoom (100 participants) (February 23). He discussed "Climate change and its impacts on rose culture" at the Hartford Flower Show (20 participants) (February 24).
- presented "CAES Research Projects in Christmas trees" for the Connecticut Christmas Tree Growers' Association Winter Meeting, Middletown, CT (73 participants) (March 4); lectured on "Life After Neonics?" to the New England Regional Turf Conference, Providence, RI, (80 attendees) (March 9).
- presented "CAES research projects in Christmas trees" for the Connecticut Christmas Tree Growers' Association Twilight Meeting, Hamden (43 participants) (June 13). He submitted "The science of frost/freeze damage and frost protection," to the Real Tree Line.

CREIGHTON, MARK H.

- Was interviewed by the Hartford Courant on the state of bee Keeping in Connecticut and health issues facing bees today (July 6) and the story appeared on the front page of the newspaper (July 11); presented invited talks to: 1) the Danbury Rotary on Beekeeping in Connecticut on beekeeping in Connecticut (July 13), and 2) at the Backyard Beekeepers Association meeting in Weston, CT on the role of the State Bee Inspector and the several health issues facing beekeepers (July 26).
- presented two talks in the demonstration tent on beekeeping systems in Connecticut; and provided a live educational hive display at Plant Science Day (August 3).

- presented a talk on honey bee health at The Connecticut Bee-keepers Association's annual "Bee School" (January 28); and reviewed the honey bee registration process, using the Connecticut e-license system to register bee hives and the services provided by The CAES to beekeepers.
- gave a presentation on "Beekeeping Basics" at the East Grandy Public Library. The presentation highlighted a modern beehive structure, described the communal organization of bees within a hive, the life cycle of worker bees and basic bee genetics. A brief history of Connecticut beekeeping was included in the presentation (February 21)
- participated on a Zoom training seminar hosted by the USDA on P. ramorum detection and sampling in Green Houses (March 8–9); participated in a AIA regional Honey Bee health update (March 10); presented a talk "Introduction to Basic Beekeeping" via Zoom for The Wethersfield Public Library (March 14); attended a Zoom talk on Giant Hornets and Honeybee Defenses with Dr. Heather Mattila (March 16); and attended a Zoom talk on the biology and history of Tropilaelaps mites and its potential impact on honeybees in the USA, by Dr. Samuel Ramsey (March 22).
- spoke with a group of students at the Montessori School in New Hartford, CT on Honey bees and beekeeping, and then he and the student group visited the school apiary and opened hives to further explore the biology of honeybees (April 20); spoke to members of the Suffield Garden Club at Hilltop Farm in Suffield CT on Straw Bale Gardening (April 22); and visited A and Z Apiaries in Hampton, CT and inspected new bee packages and spoke with beekeepers on honey bee management topics (April).

da SILVA, WASHINGTON

- Participated in the CT Farm Wine Development Council meeting as the Scientific Border Advisor Member (10 participants) (June 23, 2022).
- Interviewed by the journalist, Brian Scott-Smith, for the WSHU (a member of NPR located in Westport CT) regarding the USDA-NIFA grant that Dr. da Silva and his group were awarded to study nanocarriers of dsRNA molecules (June 27, 2022).
- Presented a seminar titled "Nano-enabled technologies: prospective weapons to tackle destructive plant viruses" at the Department of Plant Pathology and Crop Physiology at Louisiana State University in Baton Rouge, LA (50 attendees) (October 5, 2022).
- Taught a discipline "Plant Molecular Virology Lab" to postgraduate students in the department of agronomy at the Universidade Federal Rural do Semiarido (UFERSA), Mossoro, Brazil (15 students) (December 5-16, 2022).
- Presented a seminar titled "The Role of Nanotechnology in Plant Viral Disease Management: A Perspective Talk" to students and faculty members of the Department of Biology at Universidade Federal do Rio Grande do Norte (UFRN) (55 attendees) (December 19, 2022).
- Presented a seminar titled "Small Things Considered: Using RNAi and Nanotechnology to Control Plant Pathogens" at the Department of Plant Science and Landscape Architecture at UConn (25 Adults) (January 20, 2023).

- Presented a seminar titled “The Genomic Region Matters When Synthesizing dsRNA for Plant Virus Suppression via RNAi” at the Annual Meeting of the Northeastern APS Division in Southbury CT (24 attendees) (March 9-10, 2023).
- Presented an invited seminar titled “Nano-enabled Technologies: Prospective weapons to tackle destructive plant pathogens" at the Department of Energy (DoE) funded National Virtual Biosecurity of Bioenergy Crops Center (NVBBCC) Planning Meeting held at Brookhaven National Laboratory, Upton, NY (30 adults) (March 31, 2023).
- Presented a poster titled “Tunable Release of DSRNA Molecules into Plants from Sustainable Nanocarriers” at the Society of Environmental Toxicology and Chemistry (SETAC) Europe 33rd Annual Meeting held in Dublin, Ireland (100 Adults) (May 3, 2023).
- Presented a seminar titled “Small Things Considered: Using RNAI and Nanotechnology to Control Plant Pathogens” as an invited speaker at the University of Leeds, Leeds, UK (50 adults) (May 4, 2023).
  Presented a Seminar titled “Tunable release of dsRNA molecules into plants from sustainable nanocarriers” as an invited speaker at the Universidad Politécnica de Valencia (15 adults) (UPV) (June 28, 2023).

DENG, CHAOYI

- Attended the American Chemical Society (ACS) Fall 2022 meeting in Chicago, IL during August 21 - 25, 2022. Dr. Deng presented a poster for ACS’s Division of Agriculture and Food Chemistry on “The Role of Leaf Surface pH in Controlling the Transformation of Nanoscale Cu on Plant Leaf Surfaces”. The estimated Session Attendance was 15.

DIMKPA, CHRISTIAN

- Attended the 11th African Materials Research Society Conference in Dakar, Senegal, December 12-15, 2022 and gave a keynote presentation on *‘‘Approaches for Increasing Phosphorus Use Efficiency: The Case for Chitosan and Tripolyphosphate’’*. Christian Dimkpa also moderated a session on Materials for Agriculture. Approximately 500 attendees

- Attended the annual US-FDA Laboratory Flexible Funding Model (LFFM) CAP Grantee Meeting in St. Louis, Missouri, November 15–17, 2022 and gave a presentation on *‘‘Food Safety Analysis at CAES: Focus on Toxic Elements in Infant Foods’’*. Over 200 participants were present.

- Together with **Paul Aikpokpodion** visited Stony Brook University (SBU) Long Island during May 22-23, 2023 under the auspices of the NSF-funded *PFI-TT: Advancing Nanocellulose-Enabled BioNanofertillizers for*

Agricultural Applications. The project is implemented by Dr. Ben Hsaio for SBU (left in photo), and Dr. Dimkpa for CAES. The visit afforded the opportunity for a hands-on understanding of the nitro-oxidation process (NOP) for using food wastes and agricultural residues in the synthesis of nanocellulose, liquid fertilizer and biogel for agricultural and environmental remediation applications. They toured the Chemistry Department of SBU and also visited the Container Vertical Lettuce farm owned by Cubic Acres LLC. Cubic Acres LLC is a commercial partner in the *PFI-TT: Advancing Nanocellulose-Enabled BioNanofertillizers for Agricultural Applications* project.

- **Christian Dimkpa, Chaoyi Deng and Director Jason White** attended the National Science Foundation Center for Sustainable Nanotechnology (CSN) All-hands meeting in Atlanta, GA during September 13 to 15, 2022. Chaoyi Deng presented a poster on "The role of Fe_3O_4 nanoparticle surface charge on disease suppression in tomato plants (S*olanum lycopersicum*). Dr. White and Dimkpa joined other CSN faculty in discussions on work progress and future directions. The meeting was attended by ~50 participants.

DUGAS, KATHERINE

- presented a talk on “Insects in the environment” at the Pollinator Pathway Garden in Cheshire (July 20).
- gave a talk about invasive insects and jumping worms to the New Roxbury Land Trust in Putnam (May 18).

EITZER, BRIAN D.

- Was the moderator of a session titled "QA for Pesticide Analysis" at the 58th Annual North American Chemical Residue Workshop held online (July 25-29).

ELMER, WADE H.

- Along with Jason White, Ph.D., Shital Vaidya, Ph.D., and Christian Dimkpa, Ph.D. hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA research project (August 16)
- attended the Atlantic Basin Conference on Chemistry’s Annual meeting in Marrakech, Morocco, December 13-16, and presented “Use of nano Cu for crop disease management” (December 15) (13 adults).
- participated in the Annual Meeting of the Northeastern APS meeting and presented “Nano Cu for Crop Disease Management” in Southbury, CT (24 attendees) (March 9-10); presented the talk “Earthworms and Soil Health” at the South Windsor community center in South Windsor (23 adults) (March 16).

FISHER, KELSEY E.

- Presented "Monarch butterfly biology, ceology, and conservation needs" for Iowa Learning Farms Webinar Series (February 1, 2023; 135 attendees).
- Presented "Movement ecology and conservation planning for monarch butterflies" at the Northeast Iowa Research Farm Association Annual Meeting (March 15, 2023; 30 attendees)
- Served as an expert panelist after a showing of the documentary "My Garden of a Thousand Bees" at the Groton Public Library (May 23, 2023; 30 attendees)
- Provided at 30-minute presentation on CT native bees and served as an expert panelist after a showing of the documentary "Honeyland" during Real Art Ways Science on Screen series in Hartford, CT (June 14, 2023; 50 attendees)
- Presented "Implications of Movement Ecology in Conservation Planning for Monarch Butterflies (*Danaus plexippus)"* for Monarch Joint Venture Webinar Series (June 27, 2023; 170 attendees)
- Provided statements for Norwalk Pluss Magazine (March 6, 2023), Day Magazine (March 28, 2023), and Connecticut Gardener Magazine (May 3, 2023) about monarch butterfly conservation.

GLORIA-SORIA, ANDREA

- Gave an interview to reporter Katherine J. Wu from The Atlantic regarding the upcoming paper from Herre et al. in Cell "Non-canonical odor coding in the mosquito". The article was published online on August 18, 2022. https://www.theatlantic.com/science/archive/2022/08/mosquito-smell-olfaction-genetic-unstoppable-bite/671177/
- Hosted an international training via Zoom on the use of DIYABC software to infer demographic histories of *Aedes aegypti* mosquitoes (August 18, 2022; 2 foreign students).
- External grant reviewer for the Universidad de la Republica, Montevideo, Uruguay « Programa Proyectos de I+D 2022» Comisión Sectorial de Investigación Científica.
- Presented the talk "Estudios sobre la migración del *Aedes aegypti*, utilizando marcadores moleculares." at the *I Curso Internacional de Control Integrado de Vectores*. 29 Aug- 2 Sept 2022. Virtual from Cuba. (~80 attendees; 40 students).
- Presented an overview of her research at the Multistate NE1943 Annual Meeting held virtually on October 20, 2022 (21 attendees).
- Participated as a keynote speaker at the II Latin American Society for Vector Ecology Congress (LA SOVE 2022) presenting the talk "Tracking down invasions of the yellow fever mosquito, *Aedes aegypti*, using molecular markers" in La Plata, Argentina on November 1, 2022 (250 attendees).

- Received the Louis A. Magnarelli Post-Doctoral award established by The Board of Control of The Connecticut Agricultural Experiment Station. December 8, 2022.
- Presented the lighting talk "Population genetics of mosquito vectors" at the 1st Annual Yale Vector-borne and Zoonotic Diseases Symposium hosted by the Yale Department of Epidemiology of Microbial Diseases on January 20, 2023 (95 attendees).
- Presented the talk "Diversification Patterns of Invasive Aedes Mosquitoes" at the Virginia Tech Department of Entomology Seminar Series (March 3; 85 attendees).
- Secondary advisor for Meredith Bagger's Master thesis in Public Health. Vector Status of *Aedes albopictus* in Connecticut: Analyses of Invasion Pattern, Geographic Distribution, and Disease Risk. Department of Epidemiology of Microbial Diseases. Yale School of Public Health. New Haven, CT, USA. 2023.
- External advisor for Cristian Fernando Robayo Cuevas's Master thesis. Análisis filogeográgico del mitogenoma en poblaciones de Aedes (Stegomya) aegypti (DIPTERA: CULICIDAE) de África y fuera de África. Universidad Pedagógica y Tecnológica de Colombia. Facultad de Ciencias Básicas. Escuela de Biología. Tunja-Boyacá, Colombia. 2023.
- Presented an invited talk "Axiom aegypti SNP chip validation for population genetics" at the Caccone group weekly lab meeting at the Ecology & Evolutionary Biology Department of Yale University on April 3 (10 attendees).
- Gave the keynote presentation "My career in STEM: How did I get here?" at the STEM-A-THON: Underrepresentation: from adversity to success in STEM careers. Albertus Magnus College, New Haven, CT, USA. April 13 (50 attendees).

  Participated in the annual meeting of the "Comprehensive characterization of ancestral populations of the vector Aedes aegypti on Indian Ocean islands" International Working Group (8 attendees from 5 countries). Yale University, New Haven, CT, USA. June 6-9 2023.

HISKES, ROSE T.

- Participated in a Connecticut Invasive Plant Working Group (CIPWG) Symposium planning committee meeting via Zoom (16 attendees) (July 7).
- Participated in a Connecticut Invasive Plant Working Group (CIPWG) Symposium planning committee meeting via Zoom (16 attendees) (August 4). With Charlotte Pyle and Ken Feathers, led an Invasive Plant Walk and Talk in Storrs (11 attendees) (August 20)
- participated in Connecticut Invasive Plant Working Group (CIPWG) Symposium planning committee meetings via Zoom (16 attendees) (October 6 and 20). Gave a talk on 'Invasive Plants' to the Northville Residents Association

in New Milford (28 attendees) (October 22).

- hosted Master Conservationist Cassandra Schelhas for a jumping worm identification session (November 1); organized, moderated, and participated in the Connecticut Invasive Plant Working Group (CIPWG) Virtual Symposium (419 attendees) (November 3); participated in a CIPWG Symposium wrap up session (10 attendees) (November 17).
- with DR. YONGHAO LI assisted The Connecticut Tree Protective Association with their hands-on review night for students of the Arboriculture 101 course. (24 attendees) (December 8).
- met with CIPWG co-chairs (January 10); participated in the Cooperative Agricultural Pest Survey meeting via Zoom (16 attendees) (January 17).
- with the Connecticut Pest Management Association, taught a Basic Entomology Course to pest control operators and landscapers at Cabela's in East Hartford and the Valley Laboratory of The CAES in Windsor (16 attendees) (January 19, 26, and February 2); with Emmett Varricchio and Victoria Wallace co-chaired a virtual CIPWG Steering Committee Meeting (21 attendees) (February 7); gave a talk on spotted lanternfly at SiteOne in Windsor (25 attendees) (February 15); participated in the Invasive Plants Council online meeting (February 28).
- with Diane Riddle, hosted Claire, a girl scout in the diagnostic office for her gardening badge (March 7); MS. HISKES chaired a virtual CIPWG Outdoor Educator committee meeting (5 attendees) (March 16).
- conducted an invasive plant site visit at the Little River Preserve with Jim Sanders in Oxford, (April 15); conducted a Connecticut Invasive Plant Working Group (CIPWG) Invasive Plant Walk and Cut in Hebron, (12 attendees) (April 22); gave a talk on "Using Botany to Sustainably Manage Invasive Plants" at the Naugatuck Valley Council of Governments Sustainability Forum (55 attendees) (April 27).
- conducted a free Invasive Plant Walk and Talk at the Little River Preserve with Jim Sanders in Oxford, CT (8 attendees) (May 20).
- conducted a free Invasive Plant Walk and Talk at the Alfred Sabolcik Preserve with Dr. Todd Mervosh in New Hartford (16 attendees) (June 10).

KERIÖ, SUSANNA

- Hosted a collaborative research meeting with colleagues from The American Chestnut Foundation (July 19); presented an invited lecture titled "Impact of Mycorrhizae on Landscape Tree Health" at the Connecticut Tree Protective Association summer meeting (40 attendees) (July 21); provided expertise on best tree planting practices during a site visit to a chestnut orchard in Bethany (July 29).
- served on the Connecticut Urban Forest Council's Conference Plan-ning Committee (September 13); administered the Connecticut Tree Protection examinations (September 14); served on the Yale University Biosafety Committee (September 15); served as CAES representative to Connecticut Urban Forest Council at their September meeting (September 22); and gave an interview on chestnut research in CAES to Valley Shore Commu-nity Television program "Slice of Life" (September 23).

- served on the CT Tree Protection Examining Committee (October 3); attended as CAES representative in the McIntire-Stennis Grant Renewal virtual meeting (October 14); served in a meeting of the CT Urban Forest Council's conference organizing committee (October 17); served in a meeting of the Yale University Biosafety Committee (October 20); served in a meeting of the CT Urban Forest Council's conference organizing committee (October 24); participated in organizing the CT Forest Forum 2022 Conference in Plantsville, CT (October 26).
- chaired a session on beech leaf disease at the annual meeting of the Connecticut Tree Protective Association (January 19); participated in the Connecticut Urban Forest Council's Executive Meeting as secretary (January 26).
- Met with Dr. Cynnamon Dobbs and Dr. Mayra RodríguezGonzález from UConn to discuss collaboration related to urban forestry (February 9); performed tree planting inspections in New Haven for the Connecticut Urban Forest Council's Urban Forestry Climate Change Grants Program (February 15 and 24); served on Yale University's Biosafety Committee (February 16); gave a 10-minute radio interview on the impact of warming winters on trees for the Connecticut Public Radio Program "Where We Live" (February 17); participated in the Connecticut Urban Forest Council's grant review meeting (February 22).
- met with Dr. Chandi Witharana (UConn) to discuss collaboration related to street tree inventories (March 1); gave a talk on "Urban Tree Health Challenges and Urban Maple Condition in New Haven" at the CT Forest Health Monitoring Workshop (March 7); administered the arborist examinations (March 8 and 17); participated in the New England Society of American Foresters (NESAF) annual meeting in Nashua, NH (March 13-16); with DR. FAISAL QASEEM as contributing author, presented a research poster titled "Urban Maple Health in New Haven, Connecticut" at the NESAF meeting (March 14); participated in a CT Urban Forest Council meeting to discuss the council's grant programs (March 17); presented invited lecture titled "Abiotic Factors and Tree Health in Connecticut" at the CT Tree Protective Association's Tree Health workshop (March 23).
- presented an invited lecture on "Chestnut Research at CAES" at the annual meeting of the Connecticut Chapter of The American Chestnut Foundation (30 attendees) (April 15); participated in the Yale University Biosafety Committee meeting (April 20); presented an invited lecture on "Drought and Urban Tree Health" to Massachusetts arborists (170 attendees) (April 25); presented an invited webinar on "Urban Tree Health in a Changing Climate" at the Arbor Day event organized by the Rice Creek Field Station, SUNY Oswego (April 28).
- presented a talk on "Urban Maple Condition in New Haven" at the New Haven Department of Parks and Public Works (May 10); attended the Yale Biological Safety Committee meeting (May 18); met with Dr. Craig Brodersen at Yale to discuss potential research collaboration (May 24); attended the Connecticut Urban Forest Council's Annual Meeting in Bloomfield and was reelected as Secretary of the CUFC (May 25).
- administered the arborist exams at Lockwood Farm (June 14); co -organized a meet and greet with Albertus Magnus College students and teachers with DR. ANDREA GLORIA-SORIA and DR. NEIL SCHULTES (June 16); attended the Yale University Biosafety Committee meeting (June 22).

LAMONDIA, JAMES A.

- conducted a tour of Valley Laboratory tobacco plots and breeding lines for Dunn and Foster (August 1), Lewis Flowers (Universal Leaf) (August 2), and Helios Morra and Carlos Pucinelli (Alliance One Tobacco) (August 5); spoke about Management of boxwood blight as a part of a boxwood blight symposium at the APS annual meeting August 10(65 people); was interviewed by William Nelson, Premium Cigar Association, The Magazine, about the impacts of climate change on cigar wrapper tobacco in Connecticut (August 15); participated in the Society of Nematologists Honors and Awards committee selection of awardees (August 15); toured plots and discussed advanced broadleaf breeding lines with John Foster and Cuban plant breeder Dr. Alejandro (August 20); and hosted a Tobacco Field Day at the Valley Laboratory where he spoke about target spot management and fungicide trials, breeding for resistance to multiple pathogens and new varieties under development, Fusarium wilt resistance, PVY and tobacco ringspot viruses, and with **MR. JIM PRESTE** discussed reduced tillage and cover cropping (August 24).
- participated in the Society of Nematologists annual meeting as a member of the Honors and Awards Committee in Anchorage, Alaska (September 26-30).
- presented "Using biological and epidemiological knowledge to improve boxwood blight management" at the Quarterly Project Director and Associate Meeting (20 attendees) (November 16); and spoke about reduced tillage in Connecticut broadleaf tobacco for a webinar hosted by the American Farmland Trust, the recording of which is posted online (12 participants) (November 17).
- met with nematologists Kathy Lawrence and Pat Donald, toured laboratory and field facilities and discussed research at Auburn University (February 1); toured boxwood nursery producers in Oregon's Willamette Valley and spoke about 'Integrating technologies to manage boxwood blight' as a part of the SCRI BBIG Annual Meeting held in Aurora, OR (35 attendees) (February 15-16); spoke about tobacco breeding and disease management in wrapper tobaccos and Low Converter varieties of Connecticut broadleaf, and presented information about reduced tillage effects on soils and tobacco plantings at the annual Tobacco Research Meeting held in East Windsor (65 attendees) (February 22).
- chaired the CT Agricultural Information Council meeting for selection of the CT Outstanding Young Farmer (March 6); and participated in Agriculture Day at the Capital, speaking about the 2022 Century Farm Award recognizing Fairholm Farms (100 attendees) (March 22).

LI, DEWEI

- presented a lecture titled "Technical Writing" at the summer seminar session of the graduate schools of Jiangsu province, China via Tencent Meeting (258 attendees) (August 17).
- Attended the CT Tree Protective Association meeting in Plantsville (January 19); gave a presentation titled "Fungi" during the seminar series of the American Conference of Governmental Industrial Hygienists (ACGIH) (50

attendees) (January 30); and attended the biology career fair at the Central Connecticut State University (CCSU) representing The CAES (~30 students) (January 30).

- presented a seminar "Indoor Fungi: Hidden molds, and airborne fungal spores" to Yale Environmental Health & Safety via Zoom (22 attendees) (March 6).

LI, YONGHAO

- Staffed the Station booth at the Connecticut Tree Protective Association Summer Meeting in Farmington (July 21, 2022).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (6 adults) (July 22).
- Presented "All About Fungi and Fungicides – Every Gardener Needs to Know" for the Wellness Program at Conning via WebEx (39 adults) (July 28).
- Presented "Gardening with Native Plants" at the Shelton Garden Club meeting in Shelton (23 adults) (August 1).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (4 adults) (August 10).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (7 adults) (August 24).
- Presented "Tips of Container Gardening" for Spring Glen Garden Club in Hamden (12 adult) (September 12).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (6 adults) (September 14).
- Presented a poster "Dutch Elm Disease" at the Tree Warden Association of Connecticut Fall Gathering in Madison (20 adults) (September 16).
- Gave a lecture "Tree Diseases" to Connecticut Tree Warden School in New Haven (34 adults) (September 22).
- Participated in the National Plant Diagnostic Network Northeast Regional Meeting via Zoom (12 adults) (September 23).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (6 adults) (September 27) .
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (6 adults) (October 12).
- Gave a lecture "Diseases of Trees" for the Connecticut Tree Protective Association Arboriculture 101 Courses in New Haven (35 adults) (October 13).
- Presented "Principles of Organic Gardening" to the East Hartford Garden Club members in East Hartford (23 adults) (October 24).

- Instructed “Tree Diseases” in the Hand-on Night for the Connecticut Tree Protective Association Arboriculture 101 Courses in New Haven (30 adults) (October 27).
- Participated in the National Plant Diagnostic Network Northeast Regional Meeting via Zoom (14 adults) (October 28).
- Presented “Pruning 101” to the Windsor Garden Club members in Windsor (30 adults) (November 14).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (7 adults) (November 18).
- Instructed “Phytophthora bleeding canker” in the Review Night of the Connecticut Tree protective Association Arboriculture 101 Course in New Haven (24 adults) (December 8).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (7 adults) (January 11, 2023).
- Presented “Recap 2022, Bedding Crop Diseases to Prepare for 2023” at UConn 2023 Spring Bedding Plant Meeting in Torrington (27 adults) (January 18).
- Presented “Selection and Care of Houseplants” to the Avon Public Library Adult Education Program via Zoom (37 adults) (January 25).
- Interviewed by Abby Weiss at CT Insider about warmer winter temperatures and spring bulbs via phone. (February 15).
- Interviewed by Michael Fuller at NBC Connecticut about warmer winter and gardening via Zoom. (February 16).
- Gave a lecture “Diseases of Trees” for the Connecticut Tree Protective Association Arboriculture 101 Courses in New Haven (42 adults) (February 16).
- With FELICIA MILLETT, instructed “Tree Diseases” in the Hand-on Night for the Connecticut Tree Protective Association Arboriculture 101 Course in New Haven (33 adults) (March 2).
- With FELICIA MILLETT, presented “2022 Plant Disease Updates – CAES” at the Northeast Plant Diagnostic Network Regional Meeting in Southbury (21 adults) (March 6).
- Presented “Organic Disease Management” at the CT NOFA’s Winter Conference via Zoom (44 Adults) (March 8).
- Presented “Spring and Summer Gardening Tips” to Morris Cove Garden Club in New Haven (13 adults) (March 8).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (7 adults) (March 8).
- Presented “Lawn Care” to the North Haven Garden Club members in North Haven (23 adults) (March 9).
- Instructed “Phytophthora bleeding canker” in the Review Night of the Connecticut Tree protective Association Arboriculture 101 Course in New Haven (25 adults) (April 6).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (7 adults) (April 12).

- As a guest speaker, presented "Sustainable Disease Management" in 11th Jane Goodall Symposium – Sustainability at Western Connecticut State University 2033 in Danbury (32 Adults) (Aprile 19).
- Presented "Gardening with Native Plants" to Wethersfield Public Library education program via Zoom (21 adults) (April 27).
- Presented "Backyard Composting" to Conning Wellness program via WebEx (24 adults) (May 4).
- Presented "Backyard Composting" to Colchester Library education program (23 adults) (May 4).
- Presented "Organic Gardening" to Chester Garden Club in Chester (26 adults) (May 9).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (6 adults) (May 10).
- Presented "Vegetable Gardening" to Morris Cove Garden Club in New Haven (14 adults) (May 10).
- Presented "Common Diseases of Tomato and Pepper" in Foster Hill Farm in Stafford Springs (12 adults) (May 18).
- Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (7 adults) (June 14) .
- Participated in the Northeast Plant Diagnostic Network monthly meeting via Zoom (June 22).
- Talk about Plant Disease Information Office and disease diagnosis to the Station Tour from the International Festival of Arts and Ideas in New Haven (24 adult) (June 16) and (24 adults) (June 23).
- Instructed "Diagnosis Hands-on" in the Diagnosis and Management of Plant Diseases in Ornamental Greenhouses Workshop in New Haven (55 adult) (June 29).

LINSKE, MEGAN A.

- Presented selected poster pitch and research poster titled "Determining effects of winter weather conditions on nymphal *Ixodes scapularis* and adult *Amblyomma americanum* survival in Connecticut and Maine, USA" at the 16th International Conference on Lyme Borreliosis and Other Tick-Borne Diseases in Amsterdam, The Netherlands (325 attendees) (September 4-7)
- Presented a talk titled "Common Ticks and Tickborne Diseases in Connecticut" and assisted in tick identification at the Medically Important Arthropod Workshop held for Connecticut's public health officials (40 attendees) (March 28)
- Presented an invited talk titled "New and Emerging Ticks and Tick-borne Diseases in Connecticut" at the Timpro Annual Meeting hosted by the Connecticut Professional Timber Producers Association at Deer Lake Reservation in Killingworth, CT (40 attendees) (April 21)
- Hosted a guided nature hike at Deer Lake Reservation for Earth Day in Killingworth, CT (75 attendees) (April 22)

- Hosted the Northeast Section of the Wildlife Society's (NETWS) Annual Executive Committee Members meeting as President of the NETWS section at the Northeast Fish and Wildlife Agencies Conference (NEAFWA) in Hershey, PA (10 attendees) (April 30).
- Hosted the Northeast Section of the Wildlife Society's (NETWS) Annual Members meeting as President of the NETWS section at the Northeast Fish and Wildlife Agencies Conference (NEAFWA) in Hershey, PA (20 attendees) (May 1)
- Presented a CAES lunch seminar talk titled "Optimization of Targeted Acaricide Application in Integrated Tick Management" (50 attendees) (May 10)
- Presented a poster titled "Diversity, Dilution, and Disease: The Role of Hosts and Habitat in Lyme Disease Ecology" at the International North Tick Conference in Inverness, Scotland (120 attendees) (May 30)

MARRA, ROBERT E.

- Interviewed about beech leaf disease for educational video by K&J Media Services, at West Rock Ridge State Park, July 8, 2022, and in the lab, July 22, 2022.
- Interviewed by Heather Jessen, for the Daily Nutmeg, about beech leaf disease, 11 July 2022.
- Presented a seminar titled "Four Important Tree Diseases You Should Know About," for the Great Mountain Forest "Forest Health" Lecture Series, Norfolk, CT, 70 adults, July 16, 2022.
- Presented informational posters about oak wilt and beech leaf disease at the annual summer meeting of the CT Tree Protective Association, 750 adults, July 21, 2022.
- Interviewed by Lisa Rathke of the Associated Press about the impact of the region's drought on fall colors, August 30, 2022.
- Presented a seminar on beech leaf disease at the annual meeting of the Connecticut Urban Forest Council, 50 adults, October 26, 2022.
- Presented a seminar titled "The Biology of Beech Leaf Disease" at the annual winter meeting of the Connecticut Tree Protective Association, 850 adults, January 25, 2023.
- Interviewed by Gabriel Popkin about beech leaf disease for Science News, January 23, 2023.
- Presented a seminar on beech leaf disease for the University of Massachusetts Amherst Extension, 620 adults, February 24, 2023.
- Presented a seminar titled "The Role of Fungi in Forests" to the Bethany Garden Club, 20 adults, March 13, 2023.
- Interviewed about beech leaf disease by Susan Robinson, Connecticut Botanical Society, March 17, 2023.
- Interviewed about beech leaf disease and impact of climate change on forest health by Marguerite Holloway, The New Yorker, March 20, 2023.
- Presented a seminar titled "The Role of Fungi in Forests," PierceCare Senior Living Center, Brooklyn, CT, 20 adults, April 19, 2023.

- Participated in the Yale Climate Day Summit, May 4, 2023.
- Presented a field seminar on forests and pathogens, with Dr. Jeff Ward and Jerry Milne (DEEP) for the Connecticut Forests and Parks Association's Master Woodland Managers certification program, 20 adults, May 6, 2023.
- Presented a seminar titled "Climate Extremes, Part I: Impacts of Drought and Heat on Tree Health," PierceCare Senior Living Center, Brooklyn, CT, 20 adults, May 17, 2023.
- Presented a seminar titled "Climate Extremes, Part II: Tropical Storms and their Impacts of Tree Health," PierceCare Senior Living Center, Brooklyn, CT, 20 adults, June 21, 2023.

MILLETT, FELICIA

- Staffed an exhibitor table at the Annual Meeting of the Connecticut Tree Protective Association (January 19).
- Participated in the monthly meeting of the Northeast Plant Diagnostic Network via Zoom (20 adults) (January 20).
- Presented "Trichomes are Colonization Sites and Host Entry Points of the Fire Blight Pathogen on Apple Leaves" as part of the CAES Seminar Series (40 adults) (January 25).
- Staffed a booth at the Connecticut Grounds Keepers Association's Turf and Landscape Conference (February 21).
- Participated in the monthly meeting of the Northeast Plant Diagnostic Network via Zoom (20 adults) (February 24).
- With Dr. Yonghao Li, instructed the Connecticut Tree Protective Association's Arboriculture 101 Tree Conditions Lab class (March 2) (35 adults).
- Participated in the Regional Meeting of the Northeast Plant Diagnostic Network (18 adults) (March 6 - 7).
- Presented updates from the Plant Disease Information Office during the Joint Extension/Industry meeting in the annual meeting of the Northeastern Division of the American Phytopathological Society (March 8) (60 adults)
- Presented a talk "Abscission points of trichomes are host entry points of the fire blight pathogen on apple leaves" as a participant in the Graduate Student Symposium n the annual meeting of the Northeastern Division of the American Phytopathological Society (March 9) (60 adults).
- Participated in the NPDN Proficiency Committee Meeting (March 21) (5 adults) and was elected to the position of Vice-Chair of the Proficiency Committee.
- Presented "Plant Pathology and Projections" at the Connecticut Tree Protective Association's Tree Conditions Workshop (March 23) (60 adults).
- With KATHERINE DUGAS represented the PDIO and IIO labs at the Agriscience Career Fair at the Wamogo High school in Litchfield (April 5) (60 students).
- Participated in the NPDN Cross Committee Meeting (April 5) (23 adults).
- Taught students of the Connecticut Tree Protective Association's Arboriculture 101 Review Night (April 6) (35 adults).
- Participated in the NPDN Proficiency Meeting (April 18) (10 adults);

- Presented to 1st and 2nd graders as part of St. Thomas's School STEAM Festival in Jones Auditorium with **JAMIE CANTONI, KATHERINE DUGAS,** and **KELSEY FISHER** (35 students).
- Participated in the NEPDN Monthly Meeting (April 27) (10 adults).
- Participated in the NPDN Proficiency Meeting (May 16) (11 adults).
- Participated in the NEPDN Monthly Meeting (May 25) (20 adults).
- Led a tree ID walk for the Hebron Pollinator Pathways at Raymond Brook Preserve (June 15) (3 Adults).
- Participated in the NPDN Proficiency Meeting (June 20) (6 adults).
- Participated in the NEPDN Monthly Meeting (June 22) (20 adults).
- Presented "Collecting High Quality Samples" at the UConn Extension Diagnosis and Management of Plant Diseases in Ornamental Greenhouses Workshop (June 29) (55 Adults).

MOLAEI, GOUDARZ

- Was interviewed by NBC Connecticut on the tick bite-associated Alpha gal syndrome in Connecticut and human health risks (July 1); was invited to visit the U.S. Forest Services in Hamden, CT, and discuss collaborations between this agency and the CAES Department of Entomology (July 7); and directed the CAES-TTL where 333 submissions were processed and blood-engorged adult blacklegged ticks were tested for Lyme disease, babesiosis and anaplasmosis, and results were reported.
- was interviewed by CT Insider on tick population abundance and risk of human infection with tick-borne pathogens in Connecticut (August 9), and by Fox 61 on Lyme disease and vaccine development (August 12); supervised the Public Health and Entomology Tent, and assisted by **MS. NOELLE KHALIL**, presented a poster at Plant Science Day 2022, "Monitoring Ticks and Tick-borne Pathogens to Better Guide Public Health Action in Connecticut" (August 3); and directed the CAES Tick Testing Laboratory; of the 156 submissions, blood-engorged adult blacklegged ticks were tested for Lyme disease, babesiosis, and anaplasmosis, and results were reported (August 1–31).
- attended a virtual meeting with CDC scientists to discuss comparing CAES passive and active tick and tick-borne pathogen surveillance data through the CDC's Centers of Excellence (COE) and Epidemiology and Laboratory Capacity (ELC) funding mechanisms and determining if these comparisons could be useful for improving the cost-effectiveness and efficiency of tick surveillance efforts in Connecticut and throughout the US (September 27).
- Along with Douglas Brackney, Ph.D. met with Dr. Linda Niccoli, James Meek, and Sara Niesobecki of the Yale Department of Epidemiology of Microbial Diseases to discuss a joint research project on Powassan virus within the framework of the CAES Passive Tick and Tick-borne Pathogen Surveillance Program (October 3); with Philip Armstrong, Ph.D. and Andrea Gloria-Soria, Ph.D. attended annual virtual meeting of Multistate NE1943: Biology, Ecology and Management of Emerging Disease Vectors (October 20).
- was interviewed by UConn students on the impact of climate change on tick activity and recent changes in the dynamics of tick activity in the Northeast. The interview will be available online as a podcast, and as a member of

the advisory com-mittee, attended the monthly meeting of the New England Regional Center for Excellence in Vector-borne Diseases (November 29).

- attended the 2022 annual meeting of the Northeastern Mosquito Control Association and presented an update of the Northeast Regional Center for Excellence in Vector-Borne Diseases programs (December 5).
- as a member of the Advisory Council for the newly established New England Regional Center for Excellence in Vector-Borne Diseases (NEWVEC), attended the monthly meeting and discussed means to enhance and expedite the impact of this center in communities in the region (January 4); met with Dr. David Della-Giustina, Professor and Vice Chair for Education, Department of Emergency Medicine, Yale School of Medicine, and his collages to discuss a collaborative project to better understand the learning needs of frontline providers regarding recognition, diagnosis, and treatment of multiple tick-borne diseases in the Northeast (January 10); discussed and made agreement with Dr. Elizabeth Roberts, Biology Department Cahir, Southern Connecticut State University (SCSU), and Dr. Clayton Penniman, Biology Department Chair, Central Connecticut State University (CCSU), to establish undergraduate and graduate level courses in vector biology and vector-borne diseases (VBDs) and introduce a minor in VBDs for undergraduates and a concentration for graduates (MS program) in these state colleges. These projects/programs with Yale University, SCSU, and CCSU will be included in a comprehensive grant proposal to be submitted to the CDC in response to a new RFA, "Strengthening Training, Evaluations, and Partnerships in the Prevention and Control of Vector-Borne Diseases" on February 03, 2023; and was interviewed by media on the increased risk of human infection with tick-borne diseases as the result of climate change, warmer winters, and year-round tick activity. Media interviews included CT Insider (January 12); WTNH Channel 8, WCBS 880 Radio, WNBC, New York, WFSB Channel 3 (January 16); NBC Connecticut, WNPR (January 17); Hartford Radio Station (January 19); Chaz & AJ Radio (January 23); a free lance journalist from Milford, CT (January 27); met with CDC scientists to discuss data on the lone star tick (January 19), and data on the prevalence of infection in blacklegged ticks (January 26) generated by the CAES active and passive tick surveillance programs; attended the 1st Annual Yale Vectorborne and Zoonotic Diseases Symposium at the Yale School of Public Health (January 20); and participated in the CDC's virtual Vector Day 2023 meeting (January 25).
- was interviewed by Fox 61 (February 1); NPR (February 8); NPR (February 16); NBC CT (February 21) on the increased risk of human infection with tick-borne diseases as the result of climate change, warmer winters, and year-round tick activity.
- was interviewed by CBS Boston (March 2); WTNH Channel 8 (March 17); Journal Inquirer (March 20); Hartford Courant (March 20); Fox 61 (March 21); and WFSB (March 22) on the increased risk of human infection with tick-borne diseases particularly babesiosis.
- was interviewed by Channel 3 WFSB and Fox 61(April 11), AARP Media (April 14), Associated Press (April 18), WCBS RadioNews 880 (April 24), WFSB (April 25), WFMJ TV Ohio (April 28), and Fox 61 (April 28) on tick activity this year; and presented an invited talk, "Ticks and Tick-Borne Diseases of the Connecticut River Valley" at the Dinosaur State Park organized by the Central Connecticut Health District (April 27).

- was interviewed by WBZ/ CBS News (May 1), Hearst Connecticut Media Group (May 2), NBC Connecticut and News 12 Connecticut (May 10), Time Magazine (May 29), and Wall Street Journal (May 30) about tick activity this year, increasing risk of human infection with tick-borne diseases particularly babesiosis, and Alpha gal syndrome; presented a brief research, training, and outreach updates on vectorborne diseases to the monthly meeting of the New England Regional Center for Excellence in Vector-Borne Diseases (May 8); and presented an invited talk, "Range Expansion of Native and Invasive Ticks: A Looming Public Health Threat" to the Joint Connecticut LHDIP-Infectious Diseases meeting (May 24).
- was interviewed by NBC Connecticut (June 7), Hearst CT Media Group and NBC News 4 New York (June 13), Channel 3 (June 14), Fox Weather (June 22), New Jersey Advanced Media (June 28), and Connecticut Post (June 30) about native and invasive tick and tick-borne pathogen activities; attended cross CDC Centers of Excellence in Vector-borne Diseases Tick Bite Prevention Working Group (June 19); presented an invited talk, "Range Expansion of Native and Invasive Ticks: A Looming Public Health Threat" to the weekly meeting of the Connecticut Department of Public Health (June 22); presented a short talk to the tick working group of the USGS on tick surveillance and research activity at the CAES; co-presented a talk, "Evidence of Protozoan and Bacterial Infection and Co-Infection and Partial Blood Feeding in The Invasive Tick Haemaphysalis Longicornis" to the National Asian Longhorned Tick Stakeholder Call (June 26); hosted two groups of International Festival of Arts and Ideas visitors at the Tick Testing Laboratory and presented short talks on tick and tick-borne pathogen activity and surveillance (June 16 and 23); and hosted Dr. Bruce Rottmann, a medical microbiology fellow at Yale New Haven Hospital, and along with DR. KIRBY STAFFORD III, DR. DOUGLAS BRACKNEY, DR. PHILIP ARMSTRONG, DR. GALE RIDGE, DR. ANDREA GLORIA-SORIA, DR. SCOTT WILLIAMS, DR. MEGAN LINSKE, and JOHN SHEPARD provided him with training on medically important vectors and vector-borne diseases (June 20-21)

NASON, SARA L.

- participated in the monthly call of the PFAS Testing Laboratory working group (July 1, 13)
- participated in Zoom call with collaborators at Yale University and the University of Minnesota to discuss progress on a joint NIEHS grant (July 6)
- met with colleagues from the CT Department of Public Health and the University of Connecticut to discuss ongoing PFAS analysis efforts in the state (October 7); attended meetings for the Benchmarking and Publications for Non-Targeted Analysis working group (October 13, 18, 19, 27); gave a presentation titled "Contamination Uptake in Fiddleheads – Pilot Study with Tribes" at the Fall 2022 EPA Tribal Environmental Conference, Bar Harbor, ME (October 19).
- attending virtual meetings with the Benchmarking and Publications for Non-Targeted Analysis working group (November 9–10), gave a talk titled "Collaborative PFAS research using high resolution mass spectrometry: Challenges and progress" at the Eastern Analytical Symposium Plainsboro, NJ (23 attendees) (November 16); met

with Dr. Satish Myneni, Professor of Geosciences in the Molecular Environmental Geochemistry Group at Princeton University and discussed potential collaboration (November 16); and met with stakeholders interested in expanding the use of non-targeted analysis in the fields of medical device regulation and emergency response (November 17).

- attended virtual meetings for the Benchmarking and Publications for Non-Targeted Analysis working group (December 1, 6, 15); met virtually with PFAS researchers from the University of Connecticut and Yale University as part of the CT PFAS testing Laboratory Capacity and Capability discussion group (December 2); attended the Connecticut Interagency PFAS Task Force Action Plan Three Year Review Meeting in Hartford (December 8); attended the EPA Region 1 States PFAS in Biosolids Roundtable (December 14).
- met virtually with PFAS researchers from UConn and the CT Department of Public Health (CT DPH) as part of the CT PFAS testing Laboratory Capacity and Capability discussion group (January 6); coached high school students on science fair projects at the Sound School in New Haven (January 11); visited the CT DPH Laboratory and met with the PFAS team (January 12); attended virtual meetings for the Benchmarking and Publications for Non-Targeted Analysis working group (January 12 and 17); met virtually with colleagues from the US EPA to discuss collaborative research on characterizing chemical space in non-targeted analysis (January 19); met virtually with colleagues from Trajan Scientific to discuss potential collaboration on PFAS research (January 31).
- coached students on science fair projects at the Sound School in New Haven, CT (February 1, 8, and 27); met with the Benchmarking and Publications for Nontargeted Analysis working group (February 2, 9, 10, and 21); met with collaborators from the University of Albany and Princeton University to discuss an ongoing PFAS phytoremediation project in Maine (February 3, 7, and 8); met with collaborators from Yale University, the University of Minnesota, and NIH officials to discuss ongoing work on an NIEHS project on PFAS (February 6-7); met with regulatory stakeholders to discuss use of nontargeted analysis for decision making for PFAS and risk assessment (February 21-22)
- articipated in virtual meetings for the Benchmarking and Publications for Non-Targeted Analysis working group (March 3, 13, and 14); met virtually with representatives from the medical devices industry to discuss use of non-targeted analysis for regulatory purposes (March 10).
- met virtually with the Benchmarking and Publications for Non-targeted Analysis working group (April 13, 18, and 24); with DR. CLAIRE RUTLEDGE and MS. SUMMER STEBBINS, gave an educational tour of The CAES to students from the Sound School (April 24); presented lecture titled “An Overview of PFAS Research at CAES” and hosted the round table discussion at the CAES PFAS mini-Symposium, New Haven, CT (April 28).
- visited the Sound School in New Haven, CT, to discuss science fair projects with students (May 1); attended virtual meetings for the Best Practices for NonTargeted Analysis working group (May 11 and 16).
- participated in virtual meetings for the Best Practices for NonTargeted Analysis working group (June 1, 8, and 16); participated in the CT PFAS testing Laboratory Capacity and Capability discussion group (June 13); met virtually with Heather Henry from the National Institutes of Health (NIH) regarding revising and expanding our NIH funding

on PFAS (June 22); co-hosted a virtual meeting for epidemiologists from various universities and the EPA for the purpose of discussing the usefulness of and improvements needed in using non-targeted analysis in epidemiology studies (June 23).

PATEL, RAVIKUMAR R.

- presented a poster titled “Survival of the sleepiest: *Pseudomonas syringae* survives chemical controls by maintaining a toxin-associated dormant subpopulation” co-authored by **Lindsay Triplett**, at the 12th Japan-US Seminar on Plant Pathology in Ithaca, NY (85 adults) (August 29).
- presented his poster “Functional microbiomes of protist predators” at the 6th Sussex Symposium held at The CAES (November 4).
- presented a talk titled “Physiological and Genetic Mechanisms Associated With Antibiotic Persisters of Pseudomonas syringae pv. phaseolicola" at the Annual Meeting of the Northeastern Division of the American Phytopathological Society, Southbury, CT (26 adults) (March 10).

PETRUFF, TANYA A.

- gave a talk titled “Range Expansion of Aedes albopictus, Anopheles crucians and Culex erraticus through Connecticut: A Cause for Concern?” at the 2022 annual meeting of the Northeastern Mosquito Control Association in Hyannis, MA (December 5-7).
- resented a talk titled, “Connecticut Mosquito Surveillance Program for West Nile Virus and Eastern Equine Encephalitis” to community members of the Middletown Senior Center (June 5).

PRAPAYOTIN-RIVEROS, KITTY

- Attended the annual US-FDA Laboratory Flexible Funding Model (LFFM) CAP Grantee Meeting in St. Louis, Missouri, November 15–17, 2022 and gave a presentation on State Experiences with ORA DX. Over 200 participants were present.

RIDGE, GALE E.

- Was interviewed by the Hartford Courant about the health of insect populations in New England (July 01), and by the Westport Journal about fireflies (July 15); and participated in a virtual jumping worm conference organized by the University of Vermont (July 23)
- was interviewed by the New York Times about Delusional Infestation and migrations of the green darner dragonfly, Anax junius (September 12).
- presented a talk via Zoom on jumping worms to the Cheshire Garden Club and advised their board on management of the worm (October 12); presented two short talks about jumping worms via Zoom to students at Weston High

School (October 13); and was interviewed about the Western conifer seed bug and brown marmorated stink bug by Hurst News (October 19).

- was interviewed by the NewsTimes about insect activity during the winter months (November 22).
- presented a talk about bed bugs at the Medically Important Arthropods Workshop held at the Experiment Station (March 28).
- presented the talk, “Jumping Worms in Connecticut” via Zoom to the annual meeting of the Experiment Station Associates (April 26).
- was interviewed about spongy moth deforestation in Litchfield Co., by Debra Aleksinas correspondent for the Lakeville Journal (May 16); presented a talk to the Aspetuck Health Department on lice and ticks (May 18); introduced New Haven City’s Urban Initiative interns to forest insect pests (May 18).
- presented a talk on bed bug behavior and management during a symposium sponsored by the City of Bridgeport Department of Health and Social Services (June 1); trained new hires and summer assistants during the annual summer safety training program on self-protection while working in the field (June 5); and participated in a YouTube video about Hemlock Woolly Adelgid produced by Summer Rayne of Flock Finger Lakes productions (June 6).

RUTLEDGE, CLAIRE E.

- Held field trainings for new Wasp Watchers in Middletown, Willington, Portland and Killingworth, CT (July 5, 6, 12); and helped to run the Connecticut Tree Protective Association summer meeting in Farmington, CT (July 21).
- Presented an exhibit “Through the Eyes of a Wasp, the Rise and Fall of the Emerald Ash Borer in Connecticut” at Plant Science Day (August 3); and helped Plant Health Fellow, Mia Varney, who interned in her lab this summer, present a talk, “Is There Hope for Ash Trees in Connecticut?” at the PHF forum (August 4).
- taught the lecture and laboratory portion of the class “Insects that Attack Trees” for the Connecticut Tree Protective Association's Arboriculture 101 course (October 6-7).
- presented a talk titled "Emerald ash borer biological control in Connecticut" at the Environmental Research Symposium sponsored by Flanders Nature Center and Land Trust, and the Taft School in Watertown, CT (November 3); presented a talk titled "Spotted lanternfly and maple syrup" at the Annual Meeting of the Connecticut Maple Syrup Producers Association in Avon, CT (November 5); gave an invited talk titled "Tracking outbreaks of native buprestids using a native wasp" in the symposium "From culture to chemistry: Managing flatheaded borers in specialty crops" at the Entomological Society of America Annual Meeting in Vancouver, British Columbia, Canada (November 13-16), and served as a committee member for Niklas Lowe, a master of science student at CCSU, and participated at his successful thesis defense (November 22).
- resented a lecture titled, “New insects in Connecticut” live streaming as an Advanced Master Gardeners class (December 2); presented the talk “New insects in Connecticut” to the MAD Gardeners in Litchfield, CT (December 4); was interviewed by the Norwalk Bulletin in a segment titled “Long Term Hope for Control of the Emerald Ash

Borer" https://thelastgreenvalley.org/long-term-hope-for-control-of-theemerald-ash-borer/ (December 13); helped to administer the oral portion of the Connecticut Arborist Licensing Exam. New Haven (December 14); and gave a livestreamed talk, "Trapping methodologies for Bonze Birch Borer (Agrilus anxius) and Emerald Ash Borer (Agrilus plainpennis)" as part of a symposium presented by The Swedish Board of Agriculture on Survey, Diagnosis and Outbreaks, Actions for Agrilus anxius and Agrilus planipennis (December 19).

- resented the talk "Impact of EAB invasion stage and post-release time on the persistence and impact of introduced EAB larval parasitoids" to the Annual Invasive USDA Interagency Forum on Invasive Species in Annapolis, MD (January 12); attended the winter meeting of the Connecticut Cooperative Agricultural Pest Survey and presented on the emerald ash borer in Connecticut (January 17); and helped to plan and run the Annual Meeting of the Connecticut Tree Protective Association in Southington, CT (January 19).
- taught the class session "Tree Conditions Laboratory" for the Connecticut Tree Protective Society's Arboriculture 101 course (March 2); presented a talk 'The Impact of EAB Biological Control Agents on Ash Forest Structure in CT' to the Forest Health Workshop at The CAES (March 7); helped administer the oral portion of the arborist license exam (3 applicants) (March 8); presented the invited talk "Impact of EAB invasion stage and post release time on the persistence and impact of introduced EAB larval parasitoids" at the Eastern Branch of the Entomological Society of America's annual meeting in Providence, Rhode Island (March 19); and presented the talk "Entomology and Trees" at the Connecticut Tree Protective Society's "Connecticut Tree Conditions in 2023."
- taught the laboratory session "Tree Conditions Laboratory" for the Connecticut Tree Protective Society's Arboriculture 101 course (April 6); organized and ran the symposium on "Spotted Lanternfly in Connecticut" at The CAES (April 17); presented the talk "The Spotted Lanternfly" at the Earthplace, Westport, CT (April 20); and presented the talk, "Spotted Lanternfly" via Zoom to the annual meeting of the Experiment Station Associates (April 26).
- gave a lecture "Monitoring an invasive beetle with a native wasp" to the Master Gardeners class in Brooklyn, CT (May 5).

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).
- Presented a seminar "Probing metabolite requirements for *Erwinia amylovora* disease establishment ", presented at the Third International Symposium on Fire Blight of Rosaceous Plants in Dresden Germany (75 attendees) (September 8, 2023),
- Presented a talk "Probing metabolite requirements for *Erwinia amylovora* disease establishment", presented at the 2022 Northeast Tree Fruit IPM meeting October 25th, 2023, Farlee, VT

- Presented a three-lecture module on “Genetically Modified Plants in Agriculture” to Science Course Sci 031 at Yale University, Nov,18- Dec. 2 & 9, 2022.
- Presented a poster entitled. “Probing nutritional requirements *of Erwinia amylovora* in fire blight development” at the annual Sussex Plant Biology Symposium, at CAES (75 adults) (November 4, 2022)
- Arranged and served as a judge at the Quinnipiac Chapter of Sigma Xi Student Research Symposium (60 attendees) (April 26)

SHABTAI, ITAMAR

- Met with a colleague from Cornell University to discuss method development for metabolomics analysis of maize root exude in a joint project (July 11); met with colleagues from Purdue University and USDA-ARS to discuss a USDA-NIFA-AFRI grant proposal (July 20); attended a Zoom call with colleagues from the Hebrew University of Jerusalem, Israel to discuss a manuscript summarizing their work on an adsorbent which removed dissolved organic matter from surface waters (July 27).
- met with subcommittee members of the CT Council on Soil and Water Conservation to work on a Soil Health Action Plan for CT (August 9); met with colleagues from Lavras Federal University, Brazil, to discuss a manuscript that describes the adsorption mechanisms of organic phosphorous compounds to soil minerals (August 25).
- attended a video meeting for the Climate-Smart Agriculture & Forestry Working Group hosted by DEEP Office for Climate Planning (September 1); met with subcom-mittee members of the CT Council on Soil and Water Conservation to work on a Soil Health Action Plan for CT (September 7); met with a colleague from Cornell University to discuss syn-chrotron-radiation x-ray absorption spectroscopy of biochar samples (September 9).
- Attended a video meeting with collaborators from Cornell University to discuss an ongoing study looking at the interactions between root exudates and soil minerals (October 12); he met with the Spherical Grating Monochromator (SGM) beamline scientist at the Canadian Light Source to discuss data analysis of synchrotron-radiation x-ray absorption spectroscopy (October 28).
- presented a seminar for the Department of Natural Resources and Environment at the University of Connecticut (40 attendees) (November 4); met with a collaborator from Purdue University to discuss a project on microbial attachment to miner-als using synchrotron radiation spectromicroscopy (November 17); and attended the Con-necticut Agricultural Expo 2022 (November 18).
- attended a virtual meeting with Connecticut Natural Resources Conservation Service staff to discuss future soil sampling and characterization efforts (December 6); gave an oral presentation at the American Geophysical Union meeting in Chicago on “A Spectromicroscopy Study of the Organo-mineral Interactions in the Rhizosphere” (100 attendees) (December 12).
- met with a colleague from the University of Idaho to discuss an ongoing joint research project (April 10); with DR. BLAIRE STEVEN, met with a collaborator from the University of Maryland, Baltimore, to discuss a joint NSF grant proposal (April 13); joined Natural Resources Conservation Service (NRCS) staff to sample soils from White

Memorial Foundation Forest experimental plots as part of a project evaluating Dynamic Soil Properties (April 17, 18, and 20); met with collaborators from Cornell University to discuss a joint NASA-ROSES grant proposal (April 18); worked remotely at the STXM-NEXAFS beamline at the Canadian Light Source synchrotron (April 26-29).

- presented his work at the annual meeting of the Multi-State Hatch Project NC1178 "Land use and management practice impacts on soil carbon and associated agroecosystems services" held at Florence, SC (10 attendees) (June 13-14); met with collaborators from Virginia Tech to discuss upcoming work at the Canadian Light Source synchrotron (June 16); met with collaborators from Cornell University to discuss grant proposal development for user access to DoE EMSL (June 23).

SHEPARD, JOHN J.

- Was interviewed by the Hartford Courant on the potential effects of climate change on populations of mosquitoes in Connecticut (July 1); and 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 (July 11, 18, 25).
- 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 (August 1, 15, 22, 29).
- participated via Zoom in a Board of Directors meeting of the North-eastern Mosquito Control Association (September 9); and 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 (September 12, 19, 26).
- 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 (October 3, 11), and participated via Zoom in a Board of Directors meeting of the Northeastern Mosquito Control Association (October 24).
- participated in an Executive Board Meeting and presented the invited talk "Arbovirus Activity in Connecticut, 2022"; was elected to the position of 2nd Vice President at the 68th Annual Meeting of the Northeastern Mosquito Control Association in Hyannis, MA (December 4-7); and along with Tanya Petruff, met via Zoom with Dr. Addie Williams, Dr. Paola Carolina Valenzuela Leon, and Karina Sewell from NIH/NIAID to discuss the establishment of a mosquito colony for their research program (December 16).
- attended Board of Directors meeting of the Northeastern Mosquito Control Association in Mystic, CT (February 24)
- spoke about mosquitoes and mosquito-borne viruses to a group of homeschool students (March 10); and presented a talk titled "Biology, Ecology, and Feeding Behavior of Mosquitoes in Connecticut" and assisted in mosquito identification at the Medical Entomology Workshop held for Connecticut's public health officials (March 28)

- met with Arlene Watson-Paulin, a Contract Specialist from DAS, to tour Station facilities in preparation for soliciting contract bids from vendors (May 5); spoke to media members about the state Mosquito Trapping and Arbovirus Surveillance Program and demonstrated mosquito trap types at a press conference for the Milford Health Department's 2023 Mosquito Kick-off (May 11); and discussed the Mosquito Trapping and Arbovirus Surveillance Program and evaluated trap placement locations with members of the Preventive Medicine Unit on the US Naval Submarine Base in Groton (May 24).

SMITH, VICTORIA L.

- Was interviewed by the Inside Investigator, regarding spotted lanternfly in CT (July 18); participated in the summer Connecticut Tree Protective Association meeting, held at the Farmington Club, with a table display "Be On The Lookout: Spotted Lanternfly and Box Tree Moth" (July 21); and attended the Connecticut Nursery and Landscape Association summer meeting, held at Prides Corner Farms in Lebanon (July 27).
- participated in the 96th meeting of the National Plant Board, with discussions on *Phytophthora ramorum*, spotted lanternfly, and other quarantine pests and diseases, and in a panel discussion with a beech leaf disease update (July 31–August 4); and was interviewed by NBC-CT about spotted lanternfly (August 10).
- was interviewed by Patch.com and Wicked Local regarding spotted lanternfly (September 22).
- as interviewed MS. ANGELA BRANSFIELD participated via Zoom in Yale's Biosafety Committee meeting (October 20); chaired a CAES DEI Committee Meeting (October 25); and participated in the Federal Select Agent Program's Responsible Official webinar Entity Inspector Entry Requirements (October 26).
- was interviewed by WTIC Radio, concerning spotted lanternfly (January 9); participated in the spring meeting of the Cooperative Agricultural Pest Survey meeting via Zoom (January 17); participated in the winter meeting of the Connecticut Tree Protective Association, with a display on CAPS surveys, spotted lanternfly, and box tree moth, held at the AquaTurf in Southington (January 19); and participated in the Connecticut Nursery and Landscape Association Winter Symposium and presented a talk titled "CAES Update" including information on spotted lanternfly, box tree moth, forest health, and other regulatory activities (January 24).
- presented an invited talk, "Spotted Lanternfly Lunch and Learn" at SiteOne Landscape Supply in East Haven (February 21).
- participated in the Spotted Lanternfly Summit, sponsored by Penn State University and held via Zoom (March 1-2); organized and participated in the annual Forest Health Monitoring Workshop, held in The Station's Jones Auditorium (see the recording on our website: https://portal.ct.gov/CAES/Publications/Publications/ForestHealth-Monitoring-Workshops/Forest-Health-Monitoring-Workshop-2023) (March 7); participated in a workshop titled "Phytophthora ramorum: Focus on Field Activities", held via Zoom (March 8-9); was interviewed by David Desiderato of the Granby Drummer, regarding spotted lanternfly (March 16); participated in a Plant Production Act (PPA) webinar, sponsored by the National Plant Board (March 20); participated in the Forest Program Management Review, in cooperation with DEEP and the US Forest Service, held at DEEP HQ in Hartford (March 21-22);

participated in a webinar on the US-Canada Greenhouse Certification Program, sponsored by USDA Export Services (March 28); and participated in a call for planning the annual Eastern Plant Board meeting (March 29)

- participated in the 97th annual meeting of the Eastern Plant Board, held at the 1620 Hotel in Plymouth, Massachusetts (April 3-6); was interviewed by Skyler Henry of CBS News, Washington DC, about spotted lanternfly (April 12); participated in the Spotted Lanternfly in Connecticut Symposium, held in the Jones Auditorium, with a presentation on the regulatory status of SLF in CT (April 17); participated in the CT Professional Timber Producers Association meeting, held at Deer Lake Reservation in Killingworth, with an SLF update (April 21).
- participated in Digital Mobile Sketch Mapper/Pre-Season Aerial Survey Training, sponsored by the US Forest Service, held via Teams (May 17); and was interviewed by Steve Smith of the Hartford Courant, concerning No-Mow May for pollinator enhancement (May 26).
- was featured in the National Plant Board Quarterly Newsletter "SPRO Spotlight" (June 6); and was a guest on the "Keeping It Green" podcast, discussing the importance of regulatory work for protecting the nursery plant industry and other agriculture, plus spotted lanternfly (June 9).

STAFFORD, KIRBY C. III

- Participated as a member in a meeting of the Tick-Borne Disease Working Group (July 19-20); and presented on ticks and tick-borne diseases for the Hartford Master Gardeners Virtual Hot Topics series (July 19).
- participated as a member in a meeting of the Tick-Borne Disease Working Group (October 4-5); presented a talk on ticks and tick-borne diseases to the Wallingford Garden Club (October 11); and participated as a member in a meeting of the Tick-Borne Disease Working Group (October 24-25).
- participated as a member in a meeting of the national Tick-Borne Disease Working Group (November 21) as the group approved its 2022 Report to Congress and attended the annual meeting of the Entomological Society of America in Vancouver, British Columbia, Canada and presented a talk with co-author Goudarz Molaei, Ph.D. titled "Changes in the frequency and dynamics of ticks and tick-borne pathogens as a serious public health threat in the northeastern USA" (November 13–16).
- presented a talk on ticks and tick control to the Olde Ripton (Shelton) Garden Club (March 6); presented a talk on ticks, tick-borne diseases, and tick control at the Middlesex Community College for the Middlesex Institute for Lifelong Education (MILE) program (April 13), and attended the annual meeting of the Northeast Regional Center for Excellence in Vector-Borne Diseases (April 21).
- presented a talk on ticks and tick control for the Institute for Learning in Retirement in Hamden (May 25).
- participated in the visit and training of Yale Medical Microbiology Fellow Dr. Bruce Rottmann (June 20).

STEBBINS, SUMMER E.

- With Gregory Bugbee, gave an Invasive Aquatic Plant Seminar to a Limnology class at Western Connecticut State University (20 attendees) (July 12)
- With Gregory Bugbee, gave a virtual talk titled “Connecticut River Hydrilla Update” to the Connecticut River Management Working Group (15 attendees) (August 25).
- with Drs. Megan Linske, Sarah Thomas, Ileana Reyes, Amine Hassani, and Quan Zeng presented to a group of young women at Wilbur Cross High School to promote Women in STEM and a mentorship program between Wilbur Cross and CAES (10 attendees) (November 3).
- with Quan Zeng, Ph.D., Karol Alves Barroso, Meghan Cahill, Ph.D., Itamar Shabtai, Ph.D. and Leigh Whittinghill, Ph.D. hosted two students from Wilbur Cross High School as part of the Women in STEM mentorship program and provided them a tour of the laboratory facilities at The CAES’s New Haven campus.
- Was elected to the Northeast Aquatic Plant Management Society Board of Directors (January 17).
- presented a lecture titled “Hydrilla invades the Connecticut River” at the Northeast Aquatic Biologist Conference in Plymouth, MA (25 attendees) (February 17)
- was accepted into the Graduate School at the University of Connecticut, Storrs in pursuit of her Ph.D. in Remote Sensing in the Department of Natural Resources and the Environment within the Department of Agriculture, Health, and Natural Resources (March 10).
- with MS. RILEY DOHERTY, gave an invasive aquatic plant workshop to Bridgeport middle school students as part of the Trout in the Classroom program at the Beardsley Zoo (15 attendees) (May 3); gave a talk titled “West Lake Aquatic Plant Survey Results” to the West Lake Health Committee and various West Lake Associations at the Guilford Community Center (50 attendees) (May 11); with MS. RILEY DOHERTY, attended the Northeast Arc Users Spring Conference at University of Rhode Island (May 16).
- With RILEY DOHERTY attended the US Army Corps of Engineers Connecticut River Hydrilla Research and Demonstration Project Public Stakeholder Meeting in Middletown, CT (June 29).

STEVEN, BLAIRE T.

- attended the ISME-18 meeting of the International Society of Microbial Ecologists in Lausanne, Switzerland, and presented a research poster titled, "Bacteria alter the blood digestion of gnotobiotic mosquitoes” (August 14-19).
- traveled to the University of the Arctic in Tromso, Norway, to participate in a Ph.D. defense in the Faculty of Biosciences, Fisheries and Economics, gave invited lecture titled "Biological Soil Crusts as a Model for Terrestrial Carbon Cycling," (25 students and 10 faculty attendees), and held meetings to discuss collaborative potential between research at CAES and the Arctic University (October 10-13).
- resented a lecture titled "Biological Soil Crusts: Microbial Ecological Indicators of Climate Disturbances" at the Geobiology Symposium XXIX at the University of Delaware (50 attendees) (February 24).

- presented an invited lecture at Thompsons Rivers University in Kamloops, Canada titled "Biological Soil Crusts as a Model for Terrestrial Carbon Cycling" (30 students, 10 faculty) and met with University administrators concerning collaboration potential for work at the new high Arctic Research Station in Cambridge Bay, Nunuvut (March 15-17).

STONER, KIMBERLY A.

- spoke to a meeting of the Middletown Pollinator Pathway, organized by the Middletown Garden Club at the CT Forest and Park Association in Mid-dlefield, CT (September 10).
- led a “Pollinator Walk” in City Meadow in the center of Norfolk, CT, as part of the Haymarket Book Festival, followed by a discussion on management of stormwater and invasive plants and encouragement of native plants for pollinators (October 2).
- presented a talk on “Native pollinators” to the CT Beekeepers Association via Zoom (November 15).
- met with board members of the Pollinator Pathway to introduce them to Dr. Kelsey Fisher and discuss potential directions for research (January 19); met with Louise Washer and Mary Wilson of the Pollinator Pathway about possible legislation with regard to neonicotinoids (January 23); chaired a meeting of the Pollinator Advisory Committee to discuss possible legislation with regard to neonicotinoids (January 26); and chaired a meeting of the Pollinator Advisory Committee to discuss possible legislation with regard to neonicotinoids (January 31).
- testified in a public hearing in the Environment Committee, presenting alternative language for SB 963, An Act Concerning Neonicotinoids for Non-Agricultural Use on behalf of the Pollinator Advisory Committee (February 15).
- presented a talk with Laura Saucier of the CT Department of Energy and Environmental Protection on Connecticut laws pertaining to bees and pesticides and effects of climate change on pollinators to the Animal Law Section of the Connecticut Bar Association (May 16); and participated in lobby days at the state Capitol for bills pertaining to environmental justice, energy efficiency in schools and housing, and a Decarbonization Roadmap for the state to achieve its statutory climate goals in the Global Warming Solutions Act (May 17 and 24).
- spoke at a press conference at the CT State Capitol about the importance to farmers, farmworkers, and farming communities of bills being considered in the state legislature creating a climate decarbonization roadmap and strengthening environmental justice (June 5); joined the steering committee of the Working Lands Alliance (June 13); and was interviewed along with Maya van Rossum, Delaware Riverkeeper, about Green Amendments to state constitutions and the Connecticut Environmental Rights Amendment by Melinda Tuhus for her program, “The Forest and the Trees” on WPKN radio (June 27).

TAERUM, STEPHEN J.

- presented a virtual seminar for the Forestry and Agricultural Experiment Station, University of Pretoria, South Africa, titled "Exploring protist diversity and interactions in the phytobiome". This was part of the FABI International Seminar Series (70 adults) (August 25).
- along with LINDSAY TRIPLETT led a 90-minute workshop titled "Microbial Predators in Soil - Hunting for Healthy Soil Ecosystems" at the winter meeting of the Northeast Organic Farming Association of Connecticut (CT-NOFA) in Middletown, CT (18 adults) (March 12).
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TAMEZ, CARLOS

- Attended the annual US-FDA Laboratory Flexible Funding Model (LFFM) CAP Grantee Meeting in St. Louis, Missouri, November 15–17, 2022 and gave a poster presentation on Analysis of Pesticides in the State of Connecticut. Over 200 participants were present.

THOMAS, SARA

- Attended the 35th SRP annual meeting organized by the National Institute of Environmental Health Sciences (NIEHS) held at Raleigh, North Carolina during December 14-16, 2022. She gave an oral presentation on the topic "*Nanoparticle enhanced Phytoremediation of PFAS*".

TRIPLETT, LINDSAY R.

- presented an oral presentation co-authored by **Dr. Stephen Taerum** (lead author) and **Dr. Blaire Steven** titled "Microeukaryotes of the solanaceous plant phyllosphere" at Plant Health 2022 in Pittsburgh, PA (70 adults) (August 7); and presented a poster presentation titled "Functional microbiomes of rhizosphere protist predators" co-authored by Ravikumar Patel, Ph.D. (lead author), Eboni Traverso, and **Blaire Steven** (42 adults) (August 6- 10). Dr. Triplett served as one of two US organizers of the 12th Japan-US Seminar on Plant Pathology in Ithaca, NY from August 28–September 2, where she gave an oral presentation "How predators remodel the phytobiome for plant health" (91 adults) (August 29).

- served on a confidential Federal Grant Panel.
- led an orientation session for newly hired scientists, covering the basics of CAES organizational structure, the reporting calendar, and expectations for group leaders (5 attendees) (February 14).
- served as a discussion moderator for the "Networking 101" workshop at the Northeastern Division of the American Phytopathological Society in Southbury, CT (21 adults) (March 8); along with DR. STEPHEN TAERUM, led a 90-minute workshop titled "Microbial Predators in Soil- Hunting for Healthy Soil Ecosystems" at the winter meeting of the Northeast Organic Farming Association of Connecticut (CT-NOFA) in Middletown, CT (18 adults) (March 12); organized and hosted a visit of invited speaker Dr. Sydney Everhart (March 15); and participated in project planning conference calls with collaborators at Penn State University (5 participants) (March 21) and Southern Connecticut State University (3 participants) (March 30).
- gave a lecture titled "The History of Carolina Rice" to the Waterbury Senior Center (32 adults) (April 18), and participated in a meeting of the Soil Predators Working Group via Zoom (6 adults) (April 12).
- Led a half-day orientation session for the Plant Health Fellows program (12 adults) (June 5); organized lab, field, and farm safety training for new staff, seasonal employees, and volunteers (39 adults) (June 5); led a field trip to Enko Chem in Mystic (12 adults) (June 9); met with the Microbial Predators working group (7 adults) (June 15); gave a talk titled "CAES: Then and Now" on two days for the Arts and Ideas Festival Tour (30 adults per tour) (June 16 and 23); organized and co-presented Statemandated diversity training for staff, with DEBRA FREUND (94 adults) (June 16); and held a Q&A panel with graduate students in plant health (12 adults) (June 26).

VOSSBRINCK, CHARLES R.

- Began teaching a laboratory class in Introductory Biology at Gateway Community College in New Haven (November 1).

WANG, YI

- Attended the 2022 ASA, CSSA, SSSA International Annual Meeting in Baltimore, MD during Nov 6-9th 2023, and gave a poster presentation titled "Integrated Metabolomics for Disease Suppression Responses in Plants", Approximately 200 attendees were present.
- Attended the 2022 11th SNO Conference in Austin, TX during Nov 10-13th, 2023 and gave an oral presentation titled "Unique bio-assimilation of sulfur nanomaterials in plants for fungal disease suppression and crop yield augmentation". Approximately 30 attendees were present.
- Attended the American Chemical Society (ACS) Fall 2022 meeting in Chicago, IL during August 21 - 25, 2022. Yi Wang gave an oral presentation for ACS's Division of Agrochemicals entitled "Nanoscale Sulfur Uniquely Suppresses Fungal Disease and Increases Biomass and Yield of Crop Plants". The estimated Session Attendance was 40.

WARD, JEFFREY S.

- participated in a Connecticut Forest and Park Association (CFPA) Governance Committee meeting (August 9); met with Regional Water Authority employees Casey Cordes and Joshua Tracy in North Madison to discuss forest stand high-grading and rehabilitation (August 23); met with Jeremy Clark (CT DEEP Forestry) in Sharon, CT, to discuss management strategies for forests with high defoliation induced mortality (August 24); spoke on "Slash walls and oak regeneration" at the Southern New England Oak Resiliency: Lessons Learned, Looking Forward" Zoom workshop (16 attendees) (August 25); interviewed by Victoria Hellwig (Forest Ecosystem Monitoring Cooperative) about forest health and recreation (August 31).
- participated in a (FEMC) Forest Ecosystem Monitoring Cooperative State Coordinators virtual meeting (September 8); spoke on invasive species identification for the Friends of American Legion and Peoples State Forest in Barkhamsted (9 attendees) (September 10); attended virtual Updated Silvics of North America Project (USNAP) – Core Committee Meeting (September 13); participated in a meeting of Mountain Forest Trustees in Norfolk (September 17); was interviewed about impact of acorn crop failure on forest health by Robert Miller, Danbury News-Times (September 27); participated in a Connecticut Forest and Park Association (CFPA) Board of Directors meeting (September 28).
- participated in Forest Ecosystem Monitoring Cooperative (FEMC) Steering Committee Meeting (October 4); spoke on assessing post-defoliation tree health and management recommendations at "Oak defoliation wood tour" in Sharon (11 attendees) (October 9); participated in Forest Ecosystem Monitoring Cooperative (FEMC) State Coordinators virtual meeting (October 13); participated in a Connecticut Forest and Park Association Governance Committee meeting (October 17); interviewed by Willard Wood (Lakeville Journal) about the impact of spongy moth defoliation on tree health (October 20); spoke on "A short history of the Connecticut Forest" for the Orchard Valley Garden Club in Southington (33 attendees) (October 25).
- participated in a (FEMC) Forest Ecosystem Monitoring Coopera-tive State Coordinators virtual meeting (November 10); and participated in a Connecticut Forest and Park Association (CFPA) Board of Directors meeting (November 16).
- participated in a (FEMC) Forest Ecosystem Monitoring Cooperative State Coordinators meeting (December 8); participated in a Connecticut Forest and Park Association (CFPA) Governance Committee meeting (December 13)
- spoke on "A Short History of the Connecticut Forest" for the Wallingford Garden Club in Southington (37 attendees) (January 10); participated in a Forest Ecosystem Monitoring Cooperative (FEMC) State Coordinators meeting (January 12); attended the Connecticut Tree Protective Association (CTPA) annual meeting in Plantsville (January 19); participated in a Connecticut Forest and Park Association (CFPA) Board of Directors meeting (January 25).
- presented an invited seminar "Forests and Carbon Management" at the Pennsylvania Bureau of Forestry Winter Management Conference in State College, PA (300 attendees) (February 1); participated in a meeting of the Great Mountain Forest Trustees in Norfolk (February 5); participated in a Forest Ecosystem Monitoring Cooperative Joint

Committee meeting (February 7); participated in a Forest Ecosystem Monitoring Cooperative State Coordinators virtual meeting (February 9); participated in a Connecticut Forest and Park Association Governance Committee meeting (February 9); participated in a Connecticut Forest Practices Advisory Board meeting in Middlefield (February 27).

- participated in an Updated Silvics of North America Project convening conference call (March 1); participated in an Updated Silvics of North America Project, Invasives Core Committee meeting (March 3); spoke on "Slash Walls and Beyond" at the 26th Forest Health Monitoring Workshop in New Haven (68 attendees) (March 7); was awarded the New England Society of American Foresters David M. Smith Silviculture award in Nashua, NH (March 15); spoke on “Slash Walls to Reduce Browse Damage in Southern New England” at the New England Society of American Foresters' annual meeting in Nashua, NH (37 attendees) (March 15); spoke on “A Short History of the Connecticut Forest” at the Old Lyme Land Trust annual meeting (48 attendees) (March 19); participated in a Connecticut Forest and Park Association (CFPA) Board of Directors meeting (March 22); along with MR. JOSEPH P. BARSKY, met with Joe Welsh, Jon Zeiner, and Robert Turnbull (Aquarion Water Company) in Goshen to discuss alternative forest management practices (March 27).
- as appointed to the Connecticut Forest Practices Advisory Board by Governor Ned Lamont (April 4); met with Will Hochholzer and Nate Piche (DEEP Forestry) at Cockaponset State Forest to discuss forest regeneration practices (April 18); participated in a Forest Ecosystem Monitoring Cooperative (FEMC) Steering Committee Meeting (April 19); organized, hosted, and spoke at the FEMC’s Connecticut State Partnership organizing meeting (12 attendees) (April 21); spoke of forest management and succession at Master Woodland Manager Forest Ecology field workshop in North Madison (10 attendees) (April 22); spoke on “Gardening with Deer” for the Long Hill Garden Club in Trumbull (41 attendees) (April 24).
- 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 (18 attendees) (May 6); visited to with Scott Morehead and Eric Dunnack (NRCS CT) in Putnam to advise on slash wall expectations (May 10); participated in a (FEMC) Forest Ecosystem Monitoring Cooperative State Coordinators virtual meeting (May 11); was interviewed about impact of garlic mustard on forest health by Robert Miller, Danbury News-Times (May 30).
- participated in a meeting of the Great Mountain Forest Trustees in Norfolk (June 3); spoke on "Forest Carbon and Multi-Use Forest Management" at a Great Mountain Forest lecture in Norfolk (27 attendees) (June 3); led a Spanish language nature walk for Torrington Middle School English as a Second Language (ESL) students (37 students, 3 teachers) (June 13); participated in a Connecticut Forest and Park Association Governance Committee meeting (June 15); was named as a Fellow of the Society of American Foresters (June 16); spoke on "A Short History of the Connecticut Forest" for the Stonington Land Trust (24 attendees) (June 20); spoke on assessing post-defoliation tree health and management recommendations at "Oak Defoliation Wood Tour" in Sharon (19 attendees) (June 22); interviewed about forest management by Brigitte Ruthman of the Waterbury Republican (June 22); participated in a meeting of the Connecticut Forest Practices Advisory Board (June 28); along with Elisabeth Ward, Ph.D. spoke

on efficacy and construction on a field tour of slash walls in Seymour and North Madison for Don Donnelly (NJ NRCS State Forester), four of his staff, and Eric Dunnack and Todd Bobowick (CT NRCS Foresters) (7 attendees) (June 29).

WHITE, JASON C.

- along with DR. SARA NASON participated in the monthly call of the PFAS Testing Laboratory working group (July 1, 13); along with DR. WADE ELMER participated in a monthly conference call with collaborators at the University of Massachusetts Amherst to discuss progress on a USDA nanosulfur grant (July 1); hosted the quarterly CAES Safety Committee meeting (July 1); participated remotely in the PhD Dissertation defense of Jesus Cantu of the University of Texas El Paso (July 5); participated in a Zoom meeting with Christin Arnini, the Mentor Coordinator and Director for Scientific Review Committee of the New Haven Science Fair (July 5); along with DR. SARA NASON and DR. NUBIA ZUVERZA-MENA participated in Zoom call with collaborators at Yale University and the University of Minnesota to discuss progress on a joint NIEHS grant (July 6); along with DR. CHRISTIAN DIMKPA and DR. NUBIA ZUVERZA-MENA met with Felipe Franco de Oliveira and Vanessa Takeshita, who are both PhD students from University of São Paulo and are staying at CAES for nine months (July 6); participated in the weekly all-hands Zoom call for the NSF Center for Sustainable Nanotechnology (July 6, 13, 20, 27); hosted a Zoom call with collaborators at the University of Massachusetts to discuss a USDA report on toxic metals resulting from a workshop we hosted (July 6); participated in the monthly CSN Faculty meeting (July 7); met with Rania Eltanbouly of Alexandria University in Egypt to discuss future collaborative work (July 8); hosted a Zoom call with staff at Lucent BioSciences Inc. to discuss collaboration research on nano-enabled agriculture (July 9); participated in the monthly FDA LFFM Human and Animal Food Program Zoom call (July 11); hosted the monthly Zoom call for the CSN Nanochemistry-Plant working group (July 12); along with DR. SHITAL VAIDYA, DR. CHRISTIAN DIMKPA and DR. WADE ELMER hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA research project (July 12); hosted Professors from the University of Massachusetts and Haryana Agricultural University in India, and gave a tour of CAES facilities and programs (July 13); participated in a CSN Faculty Strategic Planning Zoom meeting (July 14); participated in the monthly CSN Plant-biosurfaces Zoom call (July 15, 29); hosted a Zoom call with Professor Laura Harrington of Cornell University to discuss CDC Center of Excellence funding (July 18); participated in the CSN External Advisory Board meeting (July 18); participated in the bi-monthly Experiment Station Associates Zoom meeting and gave a CAES Director's report (July 20); participated in the monthly Farmland Preservation Advisory Board meeting (July 21); hosted a Zoom call with Eric Ostivich of the University of Wisconsin Milwaukee to discuss his PhD research (July 22); participated in a Northeastern Regional Association of State Agricultural Experiment Station Directors (NERA) Multistate Activities Committee (July 27); participated in an Organizing Committee meeting for the upcoming annual FDA LFFM meeting (July 27); hosted the monthly CAES J-visa awardee meeting (July 28); participated remotely in the PhD Dissertation defense of Yuqing Ye of the University of Texas El Paso

(July 28); participated remotely in the PhD Dissertation defense of Xiaoxiao Yao of the University of Minnesota (July 28); and participated remotely in the PhD Dissertation defense of Carolina Valdes Bracamontes of the University of Texas El Paso (July 29).

- participated in a NSF Center for Sustainable Nanotechnology (CSN) Zoom call on research ethics (August 1); participated in a monthly Zoom call of the Northeast Waste Management Officials' Association (NEWMOA) focused on PFAS (August 4); held a Zoom call with Prof. Jorge Gardea-Torresdey of the University of Texas to discuss collaborative research (August 4); participated in a Teams call with Mike Farrow of the US FDA to discuss the FDA LFFM program (August 5); along with **DR. SARA THOMAS** participated in the monthly call of the PFAS Testing Laboratory working group (August 5); participated in the biweekly CSN Plant Biosurfaces call (August 5); met with Mr. Felipe Franco de Oliveira and Ms. Vanessa Takeshita of the University of Sao Pãolo who are visiting CAES for a year as part of their PhD research programs (August 8); participated in the monthly FDA LFFM Human and Animal Food Program Zoom call (August 8); participated remotely in the Research Proposal Exam of Mr. Connor Protter of the University of Wisconsin (Dr. White is on his PhD committee) (August 8); participated in a Zoom call with collaborators from Johns Hopkins University and Auburn University to discuss collaborative research (August 9); gave a remote presentation titled "Nanotechnology-enabled Agriculture: A Path to Global Food Security?" at the 2022 Global Summit: Nanotechnology for a Healthier and Sustainable Future, University of Waterloo, Ontario, Canada (August 10); participated in the Spotted Lanternfly Strategic Planning Working Group Kick-Off call (August 11); participated in the monthly CSN Faculty meeting (August 11); hosted a Zoom call with Ms. Tanushree Parsai of the Indian Institute of Technology to discuss her Fulbright Scholarship application (August 12); met with **DR. CHRISTIAN DIMKPA**, **DR. NUBIA ZUVERZA-MENA**, and **DR. TRUNG BUI** to discuss PFAS-related research (August 12); participated in a Zoom call with collaborators at the University of Delaware and the Institute of Science and Technology for Ceramics in Italy to discuss a collaborative research proposal (August 15); along with **MS. VICKIE BOMBA-LEWANDOSKI** and **MR. MICHAEL LAST** participated in a Teams call with the BITS Business Lead for Natural and Physical Resources to discuss IT programs (August 16); along with **DR. SHITAL VAIDYA, DR. CHRISTIAN DIMKPA** and **DR. WADE ELMER** hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA research project (August 16); hosted the monthly Zoom CSN Nanochemistry-Plant call (August 16); along with **MR. GREGORY BUGBEE** met with Mr. Mark Heilman of SePRO and Ms. Margot Burns of RiverCOG to discuss issues related to invasive aquatic plant species (August 16); participated in a Zoom call with collaborators at Auburn University, Louisiana State University and the University of Georgia to discuss a collaborative USDA grant proposal (August 17); participated in the weekly CSN all hands call (August 17); participated in the monthly Farmland Preservation Advisory Board meeting (August 18); participated in the Dissertation Proposal Defense of Eric Ostovich; a PhD student at the University of Wisconsin; Dr. White is on his committee (August 18); along with **DR. CHRISTIAN DIMKPA** and **DR. NUBIA ZUVERZA-MENA** met with Dr. Ileana Vera Reyes to discuss her research to be conducted at CAES; Ileana is a Fulbright Scholar from Mexico (August 19); attended the weekly CSN Plant-

Biosurfaces Zoom call (August 19); participated in a workshop at McGill University (Montreal Canada) titled "Assessing the Environmental Footprint of Plastics in Agriculture" (August 22-23); attended the 15th International Conference on the Environmental Effects of Nanoparticles and Nanomaterials at the University of Montreal (Canada) and gave a platform presentation titled "Tuning agrochemical chemistry at the nanoscale to enhance stress tolerance, crop nutrition, and yield" (August 24-26); attended the PhD Dissertation defense of Mr. Ahmed Ali at the Stockbridge School of Agriculture at the University of Massachusetts Amherst; Dr. White is a committee member (August 30); hosted the monthly CAES J-visa recipient meeting (August 31); met by Zoom with colleagues at Johns Hopkins University to discuss collaborative research (August 31); and gave a presentation titled "Center for Sustainable Nanotechnology research at CAES" to the weekly CSN Zoom call (August 31).

- along with DR. NUBIA ZUVERZA-MENA and DR. SARA THOMAS participated in a Zoom call with Trajan Scientific and Medical to discuss possible collaborative research (September 1); participated by Teams in the Climate Smart Agriculture and Forestry Working Group Meeting (September 1, 29); chaired the quarterly CAES Safety Committee meeting (September 2); participated in the monthly Center for Sustainable Nano-technology (CSN) Plant-Biosurfaces meeting (September 2, 16); along with DR. YI WANG and DR. WADE ELMER hosted a Zoom call with collaborators at the University of Massachu-setts to discuss progress on a USDA nanosulfur grant (September 2); held a Zoom call with Mr. Brian Scott Smith to discuss a podcast on PFAS research at CAES (September 2); hosted a Zoom call with Qiqing Chen of McGill University to discuss collaborative research on nano-plastics (September 5); along with DR. JOSEPH PIGNATELLO met with Mr. Christopher Conners of the University of Connecticut Technology Commercialization Services to discuss a patent and licensing issue (September 6); along with DR. SARA NASON, DR. NUBIA ZUVERZA-MENA and DR. SARA THOMAS participated in a Zoom call with collaborators at Yale University and the University of Minnesota to discuss progress on a joint NIEHS grant (September 7); participated in the 2022 Plant Science Day committee meeting (September 8); hosted Amanda Irwin of Eastern Connecticut State University to discuss their upcoming Canna-bis conference (September 8); participated in the NIEHS PFAS Analytical Networking Group call (September 8); attended the CSN All Hands Meeting in Atlanta Georgia (September 13-15); participated in the Northeastern Regional Association of State Agricultural Experiment Station Directors (NERA) Multistate Activities Committee call (September 16); attended a NSF-USDA funded workshop titled "Workshop to Identify Convergent Nanotechnology Approaches for Precision Delivery of Active Agents in Plants" at Carnegie Mellon University (September 18-20); participated in the weekly CSN All Hands Zoom call (September 21, 28); participated in the NIEHS RO1 Fall call (September 21); along with DR. SHITAL VAIDYA, DR. CHRISTIAN DIMKPA and DR. WADE ELMER hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA research project (September 21); along with DR. YI WANG hosted a Zoom with Prof. Korin Wheeler of Santa Clara University to discuss collaborative research (September 21); participated in a Zoom call with USDA NIFA staff to discuss the final report of a USDA Toxic Metals in Food workshop that I and Prof. Om Parkash Dhankher of the University of Massachusetts conducted (September 23); gave a presen-tation on Zoom titled "Nanotechnology-enabled

agriculture: A path to global food security" for the Eco-Environment and Health Talk@EEH Webinar series (September 26); hosted Caroline Anastasia of Johns Hopkins University for a CSN Lab Exchange (September 27); along with several other CAES staff participated in a Zoom call to discuss Spotted Lanternfly regulations (September 29); participated in the monthly CSN Faculty meeting (September 29); along with DR. CHAOYI DENG participated in a Zoom call with Beza Tuga of the University of Massachusetts to discuss collaborative research (September 29); hosted the monthly CAES J-visa recipient meeting (September 30); along with MR. MICHAEL LAST and DR. LINDSAY TRIPLETT hosted CT DAS staff to discuss the greenhouse renovation project (September 30); along with DR. CHRISTIAN DIMKPA and DR. NUBIA ZUVERZA-MENA met with Fulbright Scholar Dr. Ileana Vera Reyes to discuss her project (September 30); met by Zoom with collaborators at the University of Maryland Baltimore County and the Uni-versity of Wisconsin to discuss a collaborative project on MXenes (September 30); and met by Zoom with collaborators at the Auburn University and Johns Hopkins University to discuss a joint manuscript (September 30)

- participated in a Zoom call with Dr. Denise Mitrano of ETH Zurich to discuss plastics use in agriculture (October 4); along with DR. NUBIA ZUVERZA-MENA and DR. TRUNG BUI participated in a Zoom call with officials of CT DEEP and the town of Canton to discuss a PFAS-contaminated site (October 4); met by Zoom with Crop Life America to discuss mutual interests (October 4); along with DR. YI WANG met by Zoom with Prof. Korin Wheeler of Santa Clara University to discuss collaborative research (October 4, 20); along with DR. SARA NASON, DR. NUBIA ZUVERZA-MENA and DR. SARA THOMAS participated in a Zoom call with collaborators at Yale University and the University of Minnesota to discuss progress on a joint NIEHS grant (October 5); participated in the weekly Center for Sustainable Nanotechnology (CSN) All Hands Zoom call (October 5, 19, 26); participated in a Zoom call with collaborators at the University of California San Diego, University of California Riverside, and Carnegie Mellon University to discuss a joint manuscript (October 6, 13); participated in a Zoom meeting with DAS Construction Services to discuss the CAES Greenhouse project (October 7); along with DR. SHITAL VAIDYA, DR. CHRISTIAN DIMKPA and DR. WADE ELMER hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA research project (October 11, 18); hosted the monthly CSN Nanochem-Plant call on Zoom (October 11); along with MR. MICHAEL LAST and DR. LINDSAY TRIPLETT hosted the CAES quarterly Board of Control meeting (October 12); along with DR. YI WANG and DR. WADE ELMER hosted a Zoom call with collaborators at the University of Massachusetts to discuss progress on a USDA nanosulfur grant (October 14); participated in the CSN Plant-Biosurfaces monthly call (October 17); hosted Dr. Sofie Thijs of Hasselt University in Belgium and discussed collaborative research on PFAS remediation (October 17-18); was interviewed by Mr. Brian Scott-Smith of WSHU regarding the first New England Cannabis Research and Education Conference, Eastern Connecticut State University, October 21-22 (October 18); participated in an Organizing Committee Zoom call for the 2023 International Phytotechnologies Conference (October 20); participated in a Zoom meeting with collaborators from Ca' Foscari University of Venice, Italy to discuss a joint research program (October 21); along with DR. CHRISTIAN DIMKPA, met by Zoom with colleagues in

Mauritania to discuss collaborative research (October 21); attended the first New England Cannabis Research and Education Conference, Eastern Connecticut State University, October 21-22 and gave a presentation titled "The Connecticut Agricultural Experiment Station: 147 Years of Consumer Product Safety Testing Applied to Hemp and Adult Use Cannabis" (October 22); attended the Materials Innovation for Sustainable Agriculture (MISA) conference at the University of Central Florida and gave a presentation titled "Nanotechnology-enabled agriculture: A path to global food security?" (October 23-25); gave two lectures by Zoom to a graduate class at the University of Massachusetts Amherst titled Nanotechnology-enabled agriculture: A path to global food security?" and "PFAS remediation in contaminated soils" (October 27); attended the Regional Symposium on Climate Change, Planetary, and Human Health: Challenges and Opportunities and gave a presentation titled "Nanotechnology and climate smart agriculture: A path to global food security?" (October 28); and attended the 21st World Congress of Food, Science and Technology; Future of Food: Innovation, Sustainability and Health in Singapore and gave a presentation titled Nanotechnology-enabled agriculture: A path to global food security? (October 31-November 3).

- along with DR. SARA NASON, DR. NUBIA ZUVERZA-MENA AND DR. SARA THOMAS participated in a Zoom call with collaborators at Yale University and the University of Minnesota to discuss progress on a joint NIEHS grant (November 2), attended the monthly Laboratory Preparedness meeting at the CT De-partment of Public Health (November 7), met by Zoom with collaborators at Purdue Uni-versity to discuss a collaborative grant submission (November 7), hosted the monthly Cen-ter for Sustainable Nanotechnology (CSN) Nanochemistry-Plant Working Group Zoom call (November 8), hosted the monthly CAES J-Visa recipient meeting (November 8, 22), along with DR. SHITAL VAIDYA, DR. CHRISTIAN DIMKPA and DR. WADE ELMER hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA research project (November 8), spoke by phone with Prof. Lee Newman of SUNY ESF to discuss a phytoremediation grant proposal (November 9), par-ticipated in the weekly CSN All Hands Zoom call (November 9, 23, 30), held a Zoom call with collaborators at the University of Minnesota to discuss a joint manuscript preparation for Trends in Chemistry (November 10, 22), participated in the CT DEEP EEJ & Climate Smart Agriculture & Forestry Zoom call (November 10), along with DR. YI WANG met by Zoom with Prof. Korin Wheeler of Santa Clara University to discuss collaborative re-search (November 11), participated in the CSN Plant-Biosurfaces monthly call (November 14), met with CAES Research Affiliate Dr. Rania Eltanbouly to discuss her research pro-ject (November 14), attended the SETAC for North America 43rd Annual Meeting, Pitts-burgh PA, and gave a presentation titled "Nanoscale sulfur uniquely suppresses fungal dis-ease and increases biomass and yield of crop plants" (November 13-17), participated on the monthly CSN Faculty Call (November 17), along with DR. YI WANG and DR. WADE ELMER hosted a Zoom call with collaborators at the University of Massachusetts to dis-cuss progress on a USDA nanosulfur grant (November 18), along with Department of Ana-lytical Chemistry staff held a Teams call with Department of Consumer Protection Divi-sion of Drug Control staff to discuss Adult Use Cannabis Program sample analysis (November 22), held a Zoom call with Dr. Samuel Chigome of the Botswana Institute of Technology Research and Innovation (BITRI) to discuss his visit to CAES early next year (November 23), along with DR. CHRISTIAN

DIMKPA hosted a Zoom call with two stu-dents from SKUAST-Kashmir, India for intern positions funded by OCP (November 28, 30), visited Johns Hopkins University in Baltimore Maryland and gave a presentation for the Wolman Seminar Series titled “Nanotechnology-enabled agriculture: A path to global food security?” (November 30).

- visited the University of Texas El Paso and gave a presentation for the Department of Chemistry and Biochemistry Seminar Series titled “Nanotechnologyenabled agriculture: A path to global food security?” (December 2-4); met with Professor John Fortner of Yale University School of Engineering and Applied Science to discuss collaborative research (December 5); attended the monthly Laboratory Preparedness meeting at the CT Department of Public Health (December 5); met by Zoom with FDA communications staff to record a testimonial for the LFFM program that funds state laboratories for food safety and defense (December 6); participated in the weekly Center for Sustainable Nanotechnology (CSN) all hands Zoom call (December 7); along with DRS. SARA NASON, NUBIA ZUVERZA-MENA and SARA THOMAS participated in a Zoom call with collaborators at Yale University and the University of Minnesota to discuss progress on a joint NIEHS grant (December 7); attended the PFAS Task Force Action Plan Meeting at the Legislative Office Building in Hartford and gave an update on CAES projects (December 8); participated in the monthly CSN Faculty meeting (December 8); spoke by Teams with DCP Drug Control Staff concerning sample collection and analysis as part of the CT Adult Use Cannabis program (December 8); attended the Atlantic Basin Conference on Chemistry (ABCChem) in Marrakech, Morocco, and gave a presentation titled “Nanoscale sulfur uniquely suppresses fungal disease and increases biomass and yield of crop plants” (December 13-16); along with MR. MICHAEL LAST participated in a Zoom call with Albertus Magnus College administration to discuss potential use of the off campus housing for CAES visitors (December 19); participated in a Zoom call with collaborators at Purdue University, the University of Central Florida and the University of Florida to discuss a joint USDA proposal (December 19); hosted the quarterly CAES Safety Committee meeting (December 20); along with DR. CHAOYI DENG participated in a Zoom call with collaborators at the University of Minnesota to discuss a collaborative paper (December 21); along with DRS. SHITAL VAIDYA, CHRISTIAN DIMKPA and WADE ELMER hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA research project (December 21); participated in a Zoom call with collaborators at Auburn University and Johns Hopkins University to discuss a joint research proposal (December 23); along with DR. CHRISTIAN DIMKPA spoke with Dr. Minha Naseer about a new post-doctoral opportunity at CAES through the CSN (December 23); and hosted the monthly CAES J-Visa recipient meeting (December 28).
- participated in a Zoom call with collaborators at the University of Wisconsin, Johns Hopkins University, the University of Pittsburgh, and University of Minnesota to discuss a joint NSF grant application (January 2, 24, 30, and 31); along with DR. SHITAL VAIDYA, DR. CHRISTIAN DIMKPA and DR. WADE ELMER hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA research project (January 3 and 30); attended the International Conference on Food and Nutritional Security in Mohali India, and gave a presentation titled “Nanotechnology and agriculture: Balancing applications and implications for global food

security" (January 4-9); gave a presentation titled "Nanotechnology and Agriculture: Balancing applications and implications for global food security" at the National Institute of Food Technology Entrepreneurship and Management (NIFTEM) in Sonepat India (January 9); participated in the weekly Center for Sustainable Nanotechnology (CSN) all hands Zoom call (January 11); participated in a meeting with colleagues at the University of Minnesota to discuss a collaborative manuscript (January 12); participated in the bi-weekly CSN Faculty meeting (January 12 and 26); along with MR. GREGORY BUGBEE participated in the bimonthly Aquatic Invasive Species (AIS) Workgroup meeting (January 13); participated in a Zoom meeting with a colleague from Princeton University to discuss an upcoming joint CSN presentation (January 13); along with DR. SHITAL VAIDYA hosted a Zoom meeting with a potential visiting graduate student from Pakistan (January 16); participated in a Zoom call with colleagues from Finland, Brazil, Spain, and Australia about a joint grant application to an European Union call for proposals (January 16); participated as a committee member in a Master's Thesis defense of a graduate student at the University of Massachusetts and met with a visiting PhD student from China that DR. JASON WHITE is coadvising (January 17); along with MR. MICHAEL LAST and DR. LINDSAY TRIPLETT, hosted the quarterly CAES Board of Control meeting (January 18); gave an update on CAES activities at the annual meeting of the Connecticut Tree Protective Association (CTPA) (January 19); participated in the monthly Farmland Preservation Advisory Board meeting (January 19); along with DR. SARA THOMAS participated in Zoom call with a collaborator Merrimack College to discuss collaborative research on PFAS (January 19); attended a one day strategic planning meeting of the CSN in Minneapolis to prepare for the upcoming annual site visit from NSF (January 20); along with DR. CHRISTIAN DIMKPA participated in a Zoom call with a PhD student from Zhejiang University about a China Scholarship Council fellowship to spend time at The CAES (January 23); participated in a Zoom call with colleagues from Ca' Foscari University of Venice to discuss collaborative experiments as part of the INFRAMES program (January 23); along with DR. CHRISTIAN DIMKPA participated in a Zoom call with colleagues in the Yale School of Medicine and the CT Department of Public Health to discuss analysis of heavy metals in nutritional supplements (January 23); participated in a Zoom call with a colleague at Santa Clara University to discuss collaborative research (January 24); visited Rutgers, The State University of New Jersey, and gave a seminar titled "Nanotechnology-enabled Agriculture: A path to global food security?" to the Division of Environmental & Population Health Biosciences; and met with colleagues to discuss collaborative research and grant proposals (January 26); gave a presentation titled "Communicating Your Science to Non-scientists: Lessons learned over 25 years" at the CAES Postdoctoral Association Scientific Writing and Communicating Workshop (January 27); and hosted the monthly CAES J-Visa recipient meeting (January 31).

- participated in the weekly Center for Sustainable Nanotechnology (CSN) all hands Zoom call (February 1, 8, 15, and 22); along with DR. YI WANG participated in a Zoom call with collaborators at the University of Auckland to discuss a visit from their PhD student to The CAES to conduct joint experiments on the use of nanoscale sulfur and copper sulfide to manage grape pathogens (February 1); spoke by Microsoft Teams with the University of Connecticut Technology Commercialization Services about potential intellectual property of The CAES's work on

two projects (February 2); along with DR. CHRISTIAN DIMKPA spoke by Zoom with staff of the American National Standards Institute concerning participation in a potential work group and project on nanomaterials and fertilizers (February 3); participated by Zoom as a Committee Member in the Dissertation Defense of a PhD student at Johns Hopkins University (February 3); participated in a Zoom call with collaborators at the University of Wisconsin concerning a joint manuscript (February 4); attended the monthly Laboratory Preparedness Meeting at the CT Department of Public Health (February 6); along with DR. SARA THOMAS, DR. SARA NASON, and DR. NUBIA ZUVERZA-MENA participated in a Microsoft Teams call with NIEHS staff regarding participation of DR. SARA THOMAS in the KC Donnelly Externship Program (February 6); participated by Zoom in the NERA Multistate Activities Committee Meeting (February 7); along with DR. SARA NASON and DR. PEIYING WANG participated in a Zoom call with collaborators at Johns Hopkins University to discuss collaborative research (February 7); along with DR. SARA THOMAS, DR. SARA NASON, and DR. NUBIA ZUVERZA-MENA participated in a Zoom meeting with collaborators on a phytoremediation project at a PFAS contaminated site in Maine (February 8); participated in the bi-weekly CSN Faculty meeting (February 9 and 23); participated in a Zoom meeting with colleagues at the University of Minnesota, Johns Hopkins University, and University of Wisconsin to discuss a collaborative NSF grant (February 10 and 13); along with DR. YI WANG hosted a Zoom call with collaborators at the University of Massachusetts Amherst to discuss progress on a joint USDA nanoscale sulfur project (February 10); participated in a CSN Zoom call to begin preparations for an NSF Site Visit (February 10); hosted the monthly CSN Nanochemistry-Plant working group Zoom call (February 14); participated in the Farmland Preservation Advisory Board Zoom meeting (February 15); participated in the bi-weekly organizational meeting for the 2023 International Phytotechnologies Conference (February 17); participated by Zoom as the external examiner in the PhD Dissertation Defense of a graduate student at Colegio de Postgraduados in Montecillo, Mexico (February 17); travelled to Auburn University and Tuskegee University to meet with collaborators and give a seminar titled “Nanotechnology-enabled agriculture: A path to global food security?” (February 20-21); along with DR. CHRISTIAN DIMKPA, DR. WADE ELMER, and DR. SHITAL VAIDYA hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA nanoscale phosphorus project (February 23); hosted the monthly CAES J-Visa recipient meeting (February 24); along with State Entomologist DR. VICTORIA SMITH participated in a USDA call to discuss funding for spotted lanternfly control (February 24); testified in front of the Appropriations Committee at the State Legislature regarding The CAES’s budget (February 27); met with collaborators in Duke University’s sponsored INFRAMES program to plan for an upcoming meeting in Venice, Italy (February 27); along with DR. NUBIA ZUVERZA-MENA met by Zoom with collaborators at the University of California Irvine and Houston Christian University to discuss a collaborative grant proposal (February 28).

- visited North Carolina State University and presented a seminar titled “Nanotechnology-enabled agriculture: A path to global food security?” to the NSF Center for Science and Technologies for Phosphorus Sustainability (STEPS) (March 1-3); along with DR. CHRISTIAN DIMKPA met with a Ph.D. student in the Materials, Energy, and

Nanoengineering (MSN) Department at the Mohammed VI Polytechnic University (UM6P) in Morocco to discuss a possible research visit to The CAES (March 6); gave an interview by Zoom to a reporter doing a story on toxic metals in food for Undark magazine (March 6); participated in the monthly Center for Sustainable Nanotechnology (CSN) Plant -Biosurfaces Zoom call (March 6); along with DR. SARA THOMAS, DR. SARA NASON, and DR. NUBIA ZUVERZA-MENA participated in a Zoom meeting with collaborators at Yale University and the University of Minnesota to discuss our joint NIEHS grant on PFAS phytoremediation (March 7); along DR. YI WANG and DR. WASHINGTON DA SILVA met by Zoom with colleagues at the University of Auckland in New Zealand to discuss collaborative research focused on nanoscale management options for grape pathogens (March 7 and 29); along with DR. QUAN ZENG met with colleagues in Italy to discuss collaborative research focused on nanoscale management of fire blight (March 8); participated in the weekly CSN all hands Zoom call (March 8, 22, and 29); spoke by Zoom with Ed Weinberg, P.E. of ESSRE Consulting to discuss research on nutrient recovery from water and agricultural run-off (March 9); participated in a Zoom meeting with USDA officials to trouble shoot website reporting issues (March 9); participated in the bi-weekly CSN Faculty meeting (March 9 and 23); participated in a Zoom call with collaborators at Rutgers University to discuss a new project on micro-nanoplastics (March 10); along with DR. CHAOYI DENG met by Zoom with collaborators at the University of Minnesota to discuss a joint publication in Trends in Chemistry (March 10); along with DR. CHRISTIAN DIMKPA and DR. NASSIFATOU TITTIKPINA met by Zoom with collaborators at Rutgers University to discuss a joint research on nanoparticles related to wildfires (March 10); spoke with a representative of Nutrien regarding nanoscale fertilizers (March 13); along with DR. CHRISTIAN DIMKPA, and DR. SHITAL VAIDYA hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA nanoscale phosphorus project (March 14); hosted the monthly CSN Nanochem-Plant working group call (March 14); attended the Northeastern Regional Association of State Agricultural Experiment Station Directors (NERA) Spring meeting in Washington DC (March 15-16); participated in the biweekly Teams call for the organizing committee of the 2023 International Phytotechnologies Conference (March 17); along with DR. YI WANG hosted a Zoom call with collaborators at the University of Massachusetts Amherst to discuss progress on a joint USDA nanoscale sulfur project (March 17); participated in a Zoom call with collaborators at Auburn University and Johns Hopkins University to discuss preparation of a joint publication (March 17); participated in a Zoom call with collaborators at Rutgers University to discuss an application to the USDA SAS program (March 20); along with DR. CHAOYI DENG, DR. CHRISTIAN DIMKPA and DR. NEIL SCHULTES participated in a Zoom call with colleagues at the University of Central Florida to discuss experiments to measure leaf surface pH (March 20); along with DR. YI WANG spoke with representatives from Stanses LLC about their nanoscale sulfur product (March 21); participated in a webinar titled “PFAS: Breaking down the future of forever chemicals in ater” (March 21); visited Princeton University and gave a lecture titled “NanotechnologyEnabled Agriculture: A path to global food security?” (March 23); hosted the quarterly CAES Safety Committee meeting (March 24); participated in a Zoom call as part of The International Network For Researching, Advancing, and Assessing Materials for Environmental Sustainability (INFRAMES)

(March 24); along with DR. NUBIA ZUVERZAMENA participated in a Zoom call with collaborators from Texas A & M University, the University of Arkansas, the University of California Irvine, and Houston Christian University to discuss a join grant proposal (March 24); attended the American Chemical Society Spring 2023 Conference in Indianapolis IN and gave a presentation titled "Nanobiotechnology-based Strategies for Enhanced Crop Resilience" (March 26-28); along with DR. SARA NASON, DR. NUBIA ZUVERZA-MENA and DR. SARA THOMAS met by Zoom with a Yale Conservation Scholar that will be working at The CAES this summer (March 31); met by Zoom with a reporter to discuss toxic metal contamination of food (March 31); and met by Zoom with the CSN to prepare for an upcoming NSF site visit (March 31).

- participated in a Zoom call as part of The International Network For Researching, Advancing, and Assessing Materials for Environmental Sustainability (INFRAMES) (April 3) to discuss planning for an upcoming conference in Venice Italy (April 1); participated in the bi-weekly Center for Sustainable Nanotechnology (CSN) Plant Biosurfaces working group call (April 1 and 17); along with DR. SARA THOMAS, DR. SARA NASON, and DR. NUBIA ZUVERZA-MENA participated in a Zoom meeting with collaborators at Yale University and the University of Minnesota to discuss our joint NIEHS grant on PFAS phytoremediation (April 4); along with DR. CHRISTIAN DIMKPA and DR. SHITAL VAIDYA, hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA nanoscale phosphorus project (April 4); hosted the monthly CAES J-Visa recipient meeting (April 5); met by Teams with scientific staff of Nutrien to discuss nanofertilizers and gave a presentation titled "Nanoscale fertilizers: Can we really do so much with so little?" (April 5); participated in the weekly CSN all hands Zoom call (April 5 and 12); held a Zoom call with collaborators at Auckland University (New Zealand) and Louisiana State University to discuss a joint publication (April 5); along with DR. YI WANG and DR. NUBIA ZUVERZA-MENA visited Brookhaven National Laboratory in Upton, NY, and gave an invited presentation titled "Nanotechnology-enabled Agriculture: A path to global food security?" (April 6); participated in a biweekly Zoom call to discuss organization of the 2023 International Phytotechnologies Conference in Chicago at the end of May (April 7); had a Zoom call with Dr. Sanghamitra Majumdar of the US FDA (April 7); participated in a Zoom call for the CSN to prepare for an upcoming NSF Site Visit (April 7, 14, and 21); met by Teams with scientific staff of Mosaic to discuss nanofertilizers and gave a presentation titled "Nanoscale fertilizers: Can we really do so much with so little?" (April 10); along with DR. CHRISTIAN DIMKPA had a Zoom conversation with Dr. Ramesh Raliya to discuss collaborative research (April 12); participated in a Zoom call with collaborators at Carnegie Mellon University and the University of California Riverside to discuss a potential Center proposal (April 13); participated in a FDA Zoom presentation of FDA federal and state programs for California Lutheran University (April 14); along with DR. QUAN ZENG began hosting Dr. Andrea Brunelli of Ca' Foscari University of Venice, Italy to conduct research on nanoscale management options for fire blight of apple (April 17); along with MR. GREG BUGBEE, MS. SUMMER STEBBINS, and DR. JEREMIAH FOLEY participated in the quarterly call of the Aquatic Invasive Species work group (April 17); along with MR. MICHAEL LAST participated in a call with DAS Construction Services to discuss the Valley Laboratory project (April 18); along with MR. MICHAEL LAST

hosted the quarterly CAES Board of Control meeting (April 19); participated in the Farmland Preservation Advisory Board monthly meeting (April 20); gave introductory remarks at the NEVBD annual meeting at CAES (April 21); along with DR. YI WANG hosted a monthly meeting with University of Massachusetts colleagues on a USDA funded nanoscale sulfur project (April 21); attended the biannual NSF Site Visit of the CSN at the University of Wisconsin Madison and gave a presentation titled "Chemistry at Nanoparticle-Plant Interfaces" (April 23-25); and gave the Director's report at the Experiment Station Associates annual meeting (April 26).

- began hosting Professor Vinod Goyal of CCS Haryana Agricultural University who is visiting CAES for approximately three months (May 1); attended the Society for Environmental Toxicology and Chemistry (SETAC) Europe 33rd Annual Meeting in Dublin, Ireland, and gave a presentation titled "Nanobiotechnology-based Strategies for Enhanced Crop Resilience" (May 1-4); along with DR. SARA THOMAS, DR. SARA NASON, and DR. NUBIA ZUVERZA-MENA, participated in a Zoom meeting with collaborators at Yale University and the University of Minnesota to discuss our joint NIEHS grant on PFAS phytoremediation (May 2); along with DR. CHRISTIAN DIMKPA and DR. SHITAL VAIDYA, hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA nanoscale phosphorus project (May 2); participated in the NSF Center for Sustainable Nanotechnology (CSN) monthly faculty call (May 4); gave a Zoom presentation titled "Nanotechnology-enabled agriculture: A path to global food security?" to representatives from Land o Lakes and Vulpes Corporation (May 9); hosted the monthly CSN Nanochemistry-Plant working group call (May 9); gave a lecture titled "Nanotechnology-enabled agriculture: A path to global food security?" to the University of Massachusetts Amherst course STOCKSCH 650 Global Challenges in Agriculture and the Environment (May 9); along with DR. CHRISTIAN DIMKPA and DR. SHITAL VAIDYA, began hosting Naziya Nabi and Tanzeel Bashir of Sher -e-Kashmir University of Agricultural Sciences and Technology of Kashmir who will be at The CAES with industry funding from OCP Group (May 9); along with DR. SHITAL VAIDYA and CAES visitors Naziya Nabi, Tanzeel Bashir, and Dr. Vinod Goyal, visited the University of Massachusetts Stockbridge School of Agriculture to discuss collaborative work (May 10); participated in an annual CSN Faculty performance review (May 11); participated in a Zoom call with collaborators from the University of Minnesota to discuss PFAS experiments (May 11); participated in a Zoom call with colleagues at North Dakota State University and the University of California Santa Barbara to discuss a tribute session for Prof. Jorge Gardea-Torresdey at the upcoming Sustainable Nanotechnology Organization (SNO) in November (May 11); participated in a Zoom call with colleagues at Louisiana State University and the University of Auckland to discuss a collaborative manuscript (May 11); hosted a Zoom call with Luyao Qin of the Chinese Academy of Agricultural Sciences who will visit The CAES as a post-doctoral associate for three years (May 16); attended a meeting of the International Network For Researching, Advancing, and Assessing Materials for Environmental Sustainability (INFRAMES) in Venice, Italy (May 16-20); along with DR. NUBIA ZUVERZA-MENA, DR. SARA NASON, and DR. SARA THOMAS, met with collaborators at the University of Minnesota to discuss a joint experiment on plant uptake of PFAS (May 22 and 26); along with DR. NUBIA ZUVERZA-MENA, DR. CHRISTIAN DIMKPA, and DR. NASSIFATOU

TITTIKPINA, met by Zoom with collaborators at Rutgers University to discuss collaborative experiments on nanoparticles derived from wildfires (May 22); attended the 2023 International Phytotechnologies Conference at Argonne National Laboratory outside of Chicago and gave platform presentations titled “Nanoparticle-enhanced PFAS Phytoremediation” and “Nanobiotechnology-based strategies for creating climate resilient crops” and hosted an annual Editorial Board meeting of the International Journal of Phytoremediation and was elected to the IPS President’s Advisory Council (May 23-25); along with DR. CHRISTIAN DIMKPA and DR. SHITAL VAIDYA hosted a Zoom call to discuss progress on a nanoscale phosphorus grant with collaborators at Johns Hopkins University (May 30); along with DR. LEIGH WHITTINGHILL and DR. NUBIA ZUVERZA-MENA participated in a Zoom call with collaborators at the University of Arkansas, University of California Irvine, Texas A&M University and Houston Baptist University to discuss a joint grant proposal to USDA (May 30); hosted the monthly CAES J-Visa recipient meeting (May 31); participated in the Northeast Regional Association of State Agricultural Experiment Station Directors (NERA) Multistate Activities Committee meeting (May 31); and participated in a Zoom call with NERA staff and a Carnegie Mellon University graduate student to discuss collaborative research (May 31).

- met with two PhD students to discuss research on nano-enabled agriculture (June 1); along with DR. CHRISTIAN DIMKPA and DR. NUBIA ZUVERZA-MENA hosted Prof. Vinka Craver of the University of Rhode Island and Prof. Carlina Luisa Astudillo Castro of Pontificia Catholic University of Valparaiso to discuss potential collaborative research on nanotechnology and agriculture (June 2); participated in an NSF I -Corps interview with PhD students from Stonybrook University (June 2); along with DR. SARA THOMAS, DR. SARA NASON, and DR. NUBIA ZUVERZA-MENA participated in a Zoom meeting with collaborators at Yale University and the University of Minnesota to discuss our joint NIEHS grant on PFAS phytoremediation (June 6); along with DR. NUBIA ZUVERZA-MENA and DR. LEIGH WHITTINGHILL participated in a Zoom seminar with colleagues from the University of Arkansas, University of California Irvine, Texas A & M University, and Houston Christian University about a joint USDA grant proposal (June 6, 13, 20, and 27); along with DR. CHAOYI DENG participated in the weekly NSF Center for Sustainable Nanotechnology (NSF) weekly all-hands call (June 7, 14, 21, and 28); participated in a Zoom call with collaborators at the University of Delaware and the National Research Council of Italy to discuss a new USDA grant (June 9); along with DR. SARA THOMAS, DR. SARA NASON, and DR. NUBIA ZUVERZA-MENA participated in the monthly CT PFAS Laboratory Testing workgroup call (June 13); hosted the monthly NSF CSN Nanochem-Plant working group Zoom call (June 13); participated by Zoom in the Farmland Preservation Advisory Board meeting (June 15); hosted a tour for the New Haven International Festival of Arts and Ideas (June 16); participated in a Zoom call with staff from Taylor and Francis to discuss the International Journal of Phytoremediation where I am Managing Editor (June 20); along with DR. CHRISTIAN DIMKPA and DR. SHITAL VAIDYA, hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA nanoscale phosphorus project (June 20); along with DR. CHAOYI DENG participated in a Zoom call with members of the International Network For Researching, Advancing, and Assessing

Materials for Environmental Sustainability (INFRAMES) to discuss collaborative experiments (June 21); along with Michael Last participated in a Teams call with Construction Services to discuss the Valley Laboratory construction and renovation project (June 21); along with DR. SARA THOMAS, DR. SARA NASON, and DR. NUBIA ZUVERZA-MENA participated in a Zoom call with officials at the NIEHS to discuss our current research (June 22); participated in the monthly CSN Faculty call (June 22); traveled to the University of Minnesota to meet with Prof. Christy Haynes and representatives of a company interested in nano-enabled agriculture (June 23); along with DR. NUBIA ZUVERZA-MENA and DR. TRUNG BUI met with collaborators at Rutgers University and the New Jersey Institute of Technology to discuss a joint USDA project on micro-nanoplastics (June 26); along with DR. CHRISTIAN DIMKPA and MEGHAN CAHILL spoke by Zoom with officials from the FDA as part of their annual audit of the Department of Consumer Protection Foods Division and CAES CT Manufactured Foods Regulatory Program Standards (June 28); hosted the quarterly CAES Safety Committee meeting (June 30); and along with DR. WADE ELMER and DR. CHRISTIAN DIMKPA hosted Professor Swadesh Santra of the University of Central Florida to discuss collaborative research (June 30).

WHITTINGHILL, LEIGH

- met with Jacqueline Jamsheed of Elms College to discuss her work in the economics of urban agriculture at the municipal level and discuss potential future collaborations and network sharing (July 11).
- gave an invited lecture titled "Urban Agriculture for Food Security in Challenging Spaces" at Plant Science Day (100 attendees) (August 3); coauthored a research poster presentation titled "Comparison of Saffron (*Crocus sativus* L.) Phytochemical Contents form Different Growing Systems" at the American Society for Horticultural Science 2022 Annual Conference (August 3); presented a research lecture titled "Green roof technology in urban agriculture: Lessons learned in the last decade" at the Ecological Society of America annual conference in Montreal, Canada (50 attendees) (August 15).
- attended the Farmland Access and ownership for urban farmers listening tour organized by UConn extension and Keney Park Sustainability Project in the Hartford area (October 13); Attended the GC3 Climate Smart Agriculture and Forestry Working Group (October 28); Participated in a podcast interview for "Growing Greener," with Thomas Christopher and Felix Carroll, editor of “Cuttings” the newsletter of the Berkshire Botanical Garden (October 31).
- gave the lecture “Preliminary findings on the effect of different fertilizer applications on cut-and-come-again kale production” at the Yale Univer-sity’s Sussex Plant Biology Symposium (November 4); and met with Nancy Grabowski from New Opportunities Inc., and Bill Davenport of UConn Extension to discuss CAES contributions/collaboration on an urban agriculture education grant (November 16).
- participated in a NIFA grant review panel (December 2); hosted a lab visit with the Girls in STEM program with two juniors from Wilbur Cross High School (December 6); met with the CAES Postdoctoral Scholar Association board for the first time as Co-mentor (December 12); participated in the Connecticut Council on Soil and Water Conservation quarterly meeting (December 15).

- served on a CT Department of Agriculture grant review panel.
- gave the morning keynote speech titled “Green Roof Technology in Urban Agriculture: Lessons learned in the last decade” at the Toronto Metropolitan University Urban Farm Living Lab roundtable meeting (February 15); met with Bonnie Potocki and Dennis Hicks from Green Skies to discuss possible collaborative work researching vegetable production under solar panels (February 17); presented a talk for the CAES Seminar Series titled “Small Plastic Pool Container Production of Cucumbers: Preliminary Results from the First Year” (February 22); met with a team from CW resources to discuss two projects they are investigating: indoor hydroponic food production and the potential installation of a green roof on one of their Connecticut buildings (February 23).
- met with Bonnie Potocki and Dennis Hicks from Green Skies to discuss possible collaborations on a possible collaboration on vegetable production under solar panels (March 7); participated in the Connecticut Council on Soil and Water Conservation quarterly meeting (March 16); met with Jane Hayes (Hoffman Hayes and Gardner Jane) and Anèl Dannhauser to discuss a potential research collaboration examining green roof community gardens in Toronto (March 17).
- participated in The CAES DEI Committee meeting (April 11); participated in the DEI Disability and Accessibility Sub-Committee meeting and became the designated reporter for the DEI Committee (April 20); met with the Connecticut Small Fruit and Vegetable Conference planning committee to start work on the 2024 conference (April 24); served as a judge for the Sigma Xi Quinnipiac Chapter Student Research Conference (April 26); presented virtual workshop titled “Water Conservation as a Climate Smart Ag Practice Workshop” to New Haven area beginning and urban farmers (April 27); mentored a Quinnipiac University student for research experience credit (ending April 28).
- joined the Connecticut State Consulting Committee for Agricultural Science and Technology Education (May 4); participated in the CAES DEI Committee meeting (May 9); participated in the CAES DEI Disability and Accessibility Sub-Committee meeting (May 19).
- gave a talk titled “The Effect of Annual Compost Additions to Green Roof Media on Cut-and-Come-Again Lettuce Production” at the Institute of Food Technologists Research and Technology Advances in Urban Agriculture Live Webinar with the Fruit & Vegetable Products Division (June 2); participated in a stakeholder interview for an NSF I-CORPS interview with Dr. Rasel Das and Dr. Anna Hsiao, researchers from Stony Brook University (June 8); met with Dr. Rosemary Whelan and Professor Rebecca Brogan and students from the Albertus Magnus Biology Department and other CAES scientists to discuss CAES research and potential internships (June 16); gave a talk to Common Ground High School summer interns titled “Urban Agriculture Research Collaborations” about the research that she is conducting at Lockwood Farm (June 28).

WILLIAMS, SCOTT C.

- participated in a conference call with Genesis Laboratories, Inc. on upcoming research funding collaboration (July 5); participated in a Zoom call with Drs. Maria Diuk-Wasser and Daniel Carrascal (Columbia University) about

future research collaboration in modeling tick data (July 8); Participated in a Zoom call with CDC about budget logistics on a recent grant award (July 11); participated in a conference call with Genesis Laboratories, Inc. on ongoing research efforts (July 20).

- participated in a Zoom meeting with Dr. Maria Diuk-Wasser (Columbia University) along with Dr. David Kalb and Dylan Ferreira (Rhode Island Department of Environmental Management) about proposed deer research in Rhode Island (August 2); participated in a Zoom meeting with CDC staff about research collaborations across the new Centers for Excellence in Vector-Borne Diseases (August 4); had a Zoom meeting with CDC staff and newly awarded CDC grant collaborators about future research direction (August 10); had a Zoom meeting with Dr. Maria Diuk-Wasser (Columbia University) and Mr. Charles Lubelczyk (Maine Medical Center Research Institute) about research strategy for newly awarded CDC grant (August 18); spoke with UMass research affiliate Dr. Allison Snow about the possibility of treating deer on Nantucket, MA with acaricide for tick control (August 25).
- hosted a Zoom meeting with collaborators regarding a recent CDC grant award on systemic acaricide treatment of wildlife reservoirs against blacklegged ticks (September 1); attended and presented a lecture titled "Oral Delivery of a Modern-Day Systemic Acaricide Formulation for Pathogen Vector Management on White-Tailed Deer in Connecticut, USA" at the 16th International Conference on Lyme Borreliosis and Other Tick-Borne Diseases in Amsterdam, the Netherlands (325 attendees) (September 4-7); spoke with Central Connecti-cut State University biology professor Dr. Michelle Kraczkowski about student interns with CAES (September 15); Zoom call with CDC staff and collaborators regarding new grantee orientation on a recent CDC grant award on systemic acaricide treatment of wildlife reservoirs against blacklegged ticks (September 15); with DR. MEGAN LINSKE guest lectured and con-ducted a small mammal trapping and processing demonstration for undergraduate students in the Wildlife Techniques class within the College of Agriculture, Health, and Natural Resources at the University of Connecticut, Storrs (20 students, 1 professor) (September 19); met with University of Massachusetts-affiliated Emeritus Professor Dr. Allison Snow about systemic acaricide treatment of white-tailed deer against lone star and blacklegged ticks on Tuckernuck Island, Massachusetts (September 21); Zoom call with University of Massachusetts professor Dr. Stephen Rich and graduate student Eric Siegel about small rodent and acorn abundances (September 26); gave an invited lecture to members of the Daytime Gardeners of North Haven about the use of deer and rabbit repellents for averting herbivory damage to gardens (24 attendees) (September 27).
- participated in a Zoom call with Dartmouth Professor Dr. Jonathan Winter and graduate student Lucas Price about collaborative tick data investigating climate related impacts throughout the Northeast (October 3); participated in a Zoom call with collaborators from Columbia University and Maine Medical Center Research Institute about the need for IRB approval for ongoing research project (October 3); met with agricultural entomologist candidate Dr. Jeremy Anderson (October 7); met with agricultural entomologist candidate Dr. Laura Russo (October 14); met with agricultural entomologist candidate Dr. Haney Dweck (October 17); met with agricultural entomologist candidate Dr. Kelsey Fisher (October 18); participated in a Zoom call with Drs. Maria Diuk-Wasser and Daniel Ruiz-Carrascal of Columbia University about modeling efforts on past integrated tick management interventions

(October 19); gave an invited lecture on diversity and clandestine wildlife species of Guilford, CT to the group Women Recreating Retirement (27 attendees) (October 19); participated in a Zoom call to determine new CAES forester position interviewees (October 21); attended the kickoff meeting of the BanfieldBio's National Institutes of Health, Direct Phase II Small Business Innovation Research Award Team at North Carolina State University in Raleigh, NC (October 23-26).

- was interviewed by Jennifer Ahrens of Connecticut Public Ra-dio on the impact of a poor acorn crop to wildlife and public health in Connecticut (https://www.ctpublic.org/news/2022-11-13/connecticuts-depleted-acorn-crop-will-have-wide-reaching-impact) (November 9); gave an invited talk on the use of repellents in averting deer and rabbit damage to gardens to the Gardeners of Simsbury (27 attendees) (November 15); held a Zoom call with collaborators and scientists from the CDC on progress on an awarded grant project (November 28).
- hosted a candidate for the open forest ecologist position in the ESF Department (December 6-7); held a collaborative meeting between Genesis Laboratories, Inc. and White Buffalo, Inc. for a future Centers for Disease Control and Prevention (CDC) funding opportunity (December 8); participated in a Zoom meeting with Dr. Andrea Swei, Associate Professor in the Department of Biology at San Francisco State University, advising on host-targeted strategies for tick management (December 8); met virtually with regional active tick surveillance partners to discuss recent findings on tick distribution and infection in the Northeast headed by Dartmouth University postdoctoral fellow Dr. Lucas Price and Professor Dr. Jonathan Winter (December 10); participated in a Zoom call with colleagues from Cornell University and Columbia University on a collaborative strategy to apply to a CDC funding opportunity for vector control training (December 13); hosted University of Massachusetts Research Professor Dr. Allison Snow and demonstrated hosttargeted acaricidal-treatment strategies as well as white-tailed deer capture techniques (December 14); participated in a career fair for the sophomore class at Lyman Hall High School in Wallingford (December 15); hosted a candidate for the open forest ecologist position in the ESF Department (December 19-20); was job shadowed by an East Haddam High School student as a part of her senior capstone project (December 20); participated in a Zoom call with colleagues from Cornell University and Columbia University on a collaborative strategy to apply to a CDC funding opportunity for vector control training (December 20, 23).
- participated in a Zoom call about collaborative research and future CDC grant opportunity with colleagues from Cornell University and Maine Medical Center Research Institute (January 3 and 5); hosted a Zoom discussion with the hiring committee about the new forest ecologist position and offered the position to Elisabeth Ward, future Forest School graduate at the Yale University School of the Environment (January 6); hosted a Zoom call with collaborators from Maine Medical Center Research Institute and Columbia University solidifying research methodologies for a CDC-funded collaborative grant project (January 12); participated in a Zoom call with collaborators throughout the Northeast on a publication using tick data gathered through the CDC-funded Active Tick Surveillance effort (January 17); participated in a Zoom call about collaborative research and future CDC grant opportunity with colleagues from Cornell University and Maine Medical Center Research Institute (January 23);

participated in the CDC-sponsored virtual "Vector Day" for CDC grant recipients (January 25); met with and advised Dr. Allison Snow, University of Massachusetts research affiliate, on research regarding the systemic acaricide treatment of hosts for tick management (January 26); participated in a Zoom call with CDC staff on updates to the active and passive tick surveillance programs (January 26); hosted a Zoom call with CDC staff and collaborators from Maine Medical Center Research Institute and Columbia University on solidifying research methodologies for a CDC-funded collaborative grant research project (January 26); interviewed by Patricia Houser of the Milford-Orange Times about tick abundances, hosts, and habitats in Connecticut(January 27); participated in a virtual meeting of the Executive Committee of the Northeast Section of The Wildlife Society (January 30); met virtually with United States Department of Agriculture's Agricultural Research Service scientist Dr. Andrew Li on best steps forward for data analysis on a future collaborative research paper (January 31).

- met with aquatic invasive plant CAES scientist candidate Dr. Jeremiah Foley (February 3); participated in a Zoom call with staff from United States Department of Agriculture's Agricultural Research Service discussing data analysis on a collaborative research project (February 3); met with aquatic invasive plant CAES scientist candidate Dr. Timothy Earley (February 7); met with and advised Dr. Allison Snow, University of Massachusetts research affiliate, on research regarding the systemic acaricide treatment of hosts for tick management on Nantucket, MA (February 8); participated in a Zoom call with staff from the Maine Medical Center Research Institute and Maine Department of Inland Fisheries and Wildlife on permitting research on the collaborative systemic acaricidal treatment of deer and mice on Isle au Haut, ME (February 10); participated in a Zoom call with staff from the Department of Microbiology at the University of Massachusetts on the influence of acorn abundance on mouse populations and tick-borne pathogen presence (February 10); participated in a conference call with staff from Genesis Laboratories, Inc. on collaborative research efforts this upcoming summer (February 15); virtually attended the dissertation defense of Ms. Elisabeth Ward, new forest ecology scientist hire at CAES (February 15); participated in a Zoom call with collaborators from Maine Medical Center Research Institute and Columbia University on solidifying research methodologies for a CDC-funded collaborative grant research project (February 15); participated in a Zoom call with staff from CDC Division of Vector-Borne Diseases, University of Massachusetts, University of Rhode Island, Penn State University, State of Massachusetts, and Michigan State University future research efforts on the systemic treatment of white-tailed deer as a tick management strategy (February 15); was interviewed by Lisa Lumar, producer of the CW television program "Mysteries Decoded" about filming an episode on the origin of ticks and tick-borne diseases in Connecticut (February 16); met with Quinnipiac Valley Health District Director Richard Matheny and Director of Community Programs Alicia Mulvihill on steps forward for establishing a CDC-funded tick management study in the Towns of Bethany and Woodbridge (February 22); met with soil and water treatment CAES scientist candidate Dr. Osmar Menezes (February 23); participated in a Zoom call with producers Lisa Lumar and Brandon Gilbrech of the CW television program "Mysteries Decoded" about site locations and content for filming in Connecticut (February 24); met with soil and water treatment CAES scientist candidate Dr. Yingxue (Charlie) Yu (February 27); participated in a Zoom call with staff from the Maine

Medical Center Research Institute on logistics for sampling mice and ticks on Isle au Haut, ME (February 27).

- participated in Zoom meeting with research collaborators from Maine Medical Center Research Institute (March 8); participated in Zoom meeting with research collaborators from BanfieldBio, Inc. and North Carolina State University about testing tick repellency of treated fabrics (March 9); presented virtual lecture titled "Oral Delivery of Low-dose Fipronil for Experimental Systemic Acaricidal Treatment of White- footed Mice Against Ixodes scapularis" for the Department of Defense's Deployed War Fighter Protection Research Symposium (90 attendees) (March 16); with DR. MEGAN LINSKE, MS. JAMIE CANTONI, and MR. DUNCAN COZENS, entertained a film crew from The CW Network's program Mysteries Decoded and were interviewed about blacklegged tick collection, pathogen testing, and the origin of Lyme disease to be aired on a future episode (March 17); participated in a Zoom call with University of Massachusetts colleagues about research pertaining to the relationship of acorn abundance, mice, and human cases of Lyme disease throughout Connecticut (March 20); participated in a Zoom call with residents of the Town of Woodbridge on participation in a future integrated tick management study (March 22); met with public health officials from Yale University, Western Connecticut State University, and the Connecticut Department of Public Health and spoke about ongoing research on the systemic acaricidal treatment of hosts against blacklegged ticks (March 27); participated in a Zoom call with colleagues from the Maine Medical Center Research Institute and Maine Department of Agriculture, Conservation, and Forestry, Bureau of Pesticide Control on logistics for a collaborative research venture involving the systemic acaricidal treatment of blacklegged tick hosts (March 29).
- met virtually with and spoke to students in the STEM program from Staples High School (Westport, CT) about career paths in the sciences (12 attendees) (April 4); participated in a Zoom call with staff from CDC Division of Vector-Borne Diseases, University of Massachusetts, University of Rhode Island, Penn State University, State of Massachusetts, and Michigan State University about tick management strategies involving white-tailed deer (April 5); participated in a conference call on collaborative research efforts with scientists from Genesis Laboratories, Inc. (April 10); met with Valley Laboratory plant pathology scientist candidate Dr. Chase Crowell (April 13); with DR. MEGAN LINSKE traveled to Isle au Haut, ME to meet with staff from MaineHealth Institute for Research and island residents regarding collaborative research on the integrated tick management strategy of systemic acaricidal treatment of mice and deer as part of a recently awarded 5-year CDC grant (April 16-18); interviewed by Associated Press reporter Patrick Whittle about an early tick season (April 18); met with Valley Laboratory plant pathology scientist candidate Dr. Nate Westrick (April 19); participated in a Zoom call with staff from the CDC Division of Vector-Borne Diseases on progress made on a funded integrated tick management project (April 19); attended the virtual defense of Yale University School of Medicine Ph. D. candidate Rebecca Earnest (April 20); participated in the 2023 Annual Meeting of the Northeast Regional Center for Excellence in Vector-Borne Diseases and presented invited lecture titled "Experimental Systemic Acaricidal Treatment of Wildlife Hosts" Jones Auditorium, New Haven, CT (100 attendees) (April 21); participated in a Zoom call with scientists from Maine Medical Center Research Institute and Columbia University on next steps forward on a collaborative research project (April 25); as

Executive Treasurer, participated in the Annual Meeting of the Executive Committee of the Northeast Section of the Wildlife Society in Hershey, Pennsylvania, and was re-elected to a two-year term as Treasurer (April 30).

- as newly elected Executive Treasurer, participated in the Annual Members Meeting of the Northeast Section of the Wildlife Society at the Northeast Fish and Wildlife Conference in Hershey, Pennsylvania (May 1); participated in a collaborative Zoom call with members of the Banfield Biologic NIH SBIR-funded tick repellent fabric team (May 2); participated in a Zoom call with staff from CDC Division of Vector-Borne Diseases, University of Massachusetts, University of Rhode Island, Penn State University, State of Massachusetts, MaineHealth, Michigan State University, Texas A&M University, and Genesis Laboratories about tick management strategies involving white-tailed deer (May 3); as Executive Treasurer, participated in a Zoom meeting of the Executive Committee of the Northeast Section of the Wildlife Society (May 16); participated in a Zoom call with scientists from MaineHealth and Columbia University on next steps forward on a collaborative research project (May 16); participated in a Zoom call with staff from the CDC Division of Vector-Borne Diseases on progress made on a funded integrated tick management project (May 17); participated in a Zoom call with staff from CT DEEP and US Biologic on the use of a USDA-approved reservoir-targeted vaccine against Lyme disease in Connecticut (May 22); participated in a conference call with staff from Genesis Laboratories on progress on an ongoing CDC-funded systemic mouse acaricide project (May 26); traveled to Scotland for the NorthTick conference and presented research poster titled “Oral Delivery of a Modern-Day Systemic Acaricide Formulation for Pathogen Vector Management on White-Tailed Deer in Connecticut, USA” (120 participants) (May 30-31).
- was asked to write up a popular summary of a recently published paper titled “Feeding Deer Corn With Tick-Control Drug Shows Promise in New Study” for the Entomological Society of America’s Entomology Today (June 5); participated in Zoom call with recent UConn Ph.D. graduate about collaborative research regarding invasive plant control and impacts to ecosystem and public health for a National Science Foundation Small Business Innovation Research Program, Phase II grant submission (June 7); participated in a Zoom call with staff from CDC Division of Vector-Borne Diseases, Cornell University, USDA Agricultural Research Center, Maine Health, University of Massachusetts, University of Rhode Island, Penn State University, State of Massachusetts, Texas A&M, Tufts University, and Michigan State University about tick management strategies involving white-tailed deer and gave invited presentation on recently published paper involving the systemic acaricidal treatment of deer against ticks (19 attendees) (June 7); participated in a Zoom call with staff from the CDC Division of Vector-Borne Diseases on progress made on a funded integrated tick management project (June 8); participated in a collaborative Zoom call with members of the Banfield Biologic NIH SBIR-funded tick repellent fabric team (June 13); participated in an interview with Yale University Medical School Microbiology Fellow Dr. Bruce Rottmann (June 20); participated in a Zoom call with staff from the CDC Division of Vector-Borne Diseases on progress made on a funded integrated tick management project (June 21); participated in a collaborative Zoom call with members of the Banfield Biologic NIH SBIR-funded tick repellent fabric team (June 27); was appointed to the Professional Wildlife Biologist Certification Review Board for The Wildlife Society (June 27)

ZARRILLO, TRACY

- Presented a poster called “Wild Bee Diversity in Connecticut” at the CAES Plant Science Day barn exhibit (August 3, 2022)
- Gave an interview to Kathleen Connely from The Day community media about the vertical stratification of bees in forests (August 15, 2022)
- Presented an invited talk titled **“**Wild Bee Research in Connecticut” at the Bees of Rhode Island Research Symposium held at the University of Rhode Island, 11 attendees (October 5, 2022)
- Presented a talk titled “ Specialist bees in Connecticut” to the Connecticut Botanical Society, 50 attendees (April 1, 2023)
- Gave an interview to Kathleen Connely for the Zip06 newspaper about the state of native bees in Connecticut (June 9, 2023)

ZENG, QUAN

- Participated in the 4th International Erwinia Workshop (IEW 2022) in Assisi, Italy and delivered an oral presentation entitled “Expression of the Type III Secretion System Genes in Epiphytic *Erwinia amylovora* Cells on Apple Stigmas Benefits Endophytic Infection at the Hypanthium” (70 adults) (July 2)
- Participated in the 14th International Conference on Plant Pathogenic Bacteria (ICPPB) in Assisi, Italy (July 3-8) and presented a poster titled “Glandular and non-glandular trichomes are colonization sites and host entry points of the fire blight pathogen on apple leaves” (250 adults) (July 5); gave an oral presentation titled “Colonization of yeast-like fungi on apple flowers induces host immunity and prevents fire blight infection” (250 adults) (July 7).
- Participated in the Bacteriology Committee Meeting of the American Phytopathological Society (37 adults) (July 25).
- Participated in the third International Symposium on Fire Blight of Rosaceous Plants in Dresden, Germany, and gave two presentations: 1) “Glandular and non-glandular tri- chomes are colonization sites and host entry points of the fire blight pathogen on apple leaves” and 2) “Mycobiome-induced host resistance in apple against fire blight” (80 adults) (September 6–9).
- Participated in the 84th Annual Northeastern Tree Fruit IPM Meeting in Fairlee, VT and presented two talks “Mechanism of Blossom Protect in Controlling Fire Blight Infection” and “Fire blight pathogen *Erwinia amylovora* enters apple leaves through abscission points of leaf struc- tures” (October 24-26) (65 attendees); attended a virtual editorial meeting for Microbiology Spectrum (October 26).
- Presented to a group of young women at Wilbur Cross High School to promote Women in STEM and a mentorship program between Wilbur Cross and CAES (10 attendees) (November 3).
- Hosted two students from Wilbur Cross High School as part of the Women in STEM mentorship program and provided them a tour of the laboratory facilities at The CAES’s New Haven campus. (2 adults) (December 6)

- Participated in the New Haven Promise scholar recruitment for the Plant Health Fellow Program at Yale University (January 13)
- Presented an invited seminar "How Flower Microbiome Influences Host-Pathogen Interaction in Fire Blight" for the Plant Pathology Seminar at Collage of Agriculture and Life Sciences, Cornell University (28 participants via Zoom) (January 31)
- Gave an invited seminar titled “Considering Microbiome In The Host- Microbe Interaction Research” at the Department of Biological Sciences, University of Wisconsin-Milwaukee, in Wisconsin (80 adults) (February 10)
- Was interviewed by Kate Prengaman from Good Fruit Grower magazine about the use of Blossom Protect in fire blight control (March 1) article can be found here: https://www.goodfruit.com/a-plan-of-defense-against-fire-blight
- Participated in the Northeastern APS meeting and gave an oral presentation “Bacterial Inter- species Communication in Soybean Rhizosphere” in during the annual meeting in Southbury, CT (March 9-10)
- Hosted a group of researchers and graduate students from University of Maine lead by Dr. Jianjun Hao and offered a tour of the station facilities and introduced about ongoing research (March 10)
- Participated in panel discussion about streptomycin resistance in *Erwinia amylovora* in the Northeastern U.S. during the Stupid Question Session webinar at Cornell University (20 adults) (March 15)
- Gave a guest lecture for students at China Agricultural University for their “Plant Protection and Disease Management” class on the topic of “Fire Blight” through Zoom (150 adults) (March 22)
- Gave a guest lecture for students at the Department of Plant, Soil and Microbial Sciences, Michigan State University for their “Procaryotic Plant Disease” class on the topic of “Innovations in Plant Dis- ease Management” through Zoom (25 adults) (March 28).
- Gave a presentation “Apples, Apple Trees, and Bees” to three groups of students (pre-K and K) at Alphabet Academy, Hamden, CT (76 children, 10 adults) (May 18)
- Gave a presentation “Apples - History, Origin, Cultivation, Breeding and Modern Technologies” to the senior citizens at the Senior Center in Waterbury (60 adults) (May 25)
- Gave a guest lecture for students at China Agricultural University for their “Plant Protection and Disease Management” class on the topic of “Fire Blight” through Zoom (120 adults) (May 20)

ZUVERZA-MENA, NUBIA

- With Jason White, Ph.D. and Christian Dimkpa, Ph.D., met with Felipe Franco de Oliveira and Vanessa Takeshita, who are both PhD students from University of São Paulo and are staying at CAES for nine months (July 6)
- visited Prof. Yanna Liang and Ms. Chelli at the University of Albany, New York on August 23, 2022. Prof. Liang and Ms. Chelli are site volunteers in the project titled “A Combined Approach for Phytoremediation and Industrial Hemp Production,” in which the main goal is the phytoremediation and removal of Per- and Polyfluoroalkyl substances (PFAS) from contaminated soil using hemp plants. The project is being funded under the auspices of the

Magnarelli Research Grant, with the field site based in Loring, Maine. The team discussed progress on the research and outlined plans for continuing the collaboration.

- along with Drs. Trung Huu Bui, Jason White and Christian Dimkpa had a virtual meeting with an administrator from the town of Canton, CT, staff from the CT Department of Energy and Environmental Protection (DEEP), and staff from GZA GeoEnvironmental (October 4). The meeting was to discuss potential sites for collecting soil samples for a research project on PFAS; an emerging toxic contaminant of worldwide concern. DR. BUI collected soil samples from Canton on October 26; along with Sara Nason, Ph.D. presented the hybrid talk "Contaminants Uptake in Fiddleheads - Pilot Study with Tribes" at the EPA Tribal Environmental Conference in Bar Harbor, ME (October 20).
- along with Susanna Keriö, Ph.D., Leigh Whittinghill, Ph.D., and Faisal Qaseem, Ph.D. went on a field excursion in the New Haven area to test the sample collection of maple urban trees (November 1) and rate trees' health (November 9); presented "Biodegradable polymer nano-composites for controlled release and targeted delivery of phosphorus during crop growth" during the Sustainable Phosphorous Summit in Raleigh, NC (November 2-4); participated in a podcast interview with. Sara Nason, Ph.D. And Sara Thomas, Ph.D. on various research projects at The CAES that involve per- and polyfluoroalkyl substances (PFAS) (November 10); and with Washington da Silva, Ph.D. and Itamar Shabtai, Ph.D., staffed a CAES booth showcasing various lines of research at the CT Agricultural Expo in Southington (November 18).
- along with Jason White, Ph.D., Sara Nason, Ph.D., And Sara Thomas, Ph.D., participated in the monthly meeting with collaborators from Yale and the University of Minnesota (December 7) on a NIH NIEHS funded phytoremediation studies; met with Jason White, Ph.D., Dr. Chris Dimkpa, Ph.D. and Trung Huu Bui, Ph.D. regarding locking PFAS in soil with modified-biochar (December 9); attended the group meeting with Sara Nason, Ph.D. and Peiying Wang, Ph.D. on the USDA wastewater reuse project (December 12); and along with Raja Muthuramalingam, Ph.D. interviewed Ms. Sophia Al-Meshrefawi from Southern Connecticut State University for a potential internship during the spring of 2023 (December 15); and along with Sara Nason, Ph.D., virtually attended the EPA regional meeting on PFAS and biosolids where The CAES's work on the topic was highlighted (December 14)

DEPARTMENT OF ANALYTICAL CHEMISTRY

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, 2022 – June 30, 2023.

Source of Sample	Numbers of samples analyzed
Department of Agriculture	354
Department of Consumer Protection	579
Department of Energy and Environmental Protection	81
FDA, Health Depts., Cities/Towns, Misc. Foundations	9
Proficiency Test Samples	44
University Research Collaborators	56
CAES Departments	1,616
Grand Total	**2,739**

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, and Carlos Tamez
- 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, 2022, to June 30, 2023, we received 31 feed and associated grain samples for analysis of Aflatoxins (B1, B2, G1, G2), Fumonisin (FUM) and Deoxynivalenol (DON), 56 feed samples for macro minerals (Ca, K, Mg, Na, P, S) and moisture, 16 animal feed samples for pesticides analysis, and 55 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. Acid Hydrolysis, sometimes needed to supplement fat by gravimetric extraction, was brought under scope as of April, 2023. Pesticide testing of food was accredited to the ISO standard under the MFRPS program in 2016. Samples were analyzed by the methods for aflatoxin extraction, QUECHER for FUM and DON 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.

24 samples found Deoxynivalenol (DON), and 2 samples found Fumonisin (FUM). They are all lower than the Guidance level: Guidance level for Deoxynivalenol is 5000 ug/kg and guidance level for Total Fumonisin (FB1 + FB2 + FB3) is 30000 ug/kg.

These samples were also analyzed for protein, fat, and fiber. One sample failed to meet the protein label guarantee – 13.4% found - minimum for sample to pass was 17.4%. One sample failed to meet the fat label guarantee – 2.4% found – minimum for sample to pass was 2.7%. From July 1, 2022, through June 30, 2023, a total of 16 animal feed samples were analyzed for pesticide residues. Of these, 1 (6.25%) contained a total of 2 residues. There were 2 different pesticide active ingredients (Malathion and Piperonyl Butoxide) found at an average concentration of 35.5 µg/kg in horse feed. No residues were found over tolerance guidelines.

Of the 56 animal feed samples for macro minerals there were 30 samples of cat feed, 20 samples of dog feed, 5 samples of poultry feed, and 1 sample of equine 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 comply 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, 2022, to June 30, 2023, we received and are completing analysis of 31 samples for macronutrients, including nitrogen, phosphorus, and potassium. 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, and Carlos Tamez
- 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, 6 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:

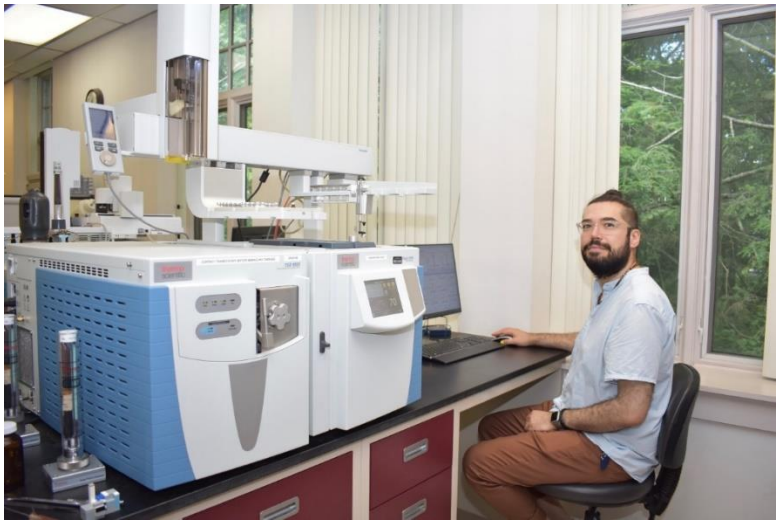
- Analysts: Terri Arsenault and Kitty Prapayotin-Riveros
- Goal: To determine the tetrahydrocannabinol (THC) content of hemp grown by state farmers prior to the sale of the product
- Summary: This new program was initiated by the 2018 Farm Bill which allowed hemp to be grown in the state. In this bill, hemp was defined as *Cannabis sativa L* with less than or equal to 0.3% total delta-9 THC. The state plan requires that each hemp variety is tested within 30 days of harvest. From July 1, 2022, to June 30, 2023, a total of 149 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 (8%) 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.

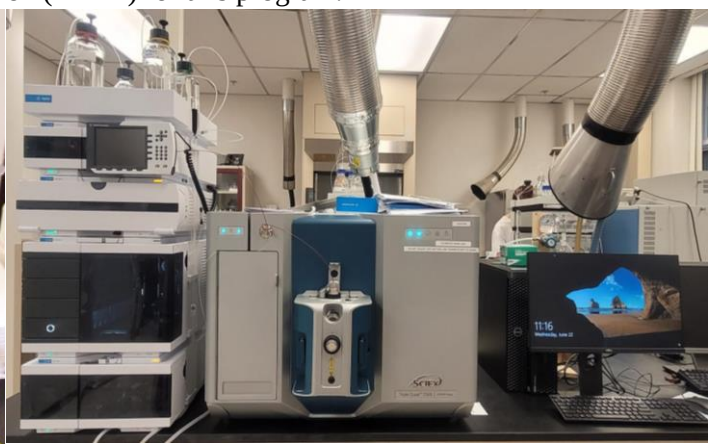
a. Pesticide residues and heavy metals in human food:

- Analysts: Carlos Tamez, 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, 2022, through June 30, 2023, a total of 100 samples of human food were analyzed for pesticide residues. Of these samples, 40 (40%) contained a total of 101 residues. Of these 40 samples, 3 were found to contain illegal residues (No Tolerance Violations). A sample of blackberries contained Phosmet, and a sample of radish top contained Chlorothalonil and Cyhalothrin (lambda). All the violative samples were collected from local CT growers. There were 27 different pesticide active ingredients found at an average concentration of 0.273 mg/kg. From July 1, 2022, through June 30, 2023, a total of 119 samples of human food (including baby food retail products, Maple Syrup, and Apple juice/cider) were analyzed for heavy metals. Of the infant rice cereal samples, 1 out of 78 samples (1.3 %) 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. A recent important highlight of our work with DCP was 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: Mike Ammirata, John Ranciato, Carlos Tamez, Meghan Cahill, and Craig Musante,
- Summary: From July 1, 2022, to June 30, 2023, 39 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 Lentil Soup, coconut jasmine rice, Fruit Spread, Mustard, Greens Salad, Protein Dark Chocolate Peanut Butter Bar, ground beef, infant formula, bottled water, hot sauce, ready to eat rice, Cheese breadsticks, honey.

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 only 1 product (wine) 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

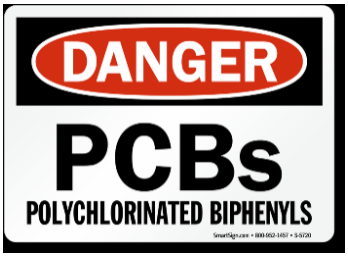
a. Analysis of marijuana products:

- 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. In addition, the program will 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).

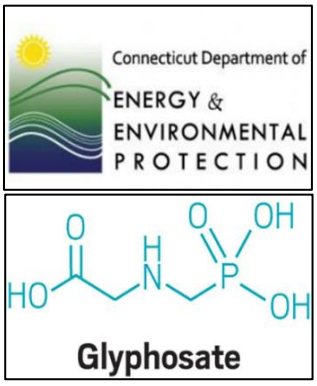
This program will ensure that products comply with the stated labels for the different cannabinoids. During the period between July 1, 2022, and June 30 2023, 117 samples of marijuana products were submitted by DCP. Level of THC ranged from 0.02 to 94.6%

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



a. Analysis of PCBs (polychlorinated biphenyls):

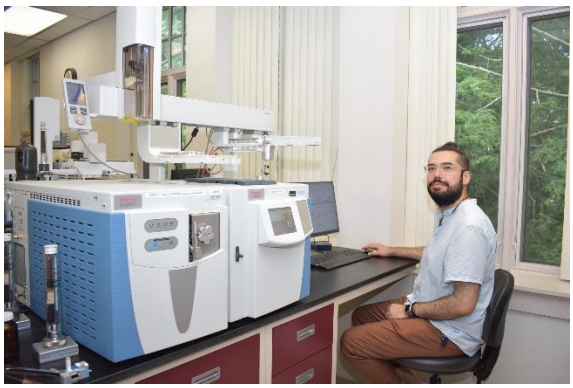
- Analysts: Michael Ammirata and Terri Arsenault
- Goals: To determine the extent of polychlorinated biphenyl (PCB) contamination in submitted samples, with matrices including soil, water, oil, sediments, and surface wipes.
- Summary: From July 1, 2022, to June 30, 2023, 58 samples were analyzed from 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. Seven samples were positive for PCB. 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: Carlos Tamez and Terri Arsenault
- 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. Submitted sample matrices include soil, water, oil, sediments, tank mixes and surface wipes.
- Summary: From July 1, 2022, to June 30, 2023, 23 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.

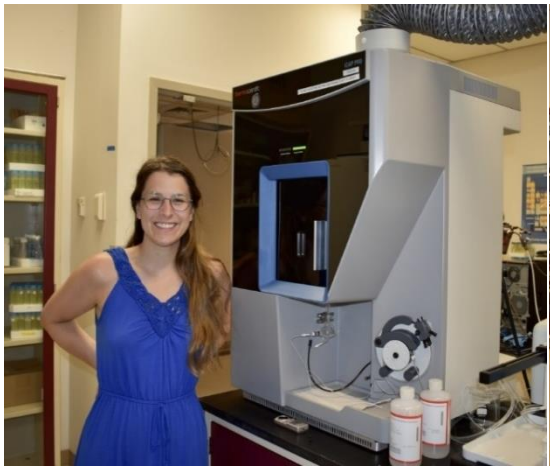


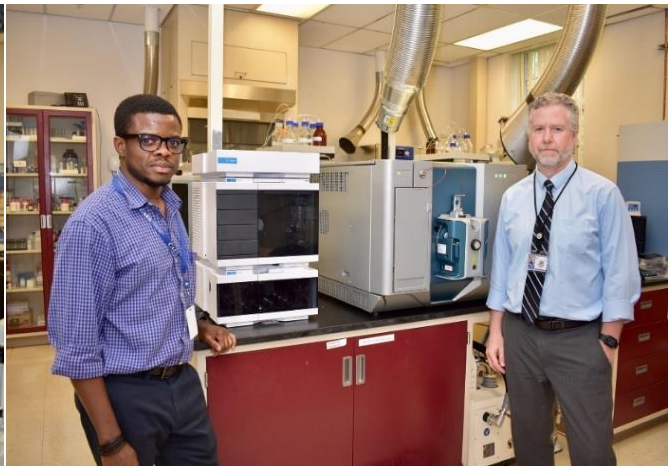
6. ANALYSES ON BEHALF OF MUNICIPAL AND FEDERAL AGENCIES

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

- Analysts: Craig Musante, Terri Arsenault, 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, we continue to implement the FDA ORA Partners Portal (ORAPP). Some of the samples in this initiative included actionable import samples. We successfully uploaded five dried fruit samples for pesticides analysis, there were imported from Canada. Three out of five samples found 13 different pesticides, though without violations.





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: Anuja, Bharadwaj, Terri Arsenault, Craig Musante, Meghan Cahill, and John Ranciato

- Summary: From July 1, 2022 through June 30, 2023, Department staff analyzed 3 samples for municipalities or other groups. Among these, Sample 8275 from Pennsylvania Department of Agriculture, investigated for Foreign Material,

Toxins Screen. Samples 8403 and 8404 from Middletown Police Department to verify the presence of tetrahydrocannabinol (THC) in dried plant material.

- 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 or have regulatory implications.

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, Christian Dimkpa, Jason 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 continues to be 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 sulfur on fungal interaction with food crops. More update on these efforts is presented under Project 3 of the Research Activity Section, and in the Department of Plant Pathology and Ecology section of this document. Two related projects each amounting to over $500,00 in USDA-AFRI NIFA grant funding on nano-enabled phosphorus which started around August of 2021 and August 2022, seek to understand the role of biopolymers and sulfur coating on phosphorus use efficiency. These projects are undertaken in conjunction with scientists in the Department of Plant Pathology and Ecology and John Hopkins University, Baltimore, University of Central Florida, Orlando, and North Dakota State University, Fargo. An NSF-funded translational research project on the evaluation of nitrogen-rich fertilizer effluents from nitro oxidation process using agricultural and food waste was inaugurated during the year under review, in collaboration with scientists at Stony Brook University, New York.

8. ANALYSIS OF CHECK SAMPLES

- Analysts: Terri Arsenault, Craig Musante, Meghan Cahill, Michael Ammirata, and Kitty Prapayotin-Riveros
- Summary: 17 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.

2. 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.

FOOD SAFETY

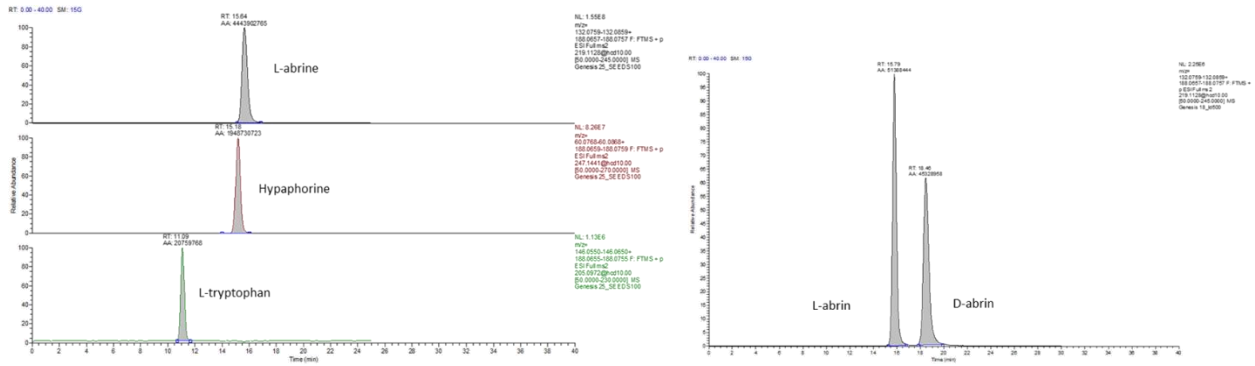
Project 1: *Improvement of analytical methods for determination of pesticide residues and heavy metals in food:*

- Investigators: Carlos Tamez, Terri Arsenault, 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 assessment to maintain ISO Accreditation fwas successfully completed in March of 2023. During the year new ICP-OES and nitrogen determinator 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 and Nassifatou Tittikpina
- 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 left during the year and a new scientist, Dr. Nassifatou Tittikpina, wrapped up the work and provided a final report to the FDA, wherein using a regular C18 column, a mixture of L-abrine, tryptophan and hypaphorine could not be separated with a mobile phase made of acetonitrile and water. Co-elution was observed with a mixture of methanol and water. With acetonitrile and methanol, a higher concentration of the compounds was observed in methanol fractions, compared to acetonitrile. Therefore, the methanol-water solvent system was selected as the mobile phase for the studies with teicoplanin. On the teicoplanin column, three compositions of mobile phases were tested with varying percentages of methanol, using a mixture of L-abrine, tryptophan and hypaphorine: (i) methanol-water containing 0.1% formic acid; (ii) methanol-water containing 5mM ammonium formate, and (iii) methanol-water both containing 5mM ammonium trifluoroacetate. Under these conditions, the best separation of the three compounds was obtained with 70% of methanol. However, ammonium trifluoroacetate lingered in the instrument. On the other hand, ammonium formate gave the best linearity (0.9999), compared with formic acid (0.9993) and ammonium trifluoroacetate (0,9904). Consequently, methanol

in water at 70% with 5mM ammonium formate was chosen as the method of choice for separating L-abrine and its related compounds on teicoplanin stationary phase (see Figure below).



This study shows that L-abrine can be effectively determined using an isocratic method with a Chirobiotic T column at 45°C. The mobile phase of 70% methanol and 30% of water with 5mM with ammonium formate achieved a suitable balance of MS sensitivity and chromatographic resolution. This method can be used in the future, with a labelled L-abrine standard, to accurately quantify the abrine content of certified seeds.

- 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.

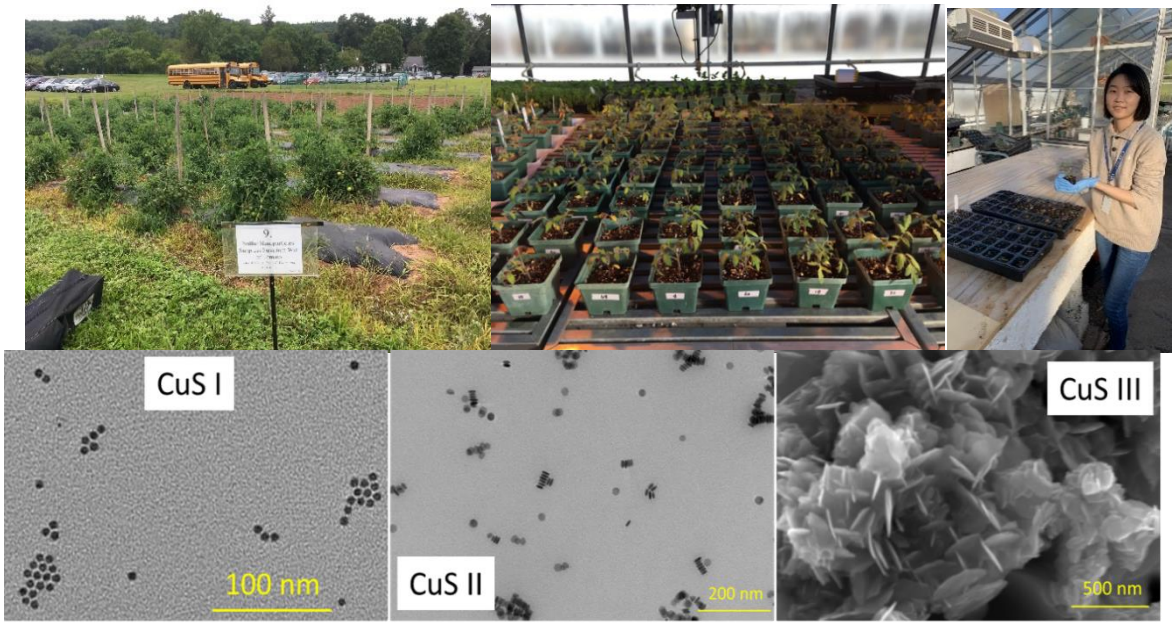
Project 3: *Nanoparticles and other contaminants in agricultural systems*:

- Investigators: Nubia Zuverza-Mena, Craig Musante, Paul Aikpokpodion, Carlos Tamez, Yi Wang, Chaoyi Deng, Shital Vaidya, Jingyi Zhou, Jason C. White and Christian Dimkpa

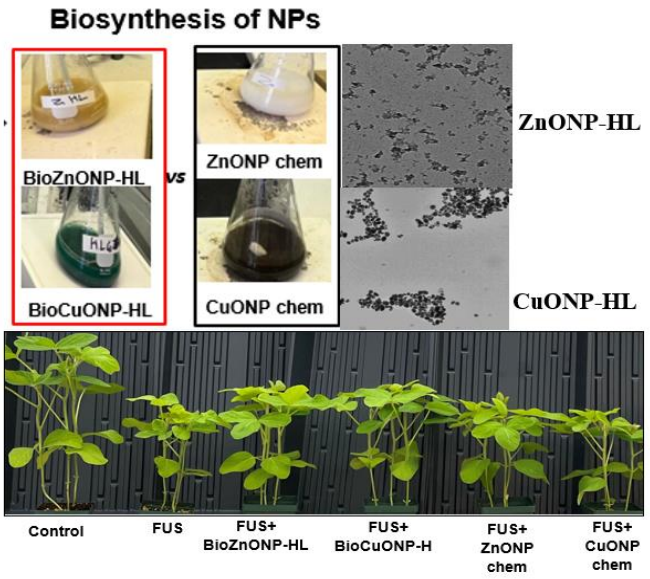
- Summary: Nanomaterials (NM) have at least one dimension less than 100 nm (one billionth of a meter) and possess unique physical and chemical properties not observed at the bulk scale. Nanotechnology, which takes advantage of these useful nanoscale properties, has become widely used in numerous sectors, 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, Stony Brook 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 of 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. A field trial further confirmed the results. CS increased tomato yield up to 3.3~3.4-fold compared to the unamended controls in the healthy groups. In the infested treatments, CS significantly reduced disease severity compared to other treatments. Foliar and soil treatment with CS increased the marketable yield of tomato fruit from plants infected with Fusarium pathogen by 107 and 192% over diseased controls, respectively. In addition, more novel formulations of nano-agrochemicals have been designed and synthesized in lab which can efficiently suppress plant dieases and improve plant growth.

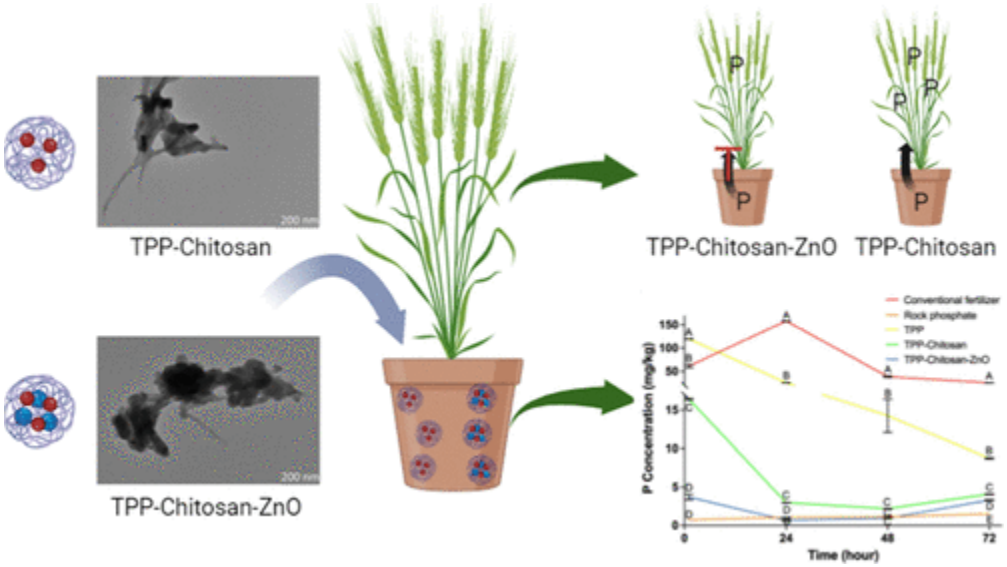


A related work spearheaded by a visiting scientist from the University of Gabes, Tunisia involved the synthesis and characterization of copper and zinc oxide nanoparticles using extracts from cannabis leaves for evaluation in crop disease control. The student returned to their country during the year to continue working on the project. At present, the synthesized nanoparticles have assessed against *Fusarium virguliforme* in soybean (*Glycine* max L.). Hemp was selected because it is known to contain large quantities of secondary metabolites that can potentially enhance the reactivity of NPs through surface property modification. Synthesizing NPs with biologically derived materials allows us to avoid using harsh and expensive synthetic reducing and capping agents. The ZnONP-HL and CuONP-HL showed average grain/crystallite size of 13.51 nm and 7.36 nm, respectively. The biologically synthesized NPs compared well with their chemically synthesized counterparts (ZnONP chem, and CuO NP chem; 18.75 nm and 10.05 nm, respectively), confirming the stabilizing role of hemp-derived biomolecules. Analysis of the hemp leaf extract and functional groups that were associated with ZnONP-HL and CuONP-HL confirmed the presence of terpenes, flavonoids, and phenolic compounds. Biosynthesized NPs were applied on soybeans as bio-nano-fungicides against *F. virguliforme* via foliar treatments. ZnONP-HL and CuONP-HL at 200 µg/mL significantly ($p < 0.05$) increased (~ 50%) soybean growth, compared to diseased controls. The NPs improved the nutrient (e.g., K, Ca, P) content and enhanced photosynthetic indicators of the plants by 100–200%. A 300% increase in the expression of soybean pathogenesis related GmPR genes encoding antifungal and defense proteins confirmed that the biosynthesized NPs enhanced disease resistance against the fungal phytopathogen. The findings from this study provide novel evidence of systemic suppression of fungal disease by nanobiopesticides, via promoting plant defense mechanisms.

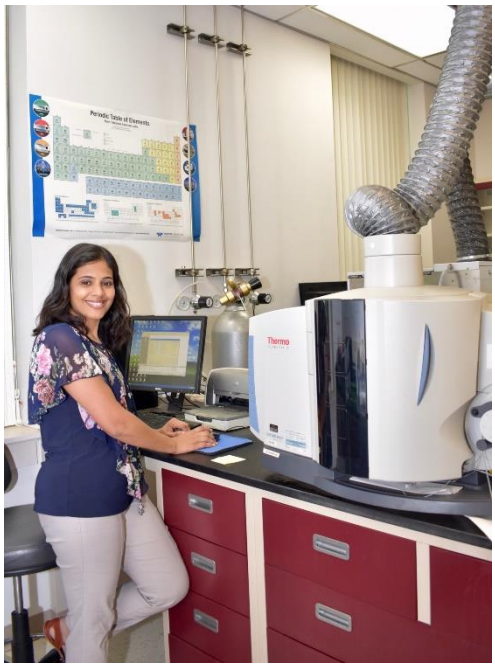


Another project was aimed at developing and evaluating tripolyphosphate (TPP) as nanofertilizer enhanced in value and plant use efficiency by formulation with chitosan and zinc oxide nanoparticles. Phosphorus (P) is the second most important crop nutrient. Despite its critical importance in plant development 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. The developed TPP-Chitosan and TPP-Chitosan-ZnO nanofertilizers exhibited positive surface charges, 5.8 and 13.8 mV, and hydrodynamic sizes of 430 and 301 nm, respectively. In soil, nanoformulations of TPP-Chitosan and TPP-Chitosan-ZnO significantly reduced cumulative P leaching during 72 h, reaching 91 and 97% reductions, respectively, compared to a conventional fertilizer, monoammonium phosphate (MAP). Cumulative P leaching after 72 h from these nanofertilizers was, respectively, 84 and 95% lower than from TPP alone. TPPChitosan-ZnO was, overall, 65% more effective in reducing P leaching, compared to TPP-Chitosan. Relative to MAP, the wheat plant height was significantly increased by TPP-Chitosan-ZnO by 33.0%. Compared to MAP, TPP-Chitosan and TPP-Chitosan-ZnO slightly increased wheat grain yield by 21 and 30%, respectively. Notably, TPP-Chitosan-ZnO significantly decreased shoot P levels, by 35.5, 47, and 45%, compared to MAP, TPP, and TPP-Chitosan, respectively. Zn release over 72 h from TPP-Chitosan-ZnO was considerably lower, compared to a control, ZnO nanoparticles, and averaged, respectively, 34.7 and 0.065 mg/L, which was 534 times higher for the former. Grain Zn was significantly higher in the TPP-Chitosan treatment, relative to MAP. TPP-Chitosan also significantly mobilized the resident K, S, Mg, and Ca from soil into the plant, helping to improve the overall nutritional quality and supporting the role of chitosan in nutrient mobilization. Taken together, our data highlight the potential for repurposing a nonfertilizer P material, TPP, for agricultural and environmental applications and the effect of applying nanotechnology on such outcomes.

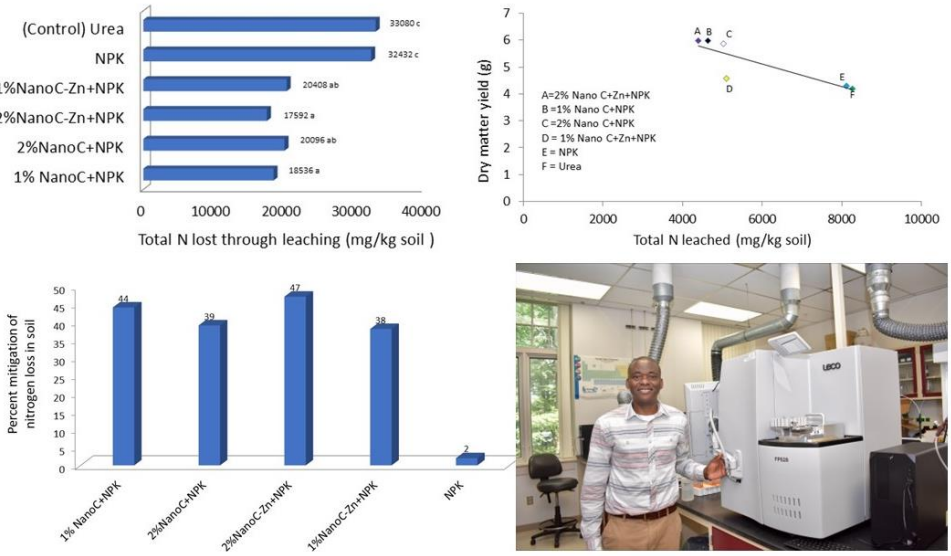


A related ongoing project in partnership with John Hopkins University scientists looks at the use of polyhydroxyalkanoates (PHA) to improve plant bioavailability and reduce environmental P loss in plant-soil systems. Biodegradable polymer nanocomposites containing PHA and phosphorus sources were synthesized. Tomato was grown in soil amended with five P-sources, used as-is or embedded within the PHA. Correlation analysis identified treatments that maintain plant growth, improve bioavailable soil P, and reduce P loss. Three performance classes were identified: (i) micro- and nano-hydroxyapatite, which did not increase bioavailable P, plant P uptake, or change P in runoff/leaching compared to controls; (ii) monocalcium phosphate (MCP), dicalcium phosphate (DCP), calcium pyrophosphate nanoparticles (CAP), and PHA-MCP that increased P-uptake and/or bioavailable P but also increased P loss in runoff/leaching; and (iii) PHA-DCP and PHA-CAP, where increased bioavailable P and plant P-uptake were achieved with minimal P loss in runoff/leaching. In addition to identifying treatments that maintain plant growth, increase bioavailable P, and minimize nutrient loss, correlation plots also revealed that (i) bioavailable P was a good indicator of plant P-uptake; (ii) leached P could be predicted from water solubility; and (iii) P loss through runoff versus leaching showed similar trends. This study highlights that biopolymers can promote plant P-uptake and improve bioavailable soil P, with implications for mitigating the negative environmental impacts of P loss from agricultural systems Specifically, the reduction in P loss is critical for controlling the eutrophication of water bodies due to nutrient overload and for sustaining the dwindling global P resources.

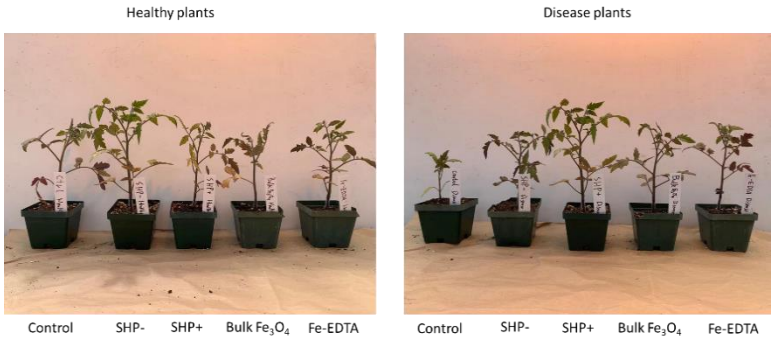


A conceptually similar project related to nutrient management was conducted to evaluate the influence of combined application of pristine and zinc (Zn)-modified nanocellulose on nitrogen loss mitigation from urea. Nanocellulose is a biomaterial with high specific surface area. It is biocompatible and biodegradable, and, thus, nontoxic and environmentally friendly. The capability of nanocellulose to reduce nitrogen loss either in the form of nitrate or ammonium relies on the numerous hydroxyl functional groups on the surface of the nanocellulose which can be modified in several ways to meet specific purposes. Results after three consecutive leaching indicated that total nitrogen loss in soil treated with 1% nanocellulose + NPK and zinc-modified 2% Nanocellulose + NPK was significantly lower than the total nitrogen loss in soils treated with only urea and NPK. With urea, a total of 33,080 mg N/kg soil was lost through leaching within five weeks of fertilizer application while 32,432 mg N/kg soil was leached from soil treated with NPK fertilizer. This is a 2% reduction in total nitrogen loss, compared with N loss in soil that received only urea application. Upon introduction of Zn-modified nanocellulose (2%), a total of 17,292 mg N/kg soil was lost through leaching in soil, representing a 47% loss mitigation. Similarly, 18,536 mg, 20,096mg and 20,400 mg N/kg soil were lost in soil treated with 1% Nanocellulose + NPK, 2% Nanocellulose and Zn-modified 1% Nanocellulose, representing 44%, 39% and 38% loss mitigations, respectively. An inverse relationship was observed between N loss and biomass yield, showing the importance of nitrogen in plant development. As the amount of nitrogen loss from the soil through leaching increased, less nitrogen was available for plant

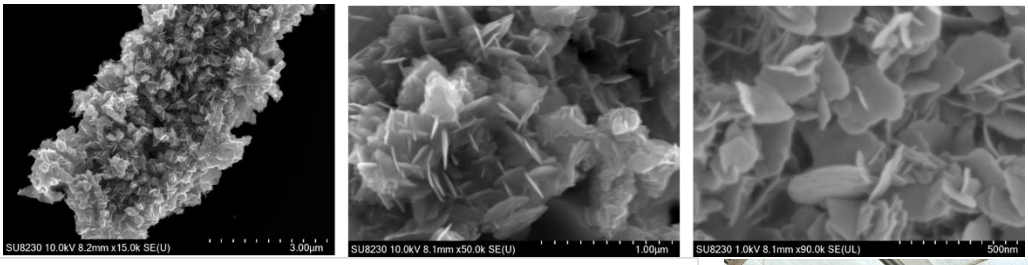
uptake for tissue development. Due to the reduction in the mobility of NO_3^- and NH_4^+ within the soil system, the application of Zn-modified 2% could significantly lower N leaching loss. Collectively, these data indicate the potential of pristine and Zn-modified nanocellulose to mitigate the loss of nitrogen in agricultural soils during the cropping season. On the other hand, the soil samples treated with urea alone and urea+KH_2PO_4 had no mechanism by which NH_4 obtained from urea ammonification and NO_3 from NH_4 nitrification processes could be retained within the soil system. Hence, a greater amount of the applied nitrogen fertilizer was lost through leaching, compared with the soil that received the combination of nanocellulose with NPK.

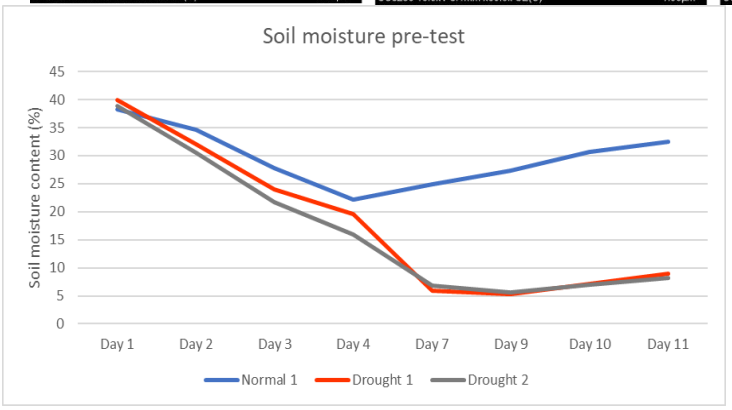


A distinct nanoscale research project under the auspices of the Center for Sustainable Nanotechnology seeks to understand the underlying chemistry governing the interaction between nanomaterials and a unique hydrophobic biological surface (i.e., the plant leaf). Here, ferric oxide (Fe_3O_4) nanoparticles 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.



A related study investigates the effect of nano CuS (nCuS) on alleviating drought stress in soybean (*Glycine* max L.). Herein nCuS was synthesized using a slow evaporation approach, with a molecular ratio between Cu and S at 8. The synthesized nCuS was characterized by XRD and showed the characteristic hexagonal structure, which aligns with the standard card of CuS. Additionally, the morphology of the synthesized CuS was analyzed by SEM, confirming the nanosized and the planar shape of the formed nCuS. Currently, the drought system is being developed and evaluated for efficiency. Current observation showed that the system is able to cause drought among soybean plants starting from Day 7 and was also able to maintain the soil moisture content at around 8%. To evaluate the drought-recovery effect of nCuS, the nCuS will be foliar applied at 250, 500, and 1000 mg Cu/L and the plant performance and nutrient acquisition will be evaluated. The results of the current work will provide useful information on sustaining and improving food production and quality under adverse abiotic stress.





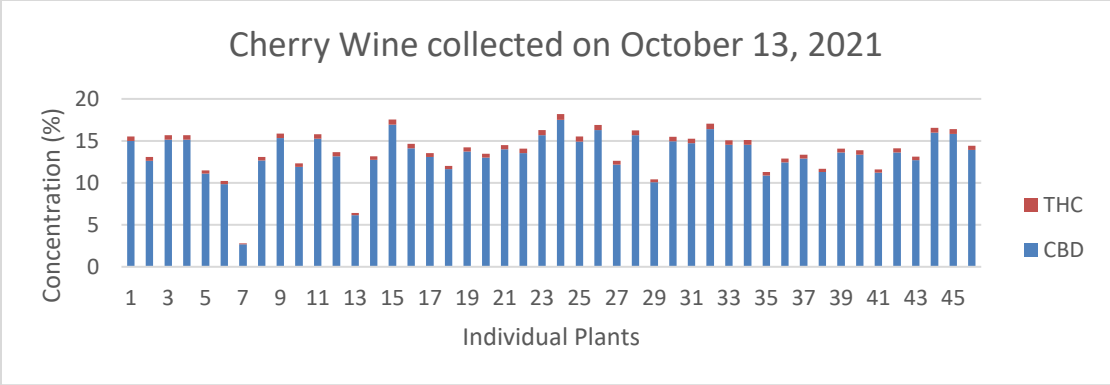
ADDITIONAL RESEARCH IN THE DEPARTMENT OF ANALYTICAL CHEMISTRY

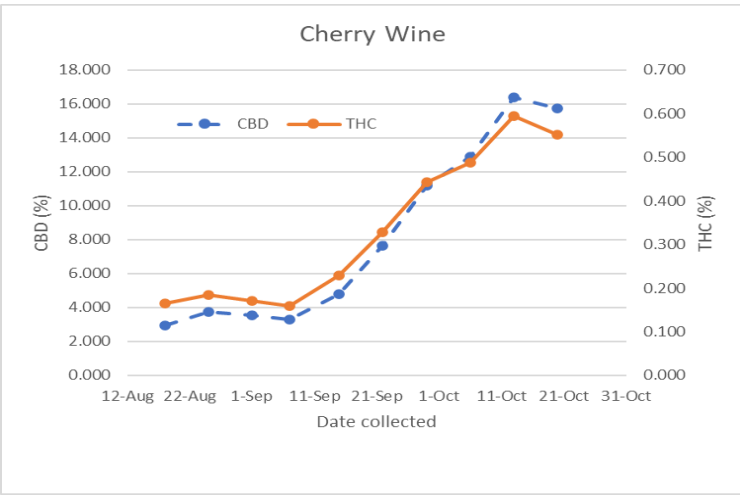
1. Hemp Research

- 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) to assess whether copper (Cu) application has any effect on the levels of CBD and THC in hemp plants grown under field conditions. The later objective is relevant considering Cu products use as fungicides in agriculture and Cu's involvement in the regulation of secondary metabolite production in plants. 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, USDA final guidance allows for sampling up to 30 days prior to harvest, but the CBD and THC escalate rapidly during maturation. This may result in a harvested crop failing post-harvest testing (if any is done) even if the grower follows the law. Lastly, hemp varieties 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.

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%.





Preliminary data to understand the second objective indicated a trend for dose and type-specific effect on the levels of these metabolites under the studied conditions, which included copper oxide nanoparticles (CuONPs; 50, 100 and 500 mg Cu/L) bulk copper oxide (CuOB; 100 mg Cu/L) and copper sulfate (ionic Cu; 100 mg Cu/L). Typically, THC and CBD levels escalate with time, reaching peak production during late Fall. When buds were harvested approximately 4 months after planting, compared to the control (no copper) treatment CuONPs at 50 mg/L increased THC and CBD levels by 7 and 9%, respectively; CuONPs at 100 mg/L increased THC and CBD levels by 15 and 13%, respectively; and ionic Cu at 100 mg/L increased THC and CBD levels by 22 and 24%, respectively. In contrast, CuONPs at 500 mg/L decreased THC and CBD levels by 11%, apiece, while CuOB did not influence THC level and only negligibly (3%) reduced CBD levels. These findings are interesting given that copper is a pesticide used in controlling a variety of fungicidal infestations in plants. It is plausible that treatment of hemp plant with Cu as a pesticide could influence THC and CBD levels, depending on the dose and Cu type, but perhaps, more importantly, on the time of harvest. More in-depth research will be undertaken on this topic.

2. Assessing the presence of PAHS in nanoparticulates mimicking wildfire deposition and effects on plant quality

- Investigators: Nassifatou Titikpina, Christian Dimkpa and Jason White

In collaboration with Rutgers university, this newer project aims to decipher new compounds synthetized de novo by plants or the variation in their secondary metabolites profiles due to exposure to particulates from wildfires (wildfire derived nanomaterials, W-NM). In addition, the fate of contaminants contained in those particulates such as polycyclic aromatic hydrocarbons (PAHs), upon uptake of particulates by plants is also being investigated. The project will elucidate the metabolic scenarios of plants when subjected to wildfires, and how such exposure impacts the nutritional and/or medicinal values of plants used for dietary purposes, including feeding and healthcare. To this end, initial efforts focused on identifying and quantitating the PAHs present in brown and black nanoparticles synthesized to mimic particulates in wildfires. There are dozens of PAHs, among which, 16 have been established as priority by the US EPA: naphtalene; acenaphtylene;

acenaphtene; fluorene; phenanthrene; anthracene; fluoranthene; pyrene; benzo(a)anthracene; chrysene; benzo(b)fluoranthene; benzo(k)fluoranthene; benzo(a)pyrene; indeno(1,2,3-cd)pyrene; benzo(ghi)perylene and dibenzo(a,h)anthracene. These PAHs are considered priority PAHs because of their toxicity to living organisms and their persistence in the environment. We have developed a gas chromatography coupled with mass spectrometry (GC-MS) method to identify and quantify the 16 PAHs in the black nanoparticles.

Various US agencies have made recommendations and or regulations on the levels of PAHs that could be encountered in various fields (ATSDR, 2012). Considering those regulations, in the event that 1 mg of the black nanoparticles end up in water, the concentration of the PAHs contained would already exceed the regulations for their presence in water, which is in the range of 2 to 4.10^{-7} ppb. In the air, considering a PAH such as chrysene, the regulations are in the range of 10.71 to 21.42 ppb. Hence, 1 mg of the black nanoparticles being present in the air would already exceed the recommended limits for chrysene. The same compounds were also identified in the brown nanoparticles, though at lower concentrations than the black nanoparticles. However, further method development is ongoing to establish the complete profile of brown nanoparticles.

Table 1: Contents (ppb) of PAHs in the black nanoparticles sample (n=3, mean ± SD) SD: standard deviation

	Concentration (ppb) ± SD
Naphtalene	128.±0.05
Acenaphtylene	325.±0.19
Acenaphtene	89.±0.32
Fluorene	100±0.06
Phenanthrene	361±0.20
Anthracene	88±0.04
Fluoranthene	1047±0.42
Pyrene	1900±1.42
Benzo(a)anthracene	213±0.12
Chrysene	234±0.10
Benzo(b)fluoranthene	293±0.13

Benzo(k)fluoranthene	193±0.10
Benzo(a)pyrene	688±0.34
Indeno(1,2,3-cd)pyrene	491±0.40
Benzo(ghi)perylene	1470±0.95

More in-depth research is currently being proposed to USDA on this subject. Lead researcher, Dr. Tittikpina, was awarded the Experiment Station Associates' Early Career Scientist Award to study this phenomenon, wherein she is exposing plants to the black and brown particles under greenhouse conditions and tracking the PAHs within the plants.

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, heavy metals in food, soils, and consumer products, and on the presence of unknown foreign materials in food and beverages. In some instances, we refer the caller to a more appropriate CAES department or state agency.

Station Bulletins: Three Station Technical Bulletins are under preparation by our department for the outgone year: When ready, these bulletins will be 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.

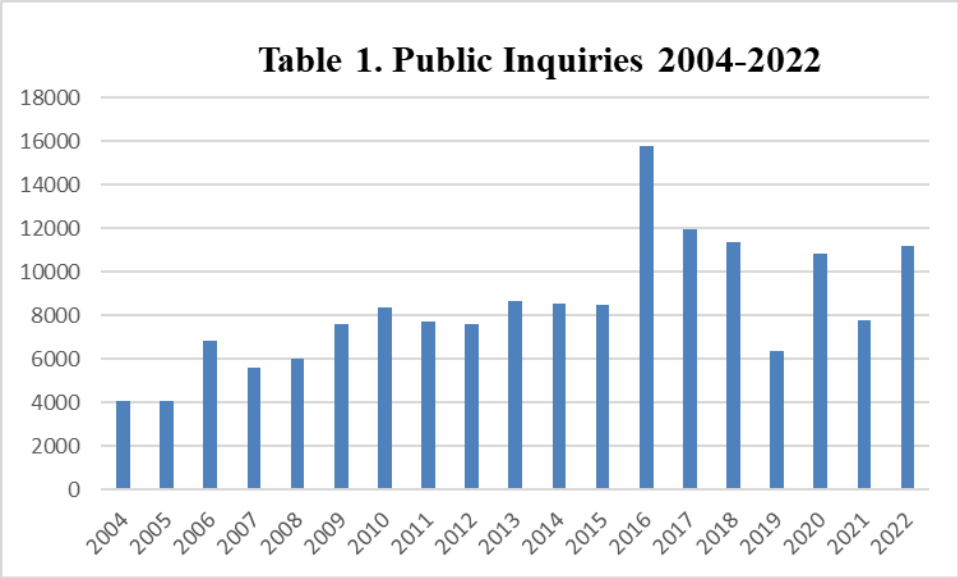
The Department of Entomology is involved in a variety of service, research, pest surveillance, and plant regulatory activities. The primary service activities are provided through the Insect Information Office (IIO). Staff in this office answer insect-related questions and identify insects and related 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 and Katherine Dugas work in the New Haven insect information office (IIO). Records on the insect identification services date back to nearly the inception of the institution (1875). Public insect inquiries were reported in the first Annual Report of The Connecticut Agricultural Experiment Station published in 1877. The station offered 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 in person citizen visits to smartphones and emails. These are currently the most common forms of communication used by the public to submit inquiries. Smartphones and emails are 61% while visitors and mails are 39%. Since the onset of the COVID-19 pandemic these two forms of contactless communication have been the principal way citizens have communicated with the IIO.

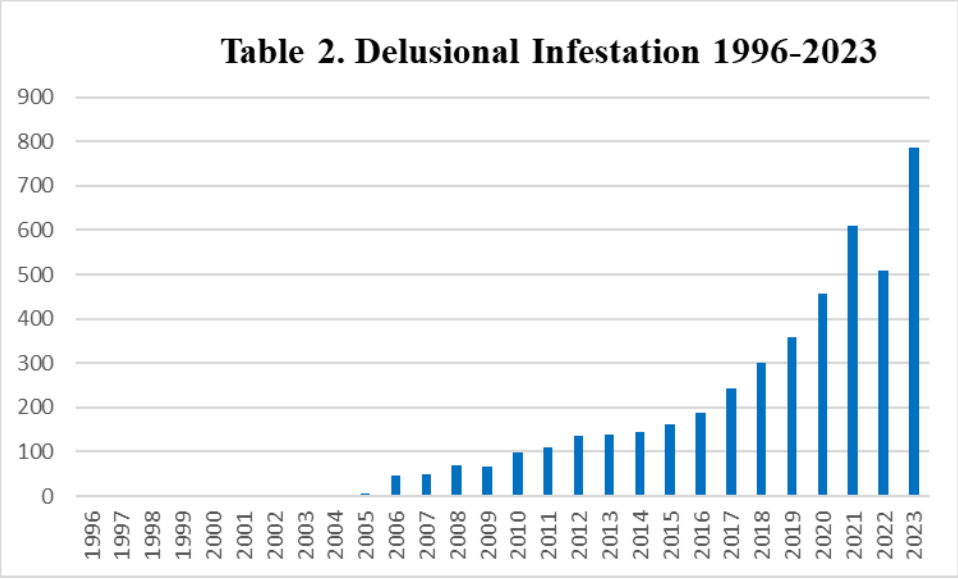
The impact of the IIO include public education to reduce pesticide use and promote non-chemical management of nuisance arthropods, protection of public health, conservation of natural habitats and species, protection of agriculture, and protection of urban structures and other buildings. The office directly 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, 2022, and June 30, 2023, the IIO handled 11,251 requests for information (Table 1).

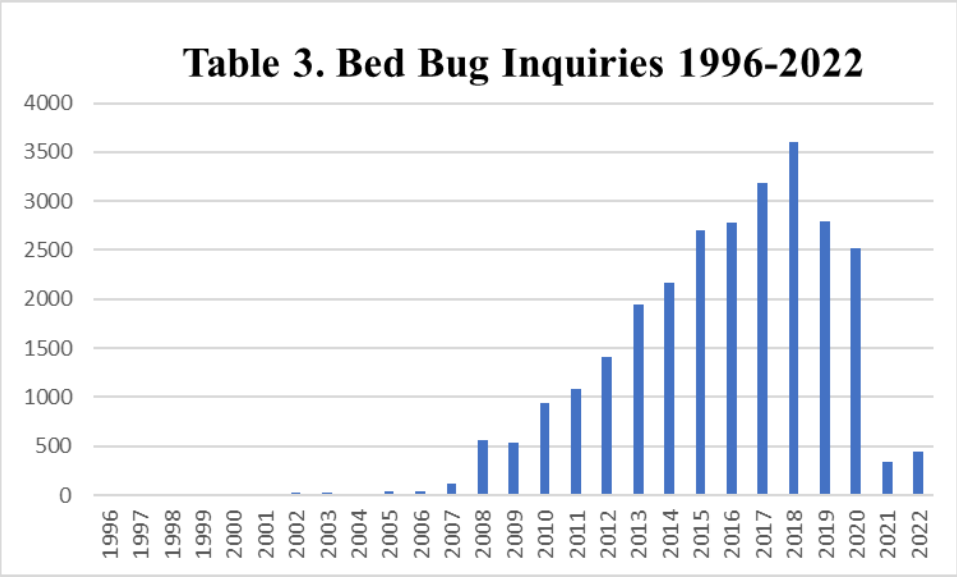
Natural resources (these include forestry, nursery, agriculture, manmade structures, and urban and suburban gardens) at 45% and man and medical issues at 43% were the most active inquiries while food and undetermined 9% and 3% respectively remained relatively low.

There were 811 categories of inquiries that included insects, arachnids, animals, pesticides, insect damage, general entomology, and horticulture. Delusional Infestation (DI) cases dramatically increased due to citizen self-reporting searches on the internet. Since 2006/2008 DI inquiries have steadily climbed from 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), 508 (2022) to 787 (2023), (Table 2). These are time consuming somatic and psychiatric cases requiring multiple phone calls, emails, and client visits. These often involve collaboration with medical professionals and family members. DI continues to remain high in part due to two leading drivers of DI, stress and depression. These are closely followed by undiagnosed underlying somatic conditions known as “Secondary DI.” “Primary DI,” which is true psychiatric illness is in the experience of the IIO very rare.

Spongy moth *Lymantria dispar* (formerly called the Gypsy moth), activity was quiet across most of Connecticut during the 2022-23 year. This was because of a wet cold spring that supported the pathogenic fungus *Entomophaga maimaiga,* the principal pathogen which manages spongy moth populations. Human feeding bed bug *Cimex lecturlarius* inquiries were a little higher this year with 444 inquiries over 2021 which saw 341 inquiries (Table. 3). Bat bug *Cimex adjunctus* inquiries were elevated with 36 calls for assistance. The reason for this cannot be explained. Additionally, it is anticipated that spotted lanternfly inquiries will increase dramatically from late summer into fall 2023 as populations establish in Connecticut.



Jumping worm inquiries remained active. Though inquiries were down during the fall of 2022 due to a late summer drought killing many adults, public inquiries picked up during the spring of 2023. This was because cocoons produced by adult from previous years survived and hatched. It was a wet spring which also favored these soil surface inhabiting worms. A mild winter and a cool wet spring also favored ticks and aphids. Inquiries for these were up during the spring of 2023. Additionally, we saw a great deal of damage by sawflies and four-lined plant bugs during the spring. The combination of drought and high-volume rainstorms flushed organic material from soils. This led to the soils becoming sandier which favored nesting activity of solitary bees and wasps. Calls about management of these were up.



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:

- Goudarz Molaei, Ph.D., Department of Entomology, The Connecticut Agricultural Experiment Station
- Philip Armstrong, Ph.D., Department of Entomology, The Connecticut Agricultural Experiment Station
- John Shepard, Department of Entomology, The Connecticut Agricultural Experiment Station
- Kirby Stafford, Ph.D., Department of Entomology, The Connecticut Agricultural Experiment Station
- Roger Wolfe, Wildlife Division, CT Department of Energy and Environmental Protection
- Scott Williams, Ph.D., Department of Environmental Science and Forestry, The Connecticut Agricultural Experiment Station
- Rebecca Johnson, Ph.D., Department of Entomology, The Connecticut Agricultural Experiment Station
- Douglas Brackney, Ph.D., Department of Entomology, The Connecticut Agricultural Experiment Station
- Andrea Gloria-Soria, Ph.D., Department of Entomology, The Connecticut Agricultural Experiment Station
- Megan Linske, Ph.D., Department of Entomology, The Connecticut Agricultural Experiment Station
- Zannatul Ferdous, Ph.D., 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 Ridge, Ph.D. It was agreed the book “Physicians Guide to Delusional Infestation” be written for the medical profession. All the speakers as well as Lyle Buss, Ph.D. 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 published as of April 2024. DOI: 10.1007/978-3-031-47032-5

Victoria Smith, Ph.D. 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.

The program and links to presentations from the Workshop may be found at Forest Health Monitoring Workshop 2023 (ct.gov). The Workshop for 2024 is scheduled for March 12, 2024.

A symposium on Spotted Lanternfly (SLF), a newly invasive pest in Connecticut, was sponsored by a CAES Board of Control grant to Claire Rutledge, Ph.D. and by the Connecticut Farm Wine Development Council. The speakers included Dr. Melody Keena of the Northeastern Forest Research Station USDA, FS speaking on SLF biology. Victoria Smith, Ph.D., State Entomologist CEAS, and Erica Willey APHIS PPQ, speaking on the regulatory status of SLF in CT and its current distribution in Connecticut. Dr. Flor Acevado of Pennsylvania State University speaking on SLF management in vineyards. Nicole Carrier of APHIS PPQ shared information on a newly invasive beetle, the grape vine borer *Xylotrechus pyrrhoderus*,(Coleoptera: Cerambycidae). This potential pest has been detected in central Massachusetts. At the end of the morning there was a panel discussion held with all the speakers and Jamie Jones of Jones Family Farm of Shelton. There were 35 attendees, and CEU's were awarded to 29 participants from Connecticut Department of Energy and Environmental Protection. The symposium was greatly facilitated by help from Niklas Lowe, a durational worker supported by a CAES BOC grant, and Kelly Fairbrother.

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

- Mia Varney – Mia completed an individual research seminar with me for Southern Connecticut State University. Her project focused on reproductive success of female emerald ash borers during two different stages of invasion. Emerald ash borers females are more successful if they mate more than one time, and their ability to locate multiple partners may vary with population density. This in turn may impact the population growth of the beetles.
- Lila Luthy and Sophie Zyla – Lila and Sophie were students of Dr. Helen Polous at Wesleyan University. They both assisted me throughout the fall collecting data on ash tree regeneration at sites across Connecticut. We examined two factors that might impact ash forest structure, whether biological control releases had occurred at a site, and how old the emerald ash borer invasion was at a site.
- Justin Bellemare – Justin completed an internship in my laboratory during the spring semester to fulfil a requirement at the University of New Haven. Justin compared species composition and abundance of velvet ants (Hymenoptera: Mutillidae), collected from naturally occurring sand plains, and artificial sand plains AKA baseball infields. He also conducted basic soil analysis of the two habitats.
- Allison Flagg – Allison completed an internship in my laboratory during the spring semester to fulfil a requirement at the University of New Haven. Allison, a Forensic Science major, used fly traps baited with meat to attract carrion flies. Using this technique, she sought to document flie species responding during the spring months in southern Connecticut. She, also set the traps in three habitats: a natural wooded area, a suburban neighborhood and an urban area. Finally, she allowed the traps to stay in place for one week each trial and collected flies daily to document any changes to species composition with changes in meat age.

Dweck's Chemical Ecology Laboratory

- Michael Sekyere, from Ghana, is a Seasonal Research Assistant and a Master student at the University of Bridgeport. His research involves testing the hypothesis that mating induces a preference shift in Spotted Wing Drosophila, causing them to switch from over-ripe fruits to ripe ones (May 8-October 31, 2023).
- Ananda Turner, an undergraduate student at Hampton University, has joined the lab as a summer intern in the SCSU Plant Health Fellows program. Ananda's research focuses on investigating the volatile landscapes of the spotted wing Drosophila (SWD). The objective is to analyze the volatile profiles of more than 30 ripe fruits in order to determine if SWD host fruits contain shared volatiles, if the volatiles of SWD host fruits are distinct from those of non-host fruits, or if the volatiles of SWD host fruits are shared with non-SWD host fruits but differ in their ratios (June 5-August 3, 2023).

Dr. Doug Brackney Laboratory

- Michael Sekyere, a master's student at the University of Bridgeport, joined the lab in the spring of 2023. He will complete his thesis in the laboratory examining the role of hemocytes in basal lamina repair.

- Desiree Kleeberg, a recent Quinnipiac University graduate, did her senior thesis work in my laboratory investigating the contribution of the microbiome mediating vector competency.

- Abbey Porzucek, a Yale School of Public Health graduate student, did a rotation in my laboratory designing and optimizing microsphere immunoassay to detect avian antibodies against EEEV in engorged wild-caught mosquitoes.

Dr. Kelsey E. Fisher Laboratory

- Bria Fielding, a recent Southern Connecticut State University graduate, completed an internship during the Spring 2023 semester, where she assisted with analyzing wing metrics of monarch butterflies collected across the world from 2016-2020 to determine migrant status.

- Lauren Conner, a master's student at Western Connecticut State University, joined the lab in May 2023. Her work analyzes plant and insect biodiversity in New Haven bioswales.

- Alina Filandro, an undergraduate Biology student at Quinnipaic University, joined the lab in May 2023. Her work investigates migrant status of monarch butterflies collected worldwide with wing metrics.

- Dewayne Smart, an undergraduate Biology student at Quinnipaic University, joined the lab in May 2023. His work is exploring the impact of VHF radio transmitter attachment on *Bombus griseocollis* behavior.

- Karena Kulakowski, an undergraduate Biology student at Central Connecticut State University and SCSU Plant Health Fellow, joined the lab in June 2023. Her work investigates the impact of beech leaf disease on beech-feeding forest Lepidoptera.

- Ashley Medel, an undergraduate Biology student at Albertus Magnus College, joinedthe lab in June 2023. Her work explores the impact of milkweed quality of monarch larval growth and development.

Dr. Andrea Gloria-Soria Laboratory

- Hosted and advised Master student Meredith Bagger from the Yale School of Public Health. She has been assisting with molecular genetics and research projects on mosquitoes, with a focus on filarial parasites carried by local mosquitoes (Started February 14, 2022). She continued to work on the presence of heartworm parasites in mosquitoes from Connecticut as part of her Master Thesis.
- Hosted and advised internship of Caden Cloutier from Albertus Magnus College. He has been assisting with molecular genetics and research projects on mosquitoes (Started November 14, 2021).
- Hosted and advised internship of Tristan Smith from Albertus Magnus College. He has been assisting with molecular genetics and research projects on mosquitoes (Started November 14, 2021).
- Hosted and advised internship of Skylar Arent from Albertus Magnus College. She has been assisting with molecular genetics and research projects on mosquitoes (Started May 30, 2023).
- Hosted and advised internship of Rachael Pelligrini from Albertus Magnus College. She has been assisting with molecular genetics and research projects on mosquitoes (Started June 30, 2023).

Tracy Zarrillo Laboratory

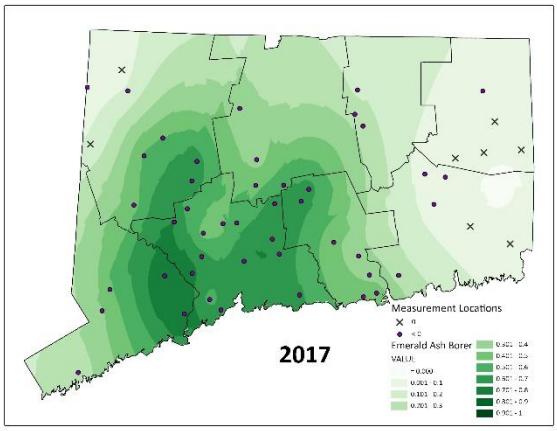
- Advised and provided taxonomic assistance to an undergraduate student David Rubin from Yale University on his senior research project. His work focused on bee diversity in Connecticut forests and how forest age can influence species richness.

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 14th year of our Wasp Watcher program. Over the course of the program, we have trained 225 watchers. In 2023, 18 veterans returned, and 8 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. This past year, two papers were published using wasp-watcher data, one assessing the distance that wasps cover surrounding their colony, and the other documenting the rise and fall of the emerald ash borer infestation in the state.



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. The beetle is of concern in Connecticut because one of its favored hosts, the pitch pine, is locally rare and is vulnerable to eradication by this tree-killing beetle. The picture shows a pitch pine in Wallingford, CT killed by southern pine beetle with bark removed. The blue streaks are a fungus which is vectored by the beetle and makes it impossible for the tree to transport water.

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 17 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 understand the impact of the biological control program on the ability of ash forests to regenerate in the wake of the emerald ash borer invasion. Looking at sites where parasitoids were released and comparing them to nearby control sites, we have found that release sites had larger surviving ash than control sites. However in both release and control sites we have found both species of larval parasitoids parasitizing emerald ash borer, including sites in which the emerald ash borer densisty is currently very low. In addition, we are seeing regeneration in all areas, with many small ash saplings and seedlings as well as basal sprouts from EAB killed trees. Future work will continue to document the long-term recovery of ash in Connecticut's forest, and the contribution to that regeneration from our introduced biological control agents.

Spotted Lanternfly in Connecticut

Dr. Claire Rutledge, Dr. Melody Keena (US FS), Dr. Robert Trotter (US FS)

Spotted lanternfly (SLF) is a recently invasive pest from southeastern Asia. It was first discovered in Pennsylvania in 2014, and populations were found in Connecticut in 2020. Along with my collaborators, we are working on two major areas. The first is collecting data to construct a complete phenological model for SLF. In particular, understanding the impact of climate on the ability of SLF to complete their long life-cycle and the potential limits of its distribution in North America. The other major thrust is to assist Connecicut grape growers to monitor for and adapt to the presence of SLF. Grapes are a favored

host of SLF and the commodity most likely to be impacted economically by SLF. A spring 2023 survey of 14 vineyards in 7 counties did not detect any SLF egg masses.

Checklist of the Bees of Connecticut and Conservation Status Assessments

Ms. Tracy Zarrillo, Dr. Kimberly Stoner, Dr. John Ascher (National University of Singapore), and Bruce Young of NatureServe

There are 383 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. Subnational conservation ranks were given to 124 bee species by CAES in cooperation with CT-DEEP and NatureServe. Of the 124 bee species assessed, 21 were designated S1 (critically imperiled), four were designated S1/S2, seven were designated S2 (imperiled), seven were designated SX (extirpated from Connecticut), and 37 species were designated SH (known from historical records but still hope for recovery). *Bombus terricola* (S1/S2) persists in Litchfield County, with the addition of one new town occurrence in the town of Litchfield.

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 and vegetation are conducted once per month from April to September to evaluate how plant and bee species diversity change over time.

Assessing Pollinator Response to Isolated Plantings of Eco-type Host Flowers in Agricultural Settings

Ms. Tracy Zarrillo

State and federal agencies (CT-DEEP, DOT, NRCS), land conservation organizations, private landowners, farmers, and pollinator conservation groups (Pollinator Pathways) are investing time and money creating

pollinator habitat and meadows throughout the state. While pollinator habitat restorations have good intentions, care must be taken to ensure they achieve their desired results. Assessing the ability of these habitats to attract and support native bees can support the success of these efforts. One aspect of many of these projects is the use of native plants. In response to demand for locally adapted native plants, ecotypic flower seed is being developed as a new commodity in Connecticut. Ecotype seeds are seeds grown from a parent stock that have genetically evolved over time to be adapted to the environment of a particular ecoregion. Ecotype seeds could be used by nurseries, farmers, state agencies, land trusts, landscapers, and private landowners to help increase native habitat in Connecticut. However, we have limited information about which bee species are supported by these native plants, or if the bee species are equally attracted to these native plants throughout the state. Some of the native flower species being grown for seed are hosts of specialist bees. Knowing which bee species are attracted and where they can be supported by certain flower species can help guide flower species selection for commercial development.

Assessing Plant and Pollinator Response to the New England Pollinator Partnership in Connecticut and Rhode Island

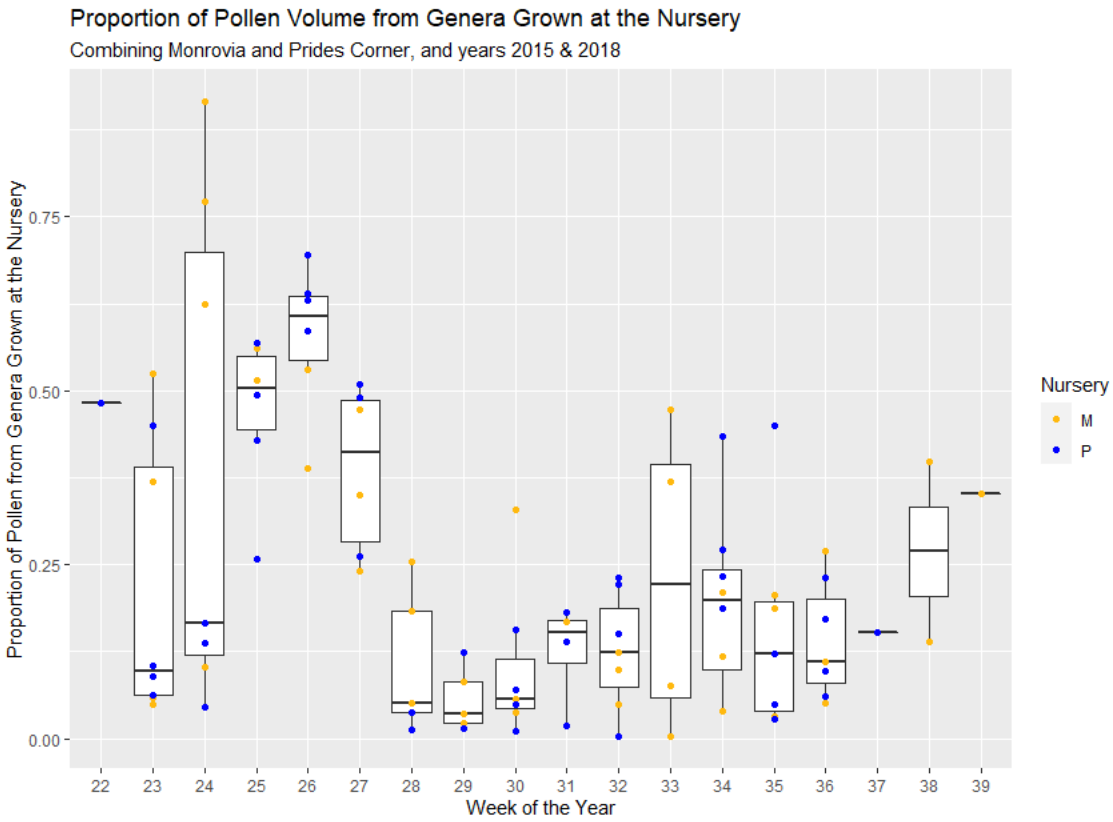
Ms. Tracy Zarrillo with collaborators Dr. Steve Alm and Ms. Casey Johnson of the University of Rhode Island

Wild native bees provide an estimated $3 billion annually in pollination services in the U. S. However, native bees have declined in recent decades with habitat loss and land use intensification. The Farm Bill has invested in a range of incentive-based conservation programs on agricultural land to mitigate recent bee declines while providing multiple other benefits for agriculture and surrounding environments. However, documentation that these programs have achieved their desired outcome of increasing wild native bees in the landscape is lacking. In this 3-year project, at least twenty Farm Bill conservation plantings in CT and RI will be surveyed for wild bees once per month from June through September. Bee and plant species richness will be documented for each site over the course of the season and the relationship between plant diversity and bee species richness will be quantified. The information from this research will help develop seed mixes specific to Connecticut and Rhode Island.

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.



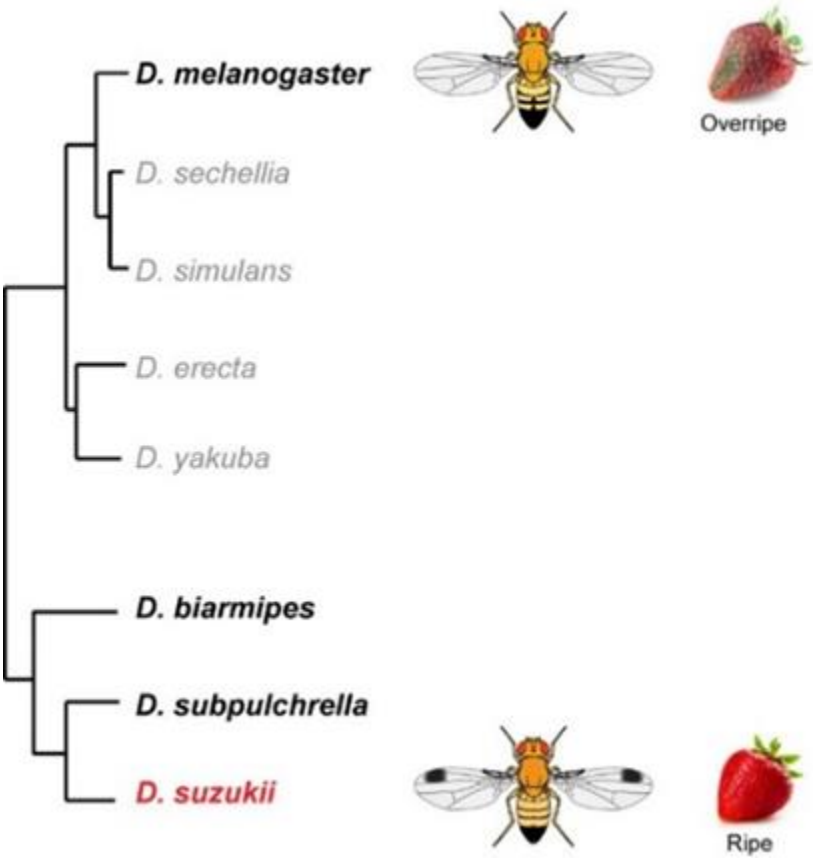
Chemical Ecology of Crop Pests

We aim to understand how pests, such as spotted wing Drosophila (SWD) and spotted lanternfly (SLF) interact with crops. At the core of this research endeavors lie a set of focused objectives: 1) Exploring Ecologically Relevant Chemical Cues: We strive to unravel chemical signals used by insects for vital functions such as sexual communication, host location, and their ability to evade natural enemies and harmful microbes. 2) Investigating Neurons and Receptors: We study the sensory neurons and receptors responsible for detecting these chemical cues toe understand how insects perceive and respond to their chemical environment. 3)Analyzing Behavioral Outputs: We investigate the behavioral outputs elicited by these cues, studying how they influence mating patterns, host selection, and defense mechanisms in insects. This knowledge forms the foundation for the development of targeted strategies to disrupt or manipulate insect behavior for pest control and integrated pest management (IPM), ultimately benefiting Connecticut's agricultural industry and food production systems.

Acid Taste Sensing in Spotted Wing Drosophila

We aim to understand the gustatory mechanisms that enable animals to adapt to new environments. When a species inhabits a novel ecological niche, one crucial aspect that must undergo evolutionary changes is its taste system. This dynamic and adaptive process ensures that the species can modify its sensory capabilities to effectively assess the suitability of newly available resources for vital activities such as feeding and egg-laying. By optimizing its interactions with the surroundings, the species can enhance its survival and reproductive success. However, the specific mechanisms underlying these adaptations are still not fully understood.

Fig. 1. Phylogenetic tree depicting the relationship between *D. suzukii* and closely related *Drosophila* species.



To bridge this gap, our research focuses on the unique egg-laying behavior of *Drosophila suzukii*, commonly known as spotted-wing *Drosophila* (SWD). Unlike its closely related species, including the model organism *D. melanogaster*, which lays eggs on fermented fruit, *D. suzukii* exhibits a distinct egg-laying preference for early maturation stages, including both ripe fruit and earlier stages of ripening (Fig.1).

To lay eggs on ripe fruit and early stages of ripening, *D. suzukii* has evolved two key modifications. First, *D. suzukii* has evolved an enlarged saw-like ovipositor, a specialized organ for egg-laying, to penetrate the skin of early maturation stages and lay eggs. Second, *D. suzukii* has acquired the ability to lay eggs on ripe fruit and earlier stages of ripening as opposed to fermented fruit. This evolutionary shift poses not only an urgent agricultural problem but also a fascinating biological question: What are the underlying mechanisms driving such a significant behavioral change?

The shift in egg-laying preference requires alterations in the perception of various sensory stimuli, particularly in taste. Previously, with the support of the National Institutes of Health (NIH) and the Life Sciences Research Foundation (LSRF), our research demonstrated at the behavioral, cellular, and molecular levels that

D. suzukii and *D. melanogaster* exhibit differential responses to bitter compounds and sugars. This research now invites a similar investigation into the sensation of other significant taste cues. Therefore, we investigate the acid taste sensation in *D. suzukii* and its contribution to the shift in egg-laying preference towards ripe fruit and earlier stages of ripening.

Olfactory Mechanisms by Which Spotted Lanternfly Interacts with its Host Plants

we aim to delve into the olfactory mechanisms and their pivotal role in an interaction that holds both economic urgency and fundamental biological significance: the interaction between the spotted lanternfly (SLF) and Connecticut's trees.

Similar to numerous other insects, the SLF primarily relies on olfactory cues to locate its host trees. Additionally, olfaction plays a crucial role for the SLF in predator avoidance, aggregation, mate selection, and identifying suitable sites for depositing its egg masses.

The long-term goal of this work is to comprehensively understand the olfactory mechanisms through which the SLF interacts with its host trees. To achieve this, we pursue three specific objectives. Firstly, we identify the odors that hold significant importance for the SLF (**objective 1**). Secondly, we pinpoint the specific neurons responsible for detecting these odors (**objective 2**). Lastly, we investigate the behaviors triggered by these odors (**objective 3**). By attaining these objectives, we anticipate discovering new and innovative approaches that are cost-effective and environmentally friendly for managing the invasion of this pest.

Spatial-temporal trends in continental-scale monarch butterfly dispersal and migration

Kelsey E. Fisher (CAES), Steven P. Bradbury (Iowa State University), Alan Wanamaker (Iowa State University), Brad Coates (USDA-ARS-CICGRU)

Monarch butterfly movement at a continental-scale (the annual migration) is understood based on indirect metrics like citizen science observations and stable isotope analyses of monarchs overwintering in Mexico; however, these methods provide course approximations of movement at a population level. For example, we know when monarchs first arrive in areas along the migration route because of reported observations to the Journey North citizen science program, but we do not know where these individuals originated and how much further they will go. Similarly, stable isotope analyses suggest that 38-56% of the overwintering monarchs (4^{th} generation individuals) originated in the Midwest US, but we do not know where previous generations within a maternal lineage developed. Based on these reports, we assume that monarchs perform a stepwise northern migration with the Midwest as the most important region for monarch butterfly production, but there are many gaps in our knowledge of the annual migration. In attempts to better understand individual-level migration and support monarch butterfly conservation, wild monarch butterflies were collected across space and time from 2016-2021 and preserved at -20°C. Specifically, monarch adults were collected in Pennsylvania, Delaware, Iowa, Ohio, Nevada, Idaho,

Hawaii, and three locations in Australia from July to August 2016, and wild individuals were continuously collected from May through October 2016 to 2021 at various locations in Iowa, USA. Using pooled mitochondrial DNA sequencing data of these geographic and temporal samples and individual stable isotope quantifications of d2H, d13C, d18O, and d15N within wing tissues, individual-level migration patterns have begun to become clear. It appears that migration may not be a stepwise process and that large-distance movements may continue through the entire breeding season. Additional studies comparing the evidence of long-distance migrant individuals identified through the genetic and stable isotope methods with historic migrant quantification methods (wing measurements and color) are underway.

Plant-insect interactions between monarchs (*Danaus plexippus*) and their host plant (*Asclepias* sp.) and the impact on conservation

Kelsey E. Fisher (CAES) and Steven P. Bradbury (Iowa State University)

Integrating aspects of larval lepidopteran behavior that enhance survival into conservation plans could increase the overall impact of conservation efforts. Monarchs perform a seemingly innate behavior in which larvae abandon their natal ramet of common milkweed, and subsequent ramets, before all the available leaf biomass on a ramet is consumed and prior to the pre-pupal wandering stage. The motivations for milkweed ramet abandonment remain unclear. We hypothesize herbivory causes reduced plant quality, which initiates searching behavior for an alternative food source. Reduced plant quality could result from (1) preferential consumption of young vegetation, (2) induced cardenolides, (3) induced defenses including "call for help" compounds to attract predators and/or parasitoids, and/or (4) reduced leaf cover resulting in exposure to potential predators. Studies to shed some light on these hypotheses are underway.

Small native plantings prevent water run-off and may benefit pollinators

Kelsey E. Fisher

Habitat fragmentation provides a significant barrier to insect movement across the landscape. Individuals that can traverse an unsuitable matrix often do so at an energetic cost, while those that cannot suffer from potential resource limitation and genetic inbreeding from habitat isolation. Connecting habitat patches, either directly with corridors or functionally with 'stepping stones,' facilitates the efficient movement of individuals across fragmented landscapes to increase population sizes and gene-flow. "Pollinator Pathways" is a grassroots volunteer organization that started in Connecticut in 2016 and aims to "de-fragment" the landscape by establishing pollinator plots on public and private lands within 750 m of each other. Similarly, although designed to mitigate water run-off, >150 bioswales were established in New Haven, CT over the past 5 years. As native plants are often utilized in bioswales, these sites have to potential serve as additional Pollinator Pathway sites and support native insects/pollinators. Currently, biodiversity surveys of nine bioswales in New Haven, CT are being conducted monthly from May to September for plant species and insect utilization to determine if these sites are supporting pollinator communities.

How connected are the sites on the pollinator pathway? Siblingship analysis of bumblebees

Kelsey E. Fisher

Bumble bees (*Bombus* sp.) are native, generalist pollinators that contribute to the fertilization of native forbs and enhance the yield of field, fruit, and seed crops. However, habitat fragmentation provides a significant barrier to bumble bee movement across the landscape, jeopardizing their capacity to deliver pollination services. Individuals that can traverse an unsuitable matrix often do so at an energetic cost, while those that cannot suffer from potential resource limitation and genetic inbreeding from habitat isolation. Connecting habitat patches, either directly with corridors or functionally with 'stepping stones,' facilitates the efficient movement of individuals across fragmented landscapes to increase population sizes and gene-flow. "Pollinator Pathways" is a grassroots volunteer organization that started in Connecticut in 2016 and aims to "de-fragment" the landscape by establishing pollinator plots on public and private lands within 750 m of each other. While commendable, the efficacy of these efforts is unknown. Here, I am using bumblebees to estimate the connectivity of the pollinator pathway. To determine landscape connectivity, we need to determine how colonies (the biological unit) utilize forage habitat provided by pollinator pathway sites. Because bumble bee workers within a colony are nearly genetically identical, a population genetics approach can be used to understand movement ecology and space use for foraging in bumble bees. With this approach, foraging workers are collected, genotyped, and assigned to sibling groups or colonies. To date, this method has been used to analyze a colony's space use for foraging, the number of colonies foraging within a habitat patch, and dispersal ability of a colony across forest barriers. I am applying these methods to quantify how many colonies are utilizing four pollinator gardens in Hamden, CT and identify if individual colonies are utilizing more than one of the surveyed sites. With this study, I am also estimating colony abundance, home range, foraging movement, and approximate nest location.

Where do bumble bees nest and overwinter?

Kelsey E. Fisher and Steven P. Bradbury (Iowa State University)

Bumble bee (*Bombus* sp.) nests and overwintering hibernacula are notoriously difficult to locate, but innovative utilization of radio telemetry has the potential to improve detection. This technique is rarely implemented with insects, as their size is limiting; however, with recent advancements, there is great potential for the employment of VHF radio telemetry. For example, in recent years, I have established myself as a leader in using VHF radio telemetry to track monarch butterfly movement and I developed a unique automated system to aid in locating flying insects. In 2021, I conducted a preliminary study to adapt my VHF radio telemetry methods for use with bumble bees (unpublished data), and successfully radio-tagged (LB2X, Holohil Systems Ltd., Ontario, Canada), tracked, and visually relocated five field-captured, large (0.467-0.833 g), bumble bee workers and queens (*B. griseocollis, B. auricomus, and B. impatiens*) with the aid of automated, car-mounted, and handheld VHF radio telemetry. As a futher preliminary study, I am currently attaching sham-transmitters

(watch batteries) to wild-caught *B. griseocollis* workers to determine the impact of attaching weight on bumble bee behaviors including foraging, resting, and grooming in comparison to untagged workers.

Are caterpillars assisting with the spread of beech leaf disease?

Kelsey E. Fisher and Raquel Rocha

Beech leaf disease (BLD) affects and kills both native and ornamental beech tree species. It is associated with a nematode, *Litylenchus crenatae mccanni*i. This disease was first reported in Ohio in 2012, and much about it, including the full cause and how it spreads is unknown. Several species of Lepidoptera are capable of feeding on beech leaves. The purpose of this study is to determine how infected leaves impact larval growth, development, and survival in comparison to larvae that feed on healthy beech leaves. Additionally, frass is being collected and analyzed from larvae fed infected leaves to see if nematodes can be passed through the insect digestive system and remain viable.

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, and Jacob Ricker, Apiary Inspector Mark Creighton, and State Survey Coordinator Dana Crandall.

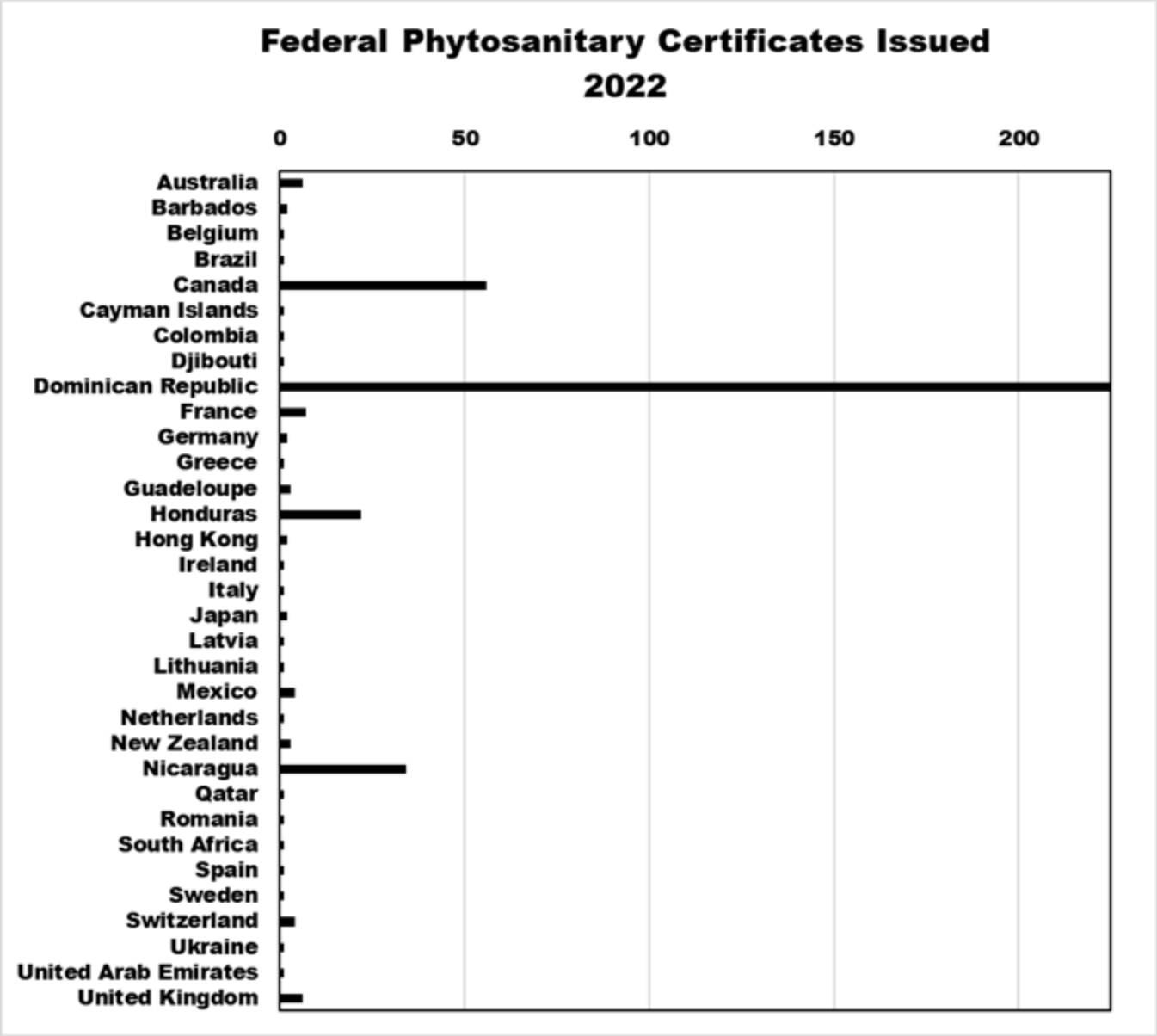
Nursery Inspection and Certification. One hundred ninety nurseries were certified to conduct intra- and interstate business. There were 142 nursery inspections during the growing season.

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.

Nursery Dealer Permits. Nursery dealer permits were issued to 90 firms.

International Phytosanitary Certificates. Three hundred ninety seven phytosanitary inspection certificates were issued covering the shipment of the following plant materials to 33 destinations outside the United States. Of the top three destinations, 226 consignments were bound for the Dominican Republic (tobacco), 56 to Canada (ornamental plants), and 34 to Nicaragua (tobacco).

Destinations for out-of-country exports from Connecticut.

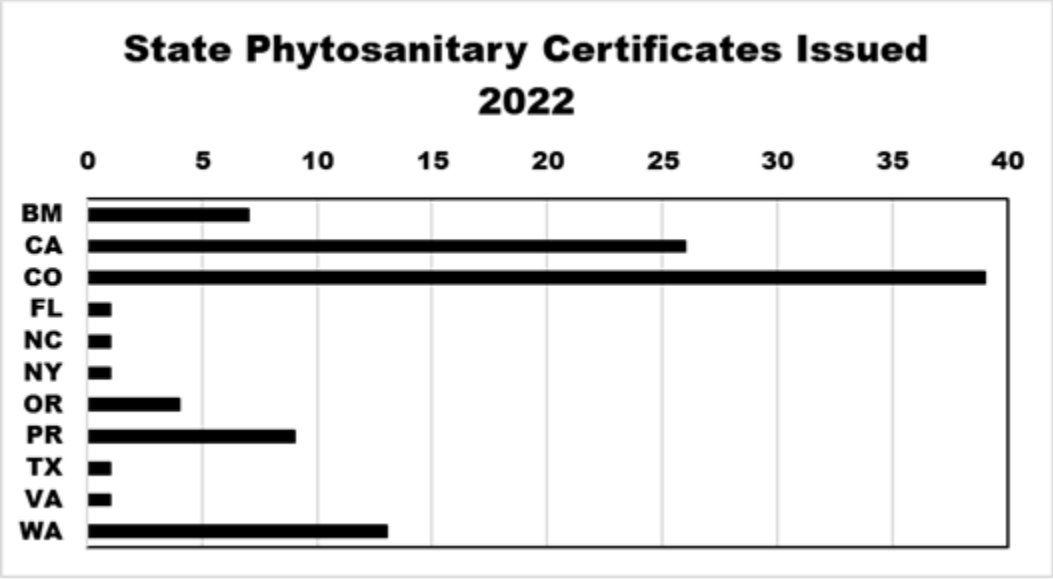


Houseplant Inspections. Eight inspections were conducted for 86 individual plants to assist homeowners moving out of state.

Domestic. A total of 103 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 (11 listed destinations). Of the top three destinations, 39 consignments were bound for Colorado, 26 to California, and 13 to Washington.

Product				Quantity
Albizia julibrissin	silktree	Bare root plants	300	plants
nursery stock	various	plants	12,985	plants
Orchids	various	In vitro plantlets	25	plantlets
Orchids	various	plants	3,192	plants
Pelargonium sp.	Geranium	plugs	1,223	plants
vegetables and herbs	various	seed	46	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 2022, there were 136 PPQ 526 Permits (Permit to move live plant pests, noxious weeds, and soil) approved in CT. There was 1 Permit 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 7 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 first found at several locations in Fairfield County, near the New York State line, in September 2020, and populations were found in 2022 in Fairfield, Litchfield, Hartford, New Haven, and New London counties. Adult insects were also reported at various locations throughout the state, in seven of eight counties. USDA plans to conduct survey and delimitation around the known populations, with treatments planned for 2023.

Lymantria dispar dispar. In 2022, we recorded 46,072 acres with significant defoliation caused by LDD, primarily in Litchfield County. In December 2022 through March 2023, 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 2023.

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 totaling about 220 acres 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 1,622 acres affected by beech leaf disease in 2022, and expect that number to increase in the coming years.

APIARY INSPECTION

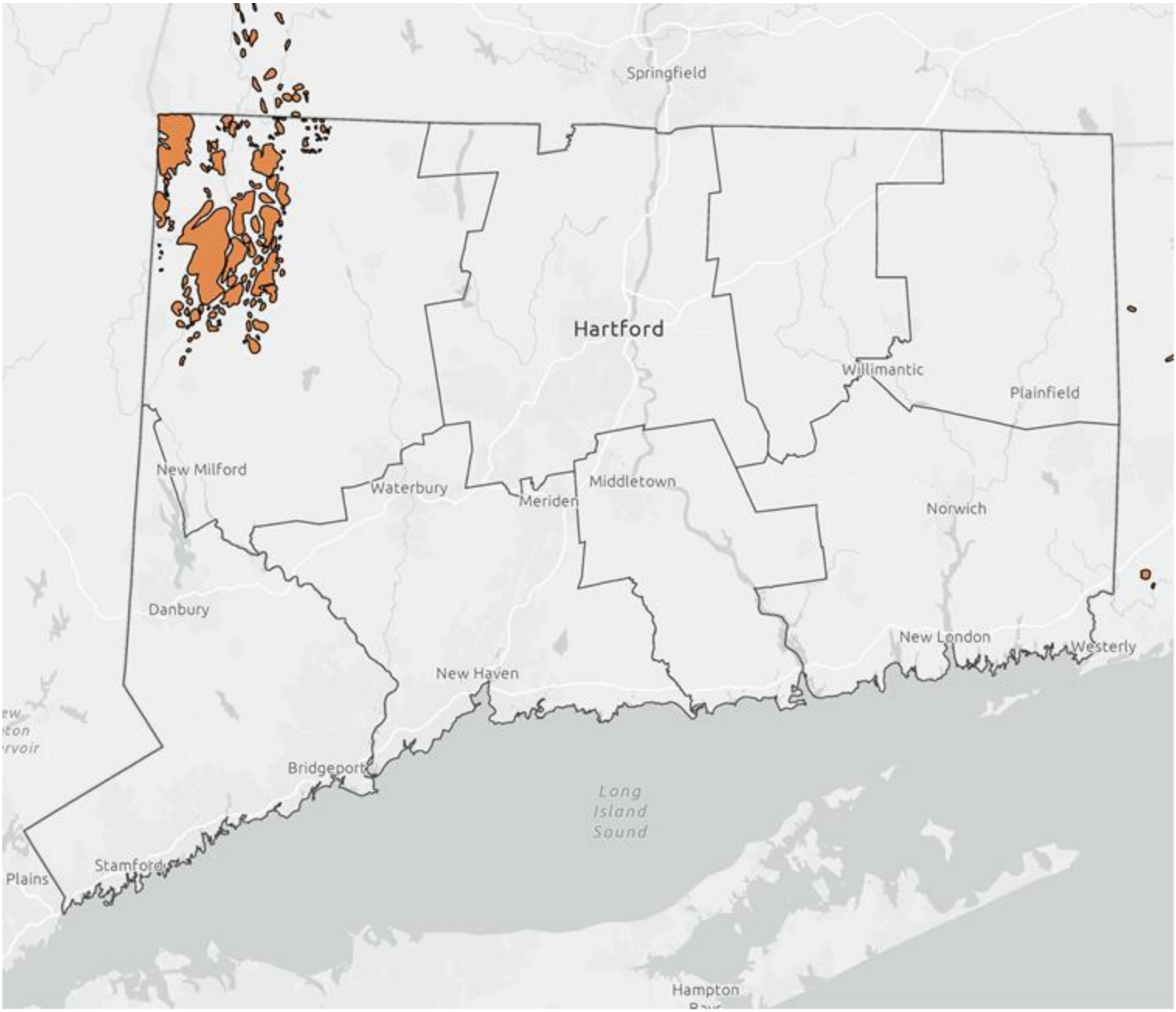
This year the focus was on supporting the small-scale beekeepers which resulted in inspecting fewer colonies. Bee Health Certificates were issued for large apiaries to sell approximately 600 nuc's to beekeepers in the tri-state area (MA, NJ, and NY), and 7 were issued for travel to South Carolina, Florida, and Maine.

Approximately 1,115 colonies were inspected at 74 apiaries

Suspected American Foulbrood cases (4) 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 49.7 %, which was the highest in the New England region. Varroa mite testing kits continue to be issued to beekeepers for the 2023 season.

Seven bee complaints were investigated and resolved.

The annual aerial survey of CT forests and natural lands was conducted during June through August of 2022; findings are below.



Special activities:

Email/telephone inquiries concerning emerald ash borer, 1 July 2022 through 30 June 2023: 9

Email/telephone inquiries concerning Asian longhorned beetle, 1 July 2022 through 30 June 2023: 18

Email/telephone inquiries concerning spotted lanternfly, 1 July 2022 through 30 June 2023: 692

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.

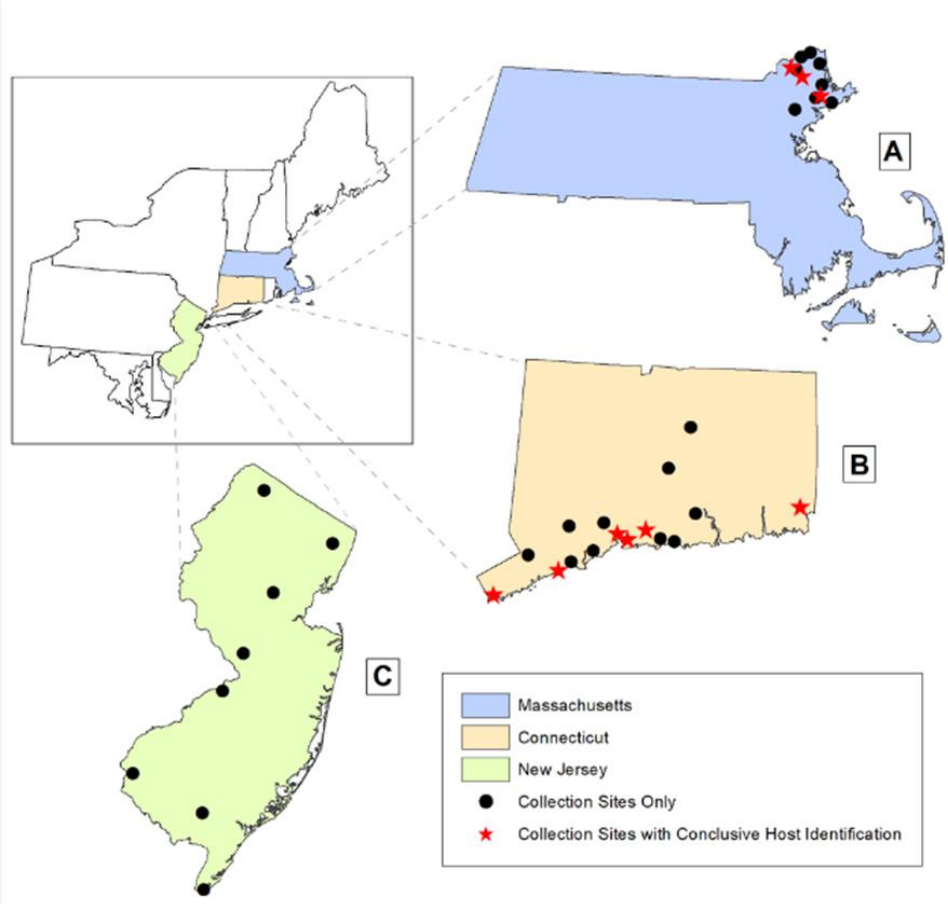
Invasive mosquito species including *Aedes albopictus* and *Aedes japonicus*, with abilities to transmit arboviruses of concern to humans, may soon pose considerable risk to human and animal health in Connecticut. The invasion and spread of *Ae. albopictus* in the U.S. occurred in the past three decades 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. Evidence of *Uranotaenia sapphirina* (Diptera: Culicidae) Feeding on Annelid Worms in the Northeastern United States

(Noelle Khalil, John J Shepard, Kimberly Foss, Goudarz Molaei*)

Mosquito host-feeding behavior is an important parameter for determining the vector potential of mosquito species in a given locale. Despite the recent discovery of *Uranotaenia sapphirina* Osten Sacken feeding on annelid hosts in Florida, host association studies for this mosquito species in the United States remain limited. To investigate the blood-feeding pattern of *Ur. sapphirina* in the northeastern United States, mosquitoes were collected from Massachusetts, Connecticut, and New Jersey using CDC miniature light traps, peat fiber resting boxes, gravid traps, and backpack aspirators. Vertebrate and invertebrate hosts of this mosquito species were identified through PCR amplification and nucleotide sequencing of portions of the mitochondrial cytochrome b gene and the 28S ribosomal RNA gene, respectively. Of 21 (24.7%) specimens successfully identified to host species, 47.6% contained solely annelid blood, 14.3% mammalian blood, 14.3% avian blood, and 23.8% with mixed blood of annelid and avian origin. The mud earthworm, *Sparganophilus tennesseensis* Reynolds (Haplotaxida: Sparganophilidae), was identified as the most common host (n = 14, including mixed bloods), followed by American robin, *Turdus migratorius* (n = 7, including mixed bloods). Testing of these blood engorged mosquitoes for West Nile virus and eastern equine encephalitis virus did not result in any positive specimens. This is the first report of *Ur. sapphirina* feeding on annelids and on both vertebrate and invertebrate hosts in mixed bloodmeals in the northeastern United States. Our findings support the recent report of *Ur. sapphirina* feeding on invertebrates and further emphasizes the inclination of some mosquito species to feed on a wider range of hosts spanning nontraditional taxonomic groups.



Uranotaenia sapphirina collection sites in the northeastern United States**: A)** Massachusetts (2021), **B)** Connecticut (2004–2021), and **C)** New Jersey (2001–2007). Collections with inconclusive bloodmeal analysis results are shown with circles, and those for which bloodmeal hosts were successfully identified are depicted with stars.

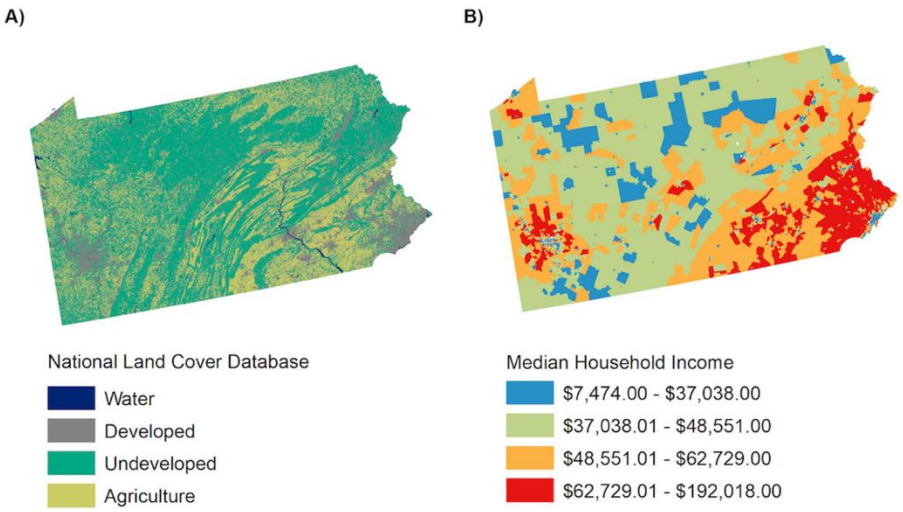
Number of engorged *Uranotaenia sapphirina* collected from Massachusetts (2021), Connecticut (2004–2021), and New Jersey (2001–2007) with inconclusive and conclusive host identification in bloodmeal analysis.

State, Town	No. with inconclusive host ID	No. with host ID	Total
Massachusetts			
Amesbury	1	0	1
Georgetown	4	2	6
Groveland	1	0	1

Hamilton	0	2	2
Haverhill	0	1	1
Ipswich	3	0	3
Lynnfield	2	0	2
Manchester	2	0	2
Merrimac	1	0	1
Newbury	1	0	1
Wenham	1	0	1
Connecticut			
Bridgeport	4	0	4
Chester	1	0	1
Cromwell	1	0	1
East Haven	2	9	11
Fairfield	3	1	4
Guilford	1	0	1
Greenwich	0	1	1
Madison	2	0	2
Manchester	1	0	1
Milford	1	0	1
Monroe	1	0	1
New Haven	3	1	4
North Branford	1	3	4
North Stonington	0	1	1
Wilton	1	0	1
Woodbridge	1	0	1
New Jersey			
Bergen	7	0	7
Burlington	3	0	3
Cape May	1	0	1
Cumberland	2	0	2
Mercer	7	0	7
Salem	1	0	1

Sussex	3	0	3
Warren	1	0	1
Total	64	21	85

Impact: Nearly three quarters (71.4%) of identifiable *Ur. sapphirina* bloodmeals contained annelid DNA, indicating that this mosquito species has a strong tendency toward feeding upon the blood of invertebrates. Our results indicate that *Ur. sapphirina* also tends to feed on vertebrate hosts, albeit at a lower frequency. Considering that *Ur. sapphirina* has been shown to feed on reservoir-competent avian and reptilian hosts, in conjunction with isolates of WNV and EEEV in field-collected mosquitoes, the potential role of this mosquito species in arbovirus transmission cannot be entirely ruled out.



A. 3. Population genetics of the Tiger Mosquito *Aedes albopictus* in the Northeast

(Andrea Gloria-Soria* A., Phillip Amstrong and collaborators from the NEVBD)

The Asian tiger mosquito (*Aedes albopictus*) arrived in the USA in the 1980's and rapidly spread throughout eastern USA within a decade. The predicted northern edge of its overwintering distribution on the East Coast of the USA roughly falls across New York, Connecticut, and Massachusetts, where the species has been recorded as early as 2000. It is unclear whether *Ae. albopictus* populations have become established and survive the cold winters in these areas or are recolonized every year. We genotyped and analyzed populations of *Ae. albopictus* from the northeast USA using 15 microsatellite markers and compared them with other populations across the country and to representatives of the major global genetic clades to investigate their connectivity and stability.

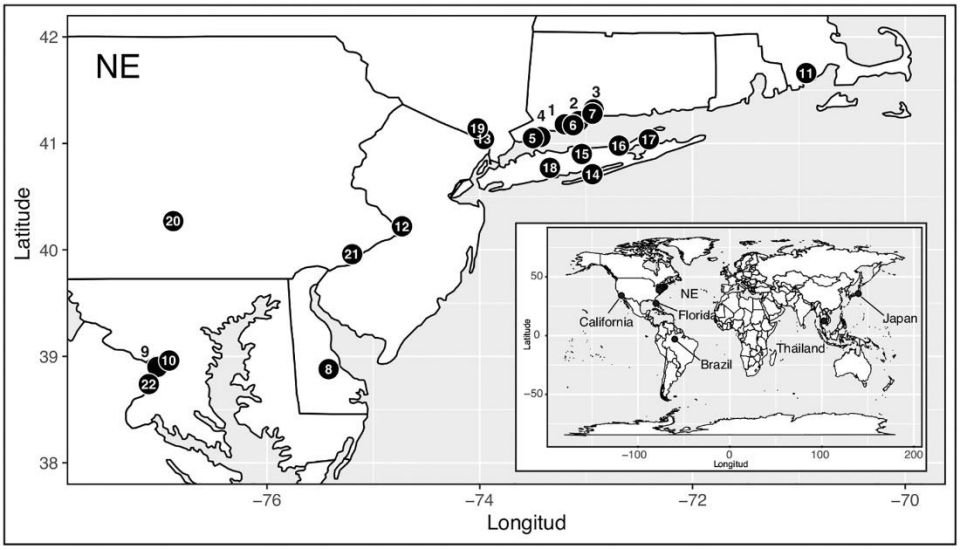


Figure: *Aedes albopictus* collection map. Outgroups included in this study, representing known genetic clusters are shown in the world map insert in the bottom right corner.

Founder effects or bottlenecks were rare at the northern range of the *Ae. albopictus* distribution in the northeastern USA, with populations displaying high levels of genetic diversity and connectivity along the East Coast. There is no evidence of population turnover in Connecticut during the course of three consecutive years, with consistent genetic structure throughout this period. Overall, these results support the presence of established populations of *Ae. albopictus* in New York, Connecticut, and Massachusetts, successfully overwintering and migrating in large numbers.

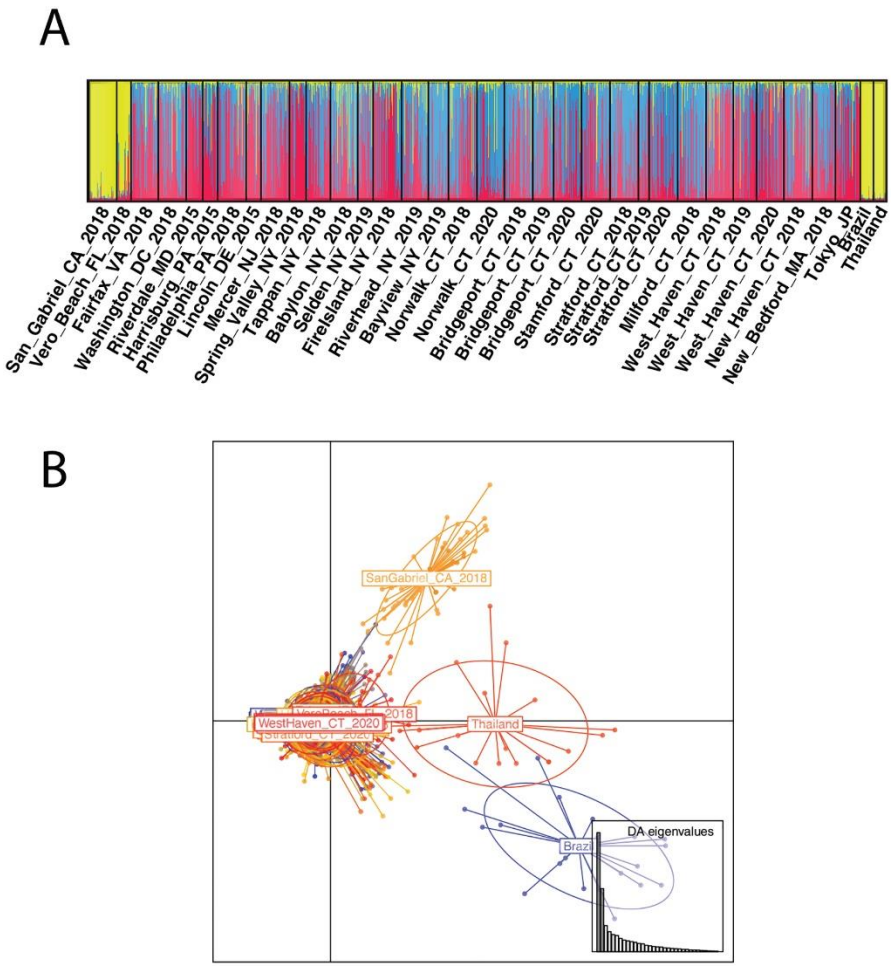


Figure: Population structure on the complete *Aedes albopictus* dataset based on 15 microsatellite markers **A** STRUCTURE plot with each individual represented by a vertical bar. The height of each bar is the probability of assignment to each of K = 3 genetic clusters (indicated by different colors) **B** discriminant analysis of principal components (DAPC).

Impact: Given the stability and interconnectedness of these populations, *Ae. albopictus* has the potential to continue to proliferate and expand its range northward under mean warming conditions of climate change. Efforts to control *Ae. albopictus* in these areas should thus focus on vector suppression rather than eradication strategies, as local populations have become firmly established and are expected to reemerge every summer.

Gloria-Soria, A., Shragai, T., Ciota, A. T., Duval, T. B., Alto, B. W., Martins, A. J., Westby, K.M., Medley, K.A., Unlu, I., Campbell, S.R., Kawalkowski, M., Yoshio T., Yukiko H., Indelicato, N., Leisnham, P.T., Caccone, A., & Armstrong, P. M. (2022). Population genetics of an invasive mosquito vector, *Aedes albopictus* in the Northeastern USA. *NeoBiota 78*: 99–127. doi: 10.3897/neobiota.78.84986

A. 4. Tracking new introductions of the yellow fever mosquito to the US and worldwide

(Andrea Gloria-Soria* and collaborators from Salt Lake City Mosquito District, and Nebraska department of Health and Human Services).

Aedes aegypti, the yellow fever mosquito, is an important vector of dengue and Zika viruses, and an invasive species in North America. *Aedes aegypti* inhabits tropical and sub-tropical areas of the world and in North America is primarily distributed throughout the southern US states and Mexico. The northern range of *Ae. aegypti* is limited by cold winter months and establishment in these areas has been mostly unsuccessful. However, frequent introductions of *Ae. aegypti* to temperate, non-endemic areas during the warmer months can

lead to seasonal activity and disease outbreaks. Two *Ae. aegypti* incursions were reported in the late summer of 2019 into York, Nebraska and Moab, Utah. These states had no history of established populations of this mosquito and no evidence of previous seasonal activity. We genotyped a subset of individuals from each location at 12 microsatellite loci and ~ 14,000 single nucleotide polymorphic markers to determine their genetic affinities to other populations worldwide and investigate their potential source of introduction. Our results support a single origin for each of the introductions from different sources. *Aedes aegypti* from Utah likely derived from Tucson, Arizona, or a nearby location. Nebraska specimen results were not as conclusive, but point to an origin from southcentral or southeastern US.

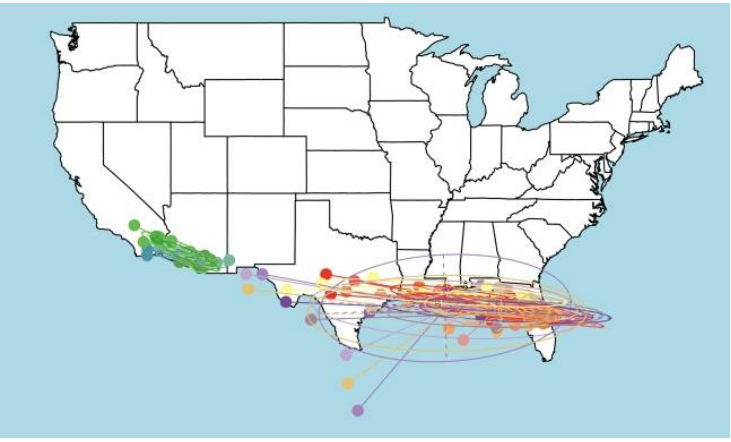


Figure: Geographic assignment of individuals from Moab, Utah (blue/green shades) and York, Nebraska (yellow/red/purple shades) as determined in Locator (Battey et al., 2020) using the Americas dataset as reference and 13,692 SNPs. Each individual is represented by 10 points of the same color (10 bootstraps), and the inertia ellipses show the area where most of the points were projected for a particular individual.

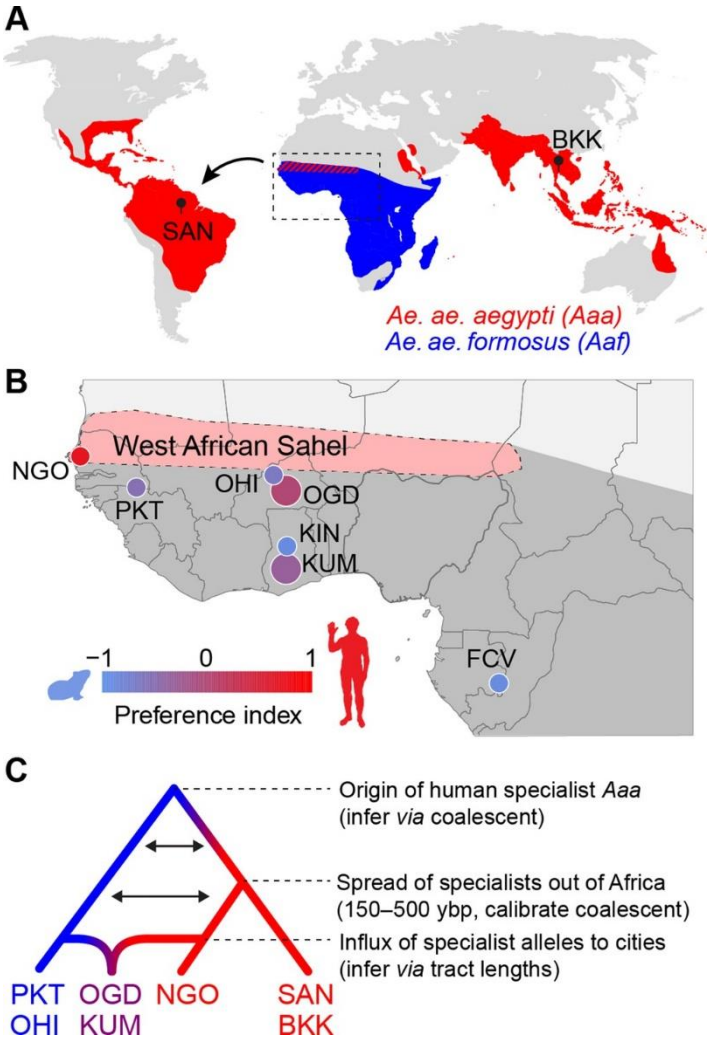
Impact: In addition to an effective, efficient, and sustainable control of invasive mosquitoes, such as *Ae. aegypti*, identifying the potential routes of introduction will be key to prevent future incursions and assess their potential health threat based on the ability of the source population to transmit a particular virus and its insecticide resistance profile, which may complicate vector control.

Gloria-Soria, A., Faraji, A., Hamik, J., White, G., Amsberry, S., Donahue, M., Buss, B., Pless, E., Cosme, L.V. and Powell, J.R. (2022). Origins of high latitude introductions of *Aedes aegypti* to Nebraska and Utah during 2019. *Infection, Genetics and Evolution, 103*: 105333.

A.5. Evolutionary history of the yellow fever mosquito *Aedes aegypti*

(Andrea Gloria-Soria, and collaborators from UCSD*, Yale University, Institute Pasteur Madagascar, IRD Montpellier, and University of Calgary).

The globally invasive mosquito subspecies *Aedes aegypti aegypti* is an effective vector of human arboviruses, in part because it specializes in biting humans and breeding in human habitats. Recent work suggests that specialization first arose as an adaptation to long, hot dry seasons in the West African Sahel, where *Ae. aegypti* relies on human-stored water for breeding. Here, we use whole-genome cross-coalescent analysis to date the emergence of human-specialist populationsand thus further probe the climate hypothesis. Importantly, we take advantage of the known migration of specialists out of Africa during the Atlantic Slave Trade to calibrate the coalescent clock and thus obtain a more precise estimate of the older evolutionary event than would otherwise be possible. We find that human-specialist mosquitoes diverged rapidly from ecological generalists approximately 5000 years ago, at the end of the African Humid Period—a time when the Sahara dried and water stored by humans became a uniquely stable, aquatic niche in the Sahel. We also use population genomic analyses to date a previously observed influx of human-specialist alleles into major West African cities. The characteristic length of tracts of human-specialist ancestry present on a generalist genetic background in Kumasi and Ouagadougou suggests the change in behavior occurred during rapid urbanization over the last 20–40 years. Taken together, we show that the timing and ecological context of two previously observed shifts towards human biting in *Ae. aegypti* differ; climate was likely the original driver, but urbanization has become increasingly important in recent decades.



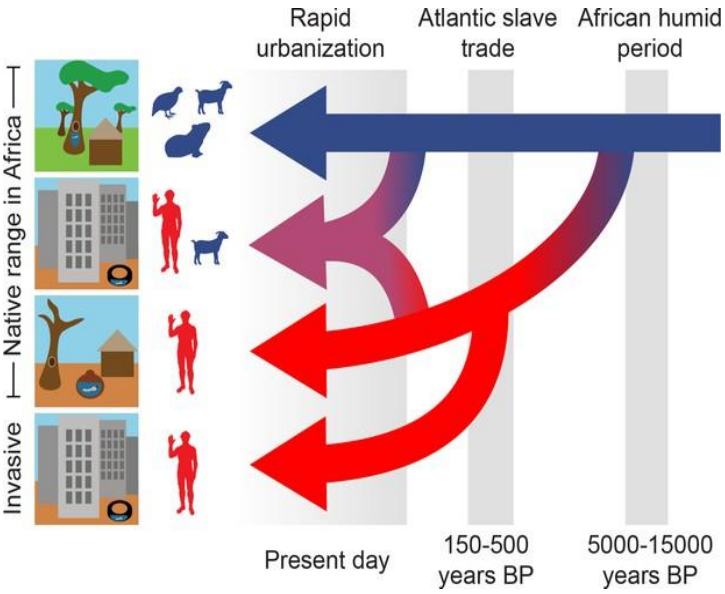


Figure: Three epochs define the origin and spread of the human-specialist form of *Ae. aegypti*. Our analyses suggest that human-specialized *Ae. aegypti* rapidly diverged from their generalist counterparts after the end of the African Humid Period, with the emergence of settled human societies in intensely seasonal habitats with long, hot dry seasons. Human specialists then migrated from West Africa to the Americas during the Atlantic Slave Trade. Finally, we find evidence of a recent influx of human-specialist ancestry into the rapidly growing cities consistent with an ongoing shift in the ecology of *Ae. aegypti* in present-day Africa.

Impact: A better understanding of the timing and selection pressures that resulted in the domestication of sylvatic *Aedes aegypti* is key to understand the underlying mechanisms involved in such adaptation. This studies can identify the traits that make the species the vector of excellence for arboviral diseases and subsequently help guide control efforts. Furthermore, by understanding the history of Ae. Aegypti, we can determine the circumstances that may lead to new domestication events in this or other invasive vector species.

Rose, N. H., Badolo, A., Sylla, M., Akorli, J., Otoo, S., Gloria-Soria, A., ... & McBride, C. S. (2023). Dating the origin and spread of specialization on human hosts in *Aedes aegypti* mosquitoes. *Elife*, *12*, e83524. https://doi.org/10.7554/eLife.83524

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

Native and invasive tick species are serious public health concerns in the United States (US). The range expansion of medically important ticks (blacklegged tick, *Ixodes scapularis*; lone star tick, *Amblyomma americanum*; Gulf Coast tick, *Amblyomma maculatum*) has placed new communities at risk for tick exposure, and novel pathogens associated with these ticks have been discovered in recent decades. The number of reported tickborne disease (TBD) cases increased from

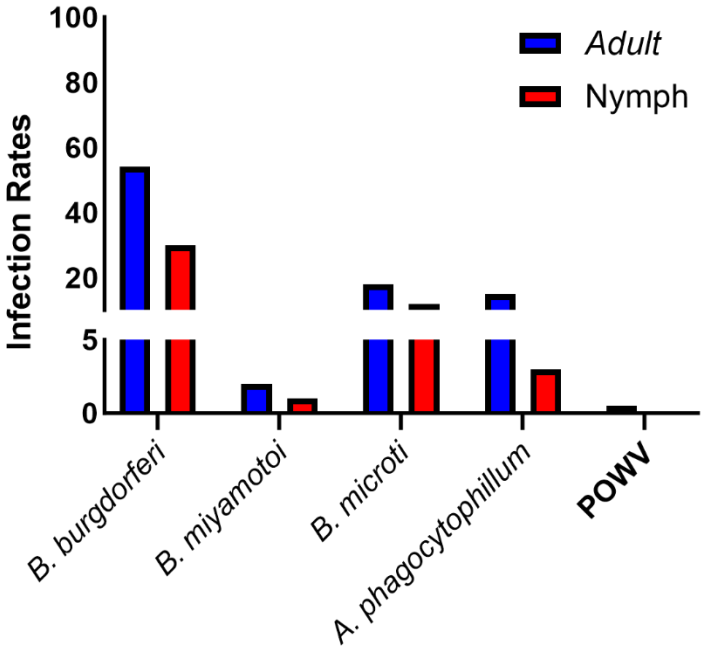
22,527 in 2004 to 50,865 in 2019, for a total of 649,628, but the actual case number is undoubtedly higher. With a total of 14,571 disease cases from 2010 to 2019, Connecticut is among the 14 states from which 95% of all Lyme disease cases are reported and had the 9th highest incidence rate (disease cases per 100,000 population) in 2019. Most TBD cases are associated with *I. scapularis*, the primary vector of *Borrelia burgdorferi* and *Borrelia mayonii* (Lyme disease), *Borrelia miyamotoi* (*B. miyamotoi* disease), *Anaplasma phagocytophilum* (anaplasmosis), *Ehrlichia muris eauclairensis* (ehrlichiosis), *Babesia microti* (babesiosis), and Powassan virus (Powassan virus disease). Climate warming, anthropogenic environmental changes, and increases in populations of key animal hosts, particularly white-tailed deer, which were decimated in the northern part of the eastern US in the 1800s and early 1900s but then rebounded in the last half century, have allowed *I. scapularis* and other tick species to proliferate and expand their ranges. Additionally, human encroachment on tick habitat has led to increased human–tick contact.

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 2022 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 Environmental Science and Forestry) and Dr. Megan A. Linske with sampling conducted by research assistant Jamie Cantoni. All the tick testing is conducted by Dr. Douglas E. Brackney and Duncan W. Cozens.

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.



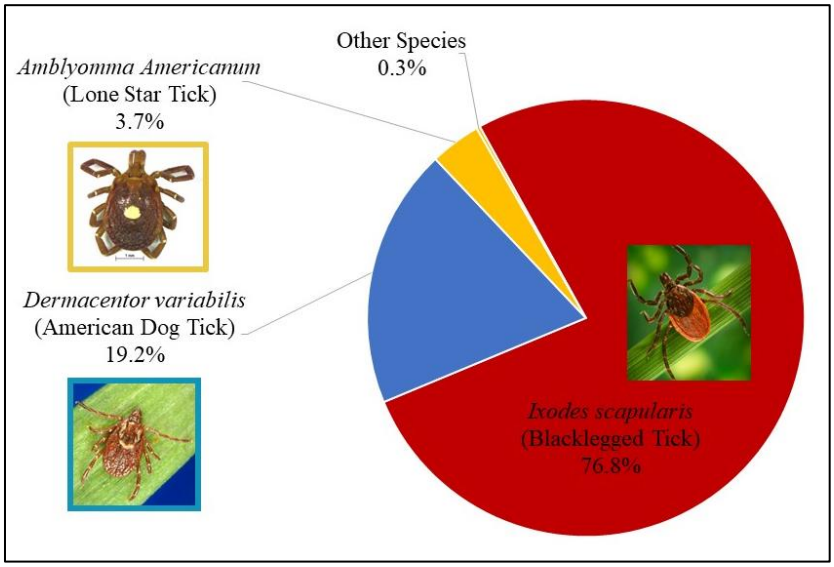
Ticks are collected at 40 paired publicly-accessible active tick surveillance sampling locations throughout CT's eight counties from April through October with a focus on the blacklegged tick, *Ixodes scapularis*. Other tick species that are being found and tabulated include American dog ticks, *Dermacentor 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 2022, a total of 462 adult female and 234 nymphs *I. scapularis* were tested for *Borrelia burgdorferi s.l.*, *Babesia microti*, *Anaplasma phagocytophilum*, *Borrelia miyamotoi*, and Powassan virus lineage II using our multiplexed RT-qPCR assay. The 2022 testing results for adult blacklegged ticks are shown in the accompanying graph.

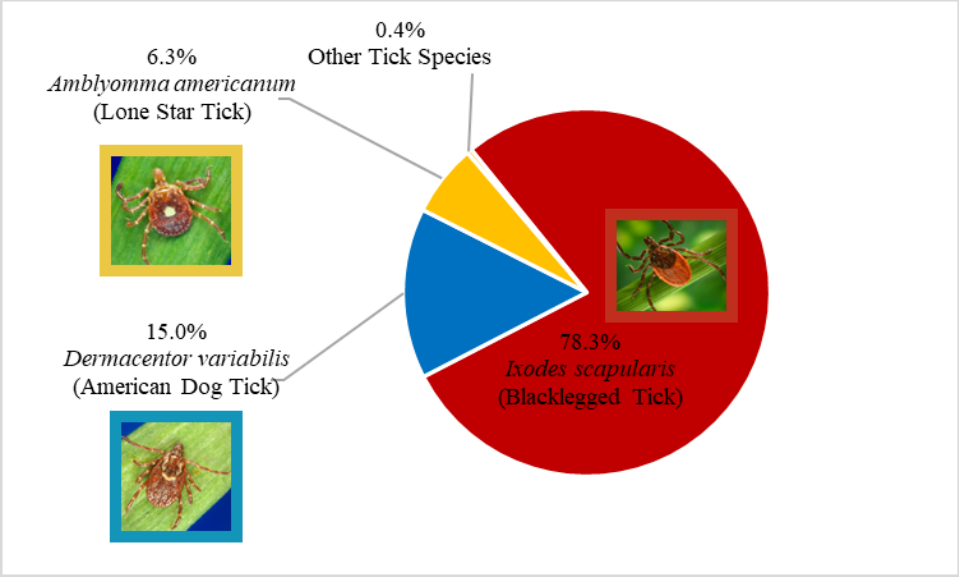
B.2. Passive Tick and Tick-borne Pathogen Surveillance Program and Tick Testing Laboratory Services for Assessing Human Health Risk with Tick-borne Diseases

(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.

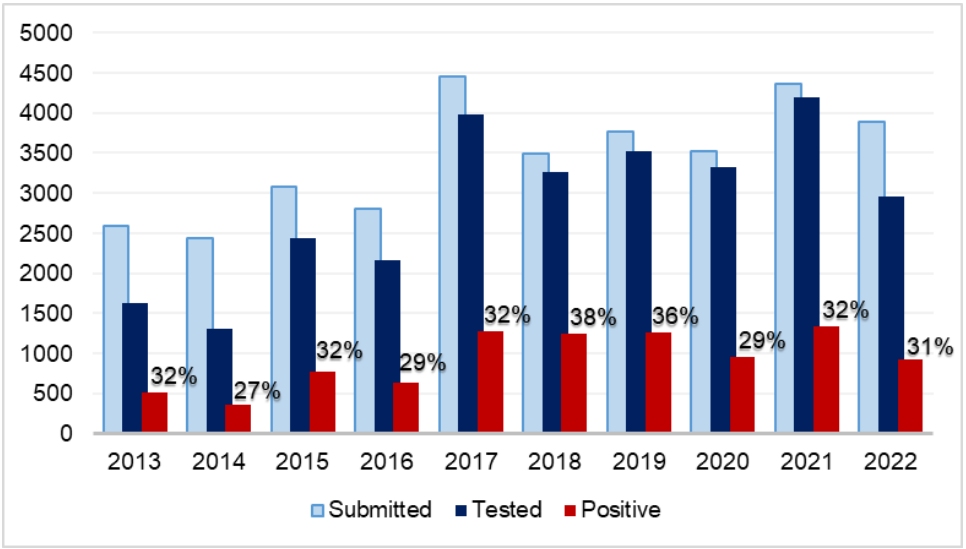
Blacklegged/deer tick, *Ixodes scapularis*, is currently responsible for transmitting seven pathogens to humans, of which the three most common are *Borrelia burgdorferi, Babesia microti*, and *Anaplasma phagocytophilum*, causing Lyme disease, babesiosis, and anaplasmosis, respectively. In 2022, the CAES-TTL received a total of 3,895 ticks submitted by residents, health departments, and physicians' offices for identification and testing. Of these, 3,048 (78.3%) were identified as *Ixodes scapularis* (blacklegged or deer tick), 584 (15.0%) as *Dermacentor variabilis* (American dog tick), 247 (6.3%) as *Amblyomma americanum* (lone star tick), and 16 (0.4%) as other tick species.



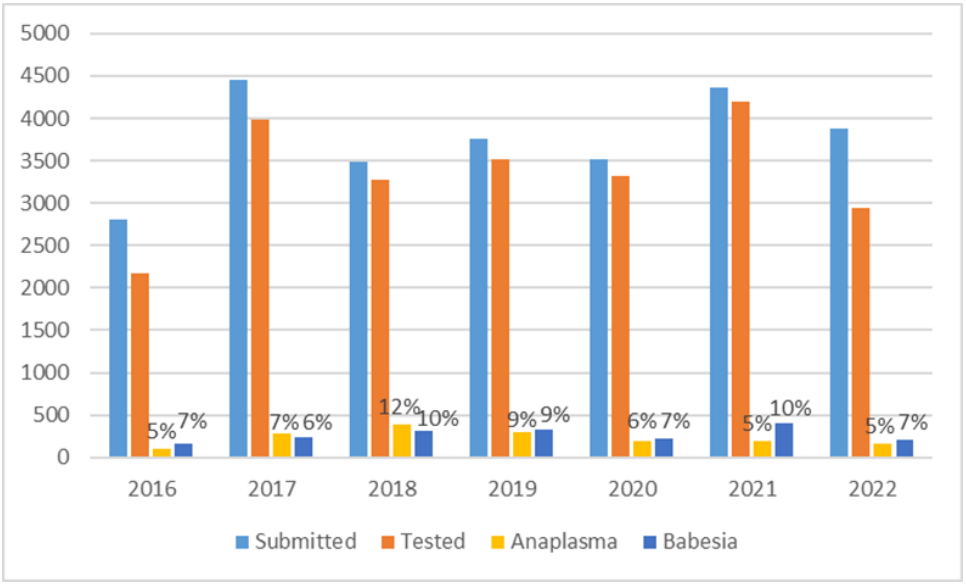


Tick species abundance and composition, Connecticut, 2022.

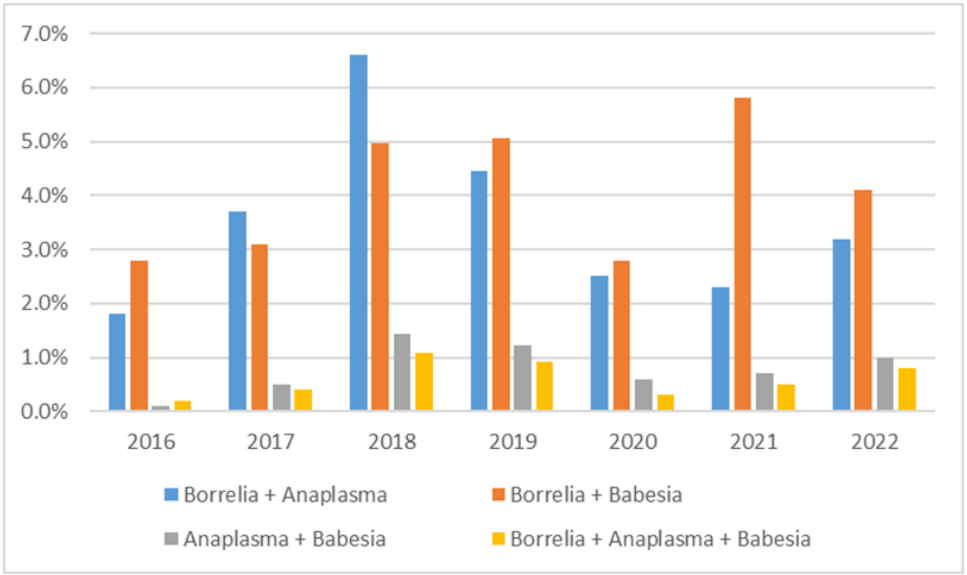
Of 2,950 adult female and nymphal blacklegged ticks screened for evidence of infection with three most prevalent tick-borne pathogens, 917 (31.1%) tested positive for *B. burgdorferi*, 157 (5.3%) for *A. phagocytophilum*, and 215 (7.3%) for *B. microti*. A total of 267 ticks were co-infected with two 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.



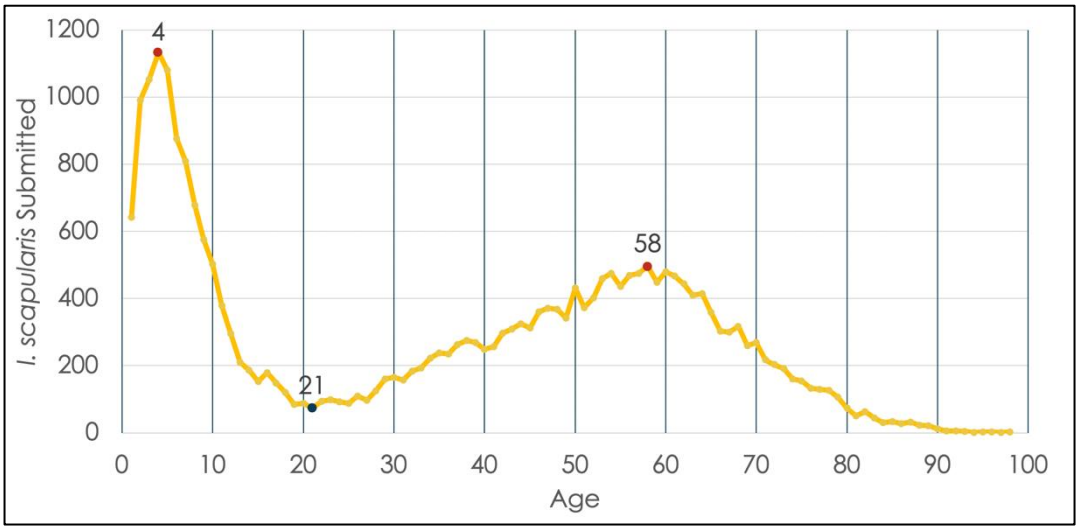
Blacklegged tick infection with Lyme disease pathogen in Connecticut, 2013-2022.



Blacklegged tick infection with pathogens responsible for Anaplasmosis and Babesiosis Agents, Connecticut, 2016-2022.



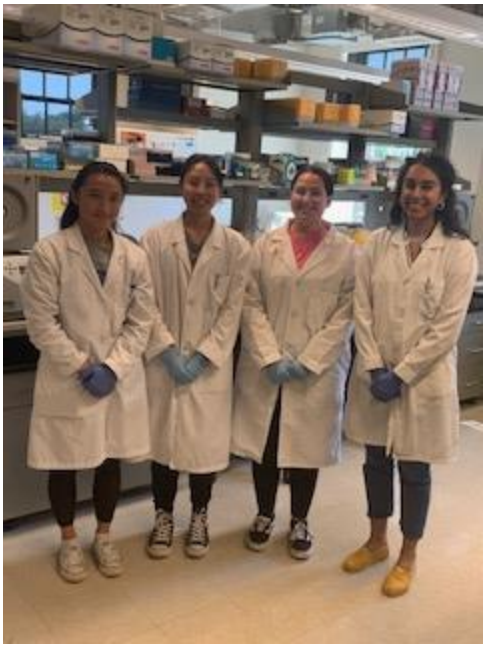
Blacklegged tick co-infection with pathogens responsible for Lyme disease, Anaplasmosis, and Babesiosis, Connecticut, 2016-2022.



Age of human hosts bitten by blacklegged ticks in Connecticut

Impact: 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. Among the factors that contribute to the changing dynamics of tick and tick-borne disease activity are reforestation, rising temperatures, an increase in trade and travel, and a rise in the abundance of animal hosts. Increases in population densities, geographic range expansion, and the ensuing potential of greater interactions with humans and wildlife highlight the importance of ticks as a public health threat. 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.



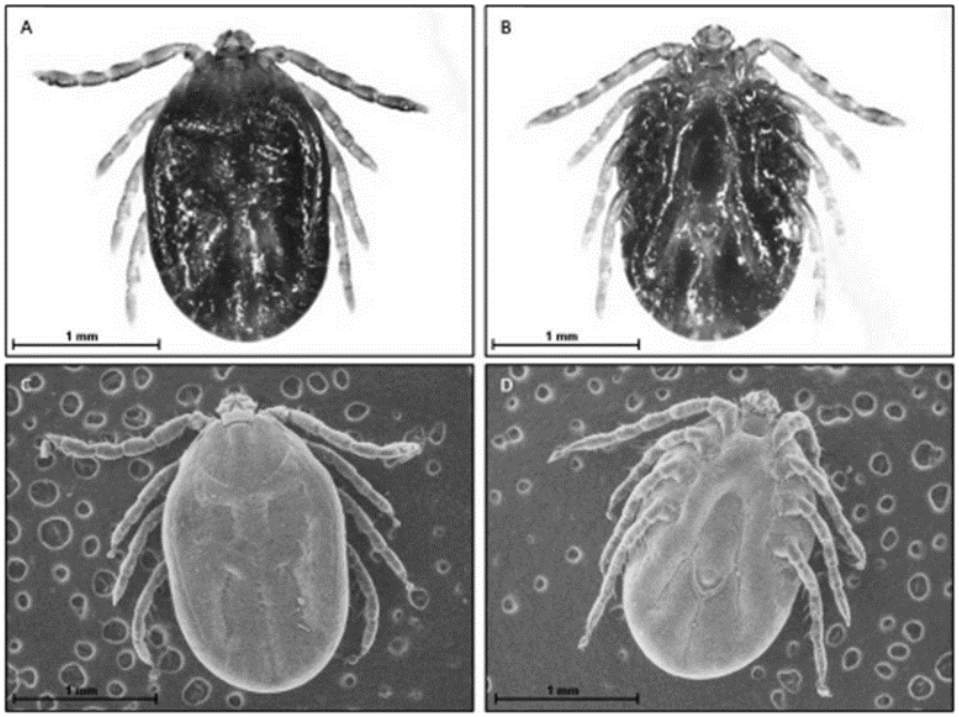
Tick Testing Laboratory Staff (2023). (Right to left) Noelle Khalil, Emily Seigel, Abigail Chang, and Kristy Lok.

B.3. Evidence of Protozoan and Bacterial Infection and Co-infection and Partial Blood Feeding in the Invasive Tick *Haemaphysalis longicornis*

(Keith J. Price, Noelle Khalil, Bryn J. Witmier, Brooke L. Coder, Christian N. Boyer, Erik Foster, Rebecca J. Eisen, and Goudarz Molaei*)

The Asian longhorned tick, *Haemaphysalis longicornis*, an invasive tick species in the United States, has been found actively host-seeking while infected with several human pathogens. Recent work has recovered large numbers of partially engorged, host-seeking *H. longicornis*, which together with infection findings raises the question of whether such ticks can reattach to a host and transmit pathogens while taking additional bloodmeals. Here we conducted molecular blood meal analysis in tandem with pathogen screening of partially engorged, host-seeking *H. longicornis* to identify feeding sources and more inclusively characterize acarological risk. Active, statewide from 2020 to 2021 resulted in the recovery of 22/1,425 (1.5%) partially engorged, host-seeking nymphal and 5/163 (3.1%) female *H. longicornis*. Pathogen testing of engorged nymphs detected 2 specimens positive for *Borrelia burgdorferi* sensu lato, 2 for *Babesia microti*, and 1 co-infected with *Bo. burgdorferi* s.l. and *Ba. microti*. No female specimens tested positive for pathogens. Conventional PCR blood meal analysis of *H. longicornis* nymphs detected avian and mammalian hosts in 3 and 18 specimens, respectively. Mammalian blood was detected in all *H. longicornis* female specimens. Only 2 *H. longicornis* nymphs produced viable sequencing results and were determined to have fed on black-crowned night heron, *Nycticorax nycticorax*. These data are the first to molecularly confirm *H. longicornis* partial blood meals from vertebrate hosts and *Ba. microti* infection and co-infection with *Bo.*

burgdorferi s.l. in host-seeking specimens in the United States, and the data help characterize important determinants indirectly affecting vectorial capacity. Repeated blood meals within a life stage by pathogen-infected ticks suggest that an understanding of the vector potential of invasive *H. longicornis* populations may be incomplete without data on their natural host-seeking behaviors and blood-feeding patterns in nature.

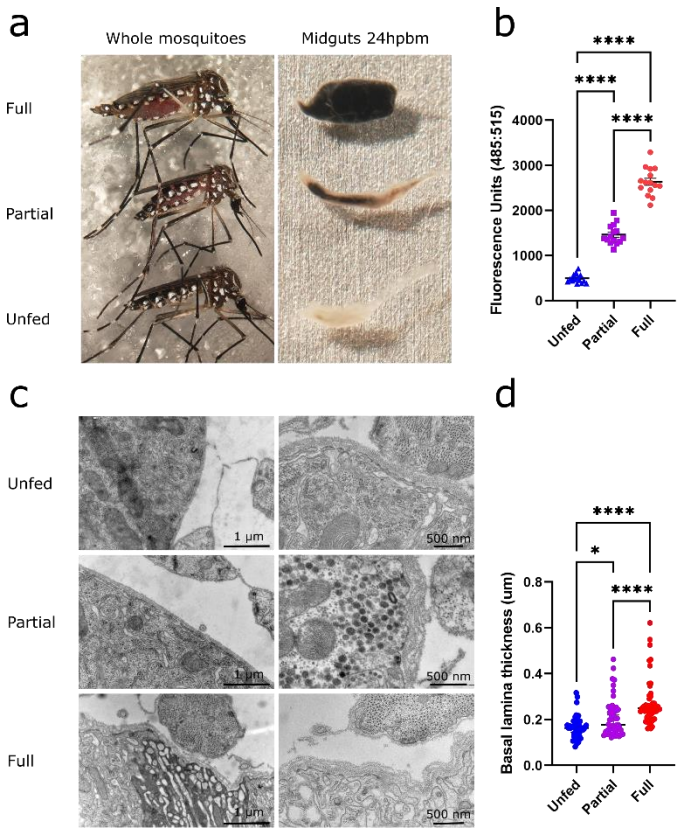


Light microscopy images of dorsal (A) and ventral (B) aspect and scanning electron microscopy images of dorsal (C) and ventral (D) aspect of adult *Haemaphysalis longicornis*.

Impact: Overall, this study provides important evidence for interrupted feeding of H. longicornis via molecular confirmation of partial blood meals of vertebrate hosts and represents the first U.S. detection of Ba. microti infection and simultaneous detection of Ba. microti and Bo. burgdorferi s.l. in this invasive tick species. The rapidly progressing invasion of H. longicornis in the United States presents an ecological disturbance and disease threat. The incorporation of blood-feeding behavior and pathogen screening in active surveillance efforts can improve understanding of potential environmental impacts and public health risks associated with H. longicornis expansion (Beard et al., 2018). Our findings highlight the growing importance of recognizing the H. longicornis invasion within an ecological and epidemiological context, which should encourage active surveillance to include density measures (e.g., Price et al., 2021b), pathogen (co)infection rates, and human-tick encounters to develop a baseline of risk and inform integrated management strategies.

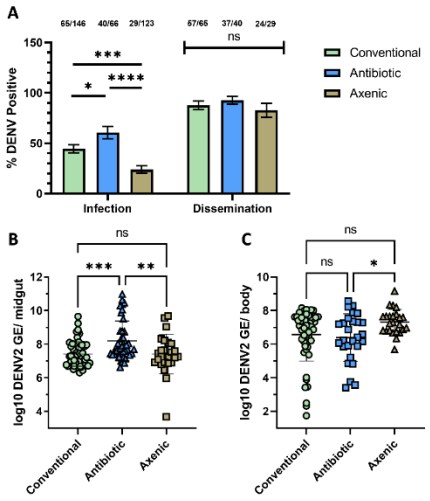
2. The impact of partial blood meals on midgut damage and viral dissemination.

(Doug Brackney, Philip Armstrong, Rebecca Johnson, Duncan Cozens)



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.

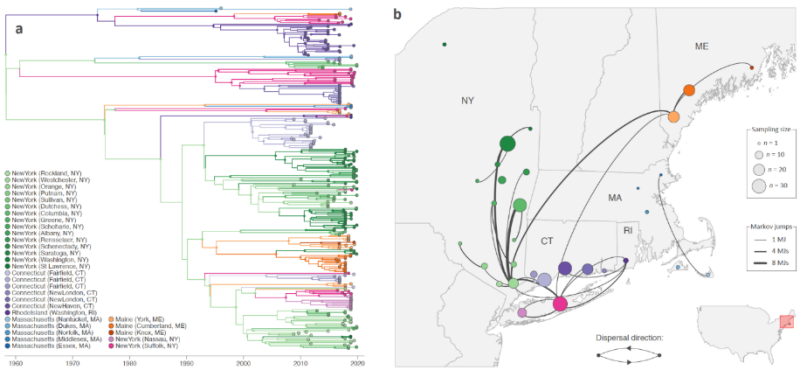
3. Using an axenic model to interrogate the role of the microbiome in mediating mosquito susceptibility to arboviruses.
(Doug Brackney, Blaire Steven, Zannatul Ferdous, Rebecca Johnson, and Duncan Cozens)



The midgut microbiota can influence mosquito susceptibility to virus infection; however, this evidence is largely predicated on experiments utilizing antibiotics. This can be problematic because antibiotic exposure may not eliminate all bacteria and can induce metabolic changes in the host. Consequently, it is difficult to distinguish the impact of the microbiome on virus infections from that of antibiotic exposure. To address this ambiguity, we have compared the vector competence of axenic (microbe-free), antibiotic-treated, and conventionally reared *Ae. aegypti* mosquitoes for dengue virus 2 (DENV-2) and chikungunya virus (CHIKV). Antibiotics significantly increased DENV-2 and decreased CHIKV infection rates compared to the conventionally reared groups, while infection rates were reduced for both in the axenic group. Transcriptomic analysis of the mosquito revealed limited differences in gene expression between antibiotic treated and controls; yet midgut microbiome composition was significantly altered. Together, these data suggest that the presence of a gut microbiome and its composition are critical determinants mediating virus infection of mosquitoes.

4. Phylogeographic reconstruction of the emergence and spread of Powassan virus in the northeastern United States.
(Doug Brackney, Phil Armstrong and Yale School of Public Health collaborators)

Powassan virus is an emerging tick-borne virus of concern for public health, but very little is known about its transmission patterns and ecology. Here, we expanded the genomic dataset by sequencing 279 Powassan viruses isolated from *Ixodes scapularis* ticks from the northeastern United States. Our phylogeographic reconstructions revealed that Powassan virus lineage II was likely introduced or emerged from a relict population in the Northeast between 1940-1975. Sequences strongly clustered by sampling location, suggesting a highly focal geographical distribution. Our analyses further indicated that Powassan virus lineage II emerged in the northeastern U.S. mostly following a south to north pattern, with a weighted lineage dispersal velocity of ~3 km/year. Since the emergence in the Northeast, we found an overall increase in the effective population size of Powassan virus lineage II, but with growth stagnating during recent years. The cascading effect of population expansion of white-tailed deer and I. scapularis populations likely facilitated the emergence of Powassan virus in the northeastern U.S.



Connecticut's landscape is a quilt of forests, farms, towns, and cities. Scientists in the Department of Environmental Science and Forestry are studying the factors that influence forest and farm productivity ticks and public health, 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, integrated tick management strategies, as well soil ecology, carbon sequestration, and soil remediation. Within the Department, the Applied Environmental Analytical Chemistry program is an interdepartmental effort between Environmental Science and Forestry and Analytical Chemistry with a 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. The 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 waste related matrices.

ADVANCES IN KNOWLEDGE

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 (retired), 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

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

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.

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 (retired), 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 (retired), Heidi Stuber, and Jamie Cantoni. Funded by the Centers for Disease Control and Prevention, 75D30120C09843.

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.

Drawing blood from a live, sedated 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 2022 in Norwalk, CT (when adult and nymphal lone star ticks are active) and in fall 2021 and 2022 (when adult blacklegged ticks are active) in Bridgeport, CT we fed out treated corn to two separate herds of deer. We captured nearly 80 deer from both sites over the two years, and those from Norwalk showed increased levels of the active ingredient in their system reported to be fatal to feeding ticks. In Birdgeport in the fall, levels were lesser than in Norwalk, but still high enough to be effective against 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.

Field trial of fipronil-laced bait to control *Ixodes scapularis* immatures on rodents

Drs. Scott C. Williams and Megan A. Linske assisted by Heidi Stuber and Jamie Cantoni. Funded by a subcontract with Genesis Laboratories, Inc. and the Centers for Disease Control and Prevention.

The main purpose of this work is to evaluate the impact of an orally delivered acaricide, in the form of a fipronil-laced rodent bait, on the feeding success of *Ixodes scapularis* (blacklegged ticks) immatures on rodent hosts, including *Peromyscus* mice. The outcome of the research will be of direct relevance for homeowners and professional landscaping firms engaging in tick control activities. In summers 2022 and 2023, we feed out 100s of pounds of fipronil-laced bait in residential properties and trapped and blood-sampled small rodents in the Town of Guilford, CT. In 2022, we tested a subsample of rodent blood for active ingredient fipronil and found that mice had far exceeded the level of fipronil needed to manage immature blacklegged ticks. In 2023 we reduced bait distribution to every other week instead of weekly and captured and blood-sampled 213 unique white-footed mice on 286 occasions. Efforts have recently concluded and blood samples will be sent to Genesis Laboratories, Inc. for analysis of fipronil presence. Next year will be the final field season to determine impacts to managing immature blacklegged ticks on rodents to benefit public health.

Impact:

- If we can show that small rodents consume enough treated bait to manage immature ticks, this could be a positive step toward reducing both tick and pathogen abundances in suburban neighborhoods and could lessen tick-borne disease transmission and improve public health.

Suppression of Host-Seeking *Ixodes scapularis* Abundances and Interruption of Pathogen Transmission Through Orally Delivered Systemic Acaricide Treatment of White-tailed Deer and *Peromyscus* spp.

Drs. Scott C. Williams and Megan A. Linske assisted by Heidi Stuber and Jamie Cantoni. A competitive 5-year cooperative agreement funded by the Centers for Disease Control and Prevention.

The purpose of this research is to evaluate the efficacy and reproducibility of the use of existing commercially available systemic acaricide treatment of white-tailed deer (*Odocoileus virginianus* (Zimmermann)) and *Peromyscus* spp. in multiple high-risk settings throughout the Northeast on suppression of *Borrelia*-infected host-seeking *Ixodes scapularis* nymphs. Feeding *O. virginianus* and *Peromyscus* spp. acaricide-laced baits is an approach that will target and systemically treat the two major hosts responsible for *I. scapularis* reproduction and pathogen maintenance and transmission to humans/pets anywhere in the United States where Lyme disease is endemic. We hypothesize that such treatment will be more effective where limited hosts are available to *I. scapularis* but will also document that systemic acaricidal treatment of both major

hosts will be effective despite alternate host diversity. We will test the effectiveness of systemic treatment of *O. virginianus* and *Peromyscus* spp. both singly and in combination on reduction of *I. scapularis* burdens on *Peromyscus* spp., host-seeking *I. scapularis* nymphs, and pathogen infection in both *I. scapularis* and *Peromyscus* spp. We will test this strategy on *O. virginianus* and *Peromyscus* spp. in two inland settings in Connecticut with a known suite of multiple alternate hosts available to *I. scapularis* as well as on Isle au Haut, Maine with a limited number of alternate hosts. This first year is the baseline year of the study so efforts are restricted to tick sampling and rodent trapping to determine population abundances and pathogen infection in each. Ticks have been sampled and rodent trapping efforts are well underway in both Maine and Connecticut.

Impact:

- Having shown that deer and mice will consume treated bait, this research seeks to determine if the combined treatment of both will result in fewer pathogen-infected nymphal I. scapularis on the landscape which could lessen tick-borne disease transmission and improve public health at a regional scale beyond individually treated backyards.

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

Dr. Susanna Keriö, co-investigators Dr. Faisal Qaseem, Dr. Leigh Whittinghill. Assisted by Liberty Bednarz, Susan Yang (Naugatuck Community College), Ana DiMauro (Plant Health Fellow), and Eveleen Jiang (UConn student). Funded through the Louis A. Magnarelli Postdoctoral Program at CAES.

Urban trees have a critical role in improving the habitability of towns and cities in Connecticut where 86% of the population lives in urban areas. Results from a CAES urban tree survey in New Haven in 2020 indicate that urban maple mortality in New Haven has increased from 2010, but the causal factors are unclear. The goal of this project is to study the potential of non-structural carbohydrate (NSC) levels as an early indicator of urban maple decline syndrome. The project leverages existing maple health monitoring data in New Haven and Hartford to associate observed patterns in tree health decline with NSC levels. Our goal is to sample 240 urban maples in New Haven and Hartford to determine NSC thresholds for urban maple decline syndrome. Additionally, the project will study the association of NSC levels with site factors, soil properties, and tree growth metrics to quantify urban maple stress. During the field work, the involved CAES scientists and research assistant have discussed the importance of urban tree health with more than 50 members of the public.

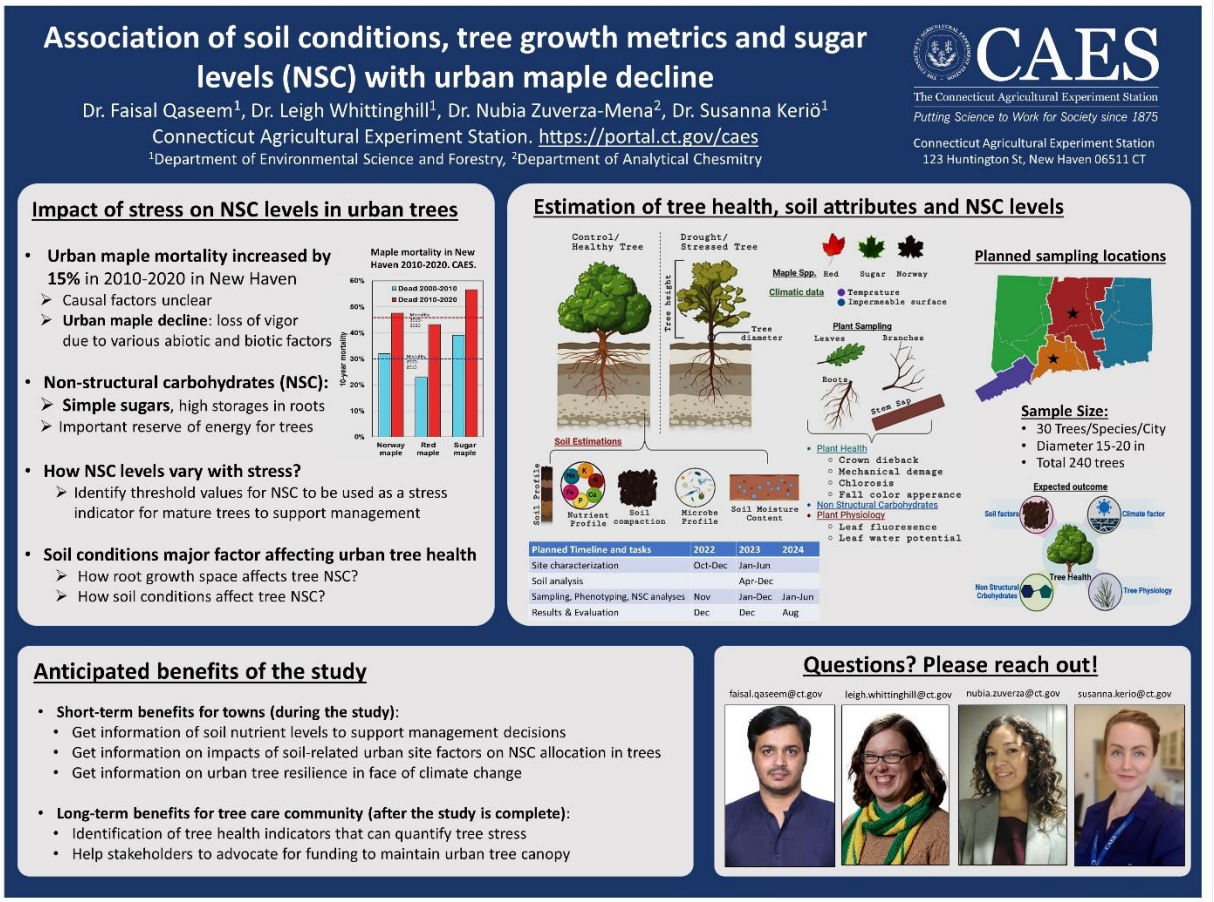


Figure 1. Visual outline of the project studying the association of urban heat island effect, pavement, and soil conditions with urban maple health.

Impact:

- Identifying threshold values for non-structural carbohydrates could have practical applications in tree health diagnostics to quantify tree stress and to guide tree management decisions to improve tree health in Connecticut.

Variation in blight severity and inhibitory properties of bark against Cryphonectria parasitica in 16-year-old full-sib progeny of *Castanea mollissima* ('Mahogany' x 'Nanking')

Dr. Susanna Keriö. Assisted by Assisted by Liberty Bednarz, Susan Yang (Naugatuck Community College), Ana DiMauro (Plant Health Fellow), and Eveleen Jiang (UConn student). Collaborator Bruce Levine, University of Maryland. Funded by The American Chestnut Foundation.

Chinese chestnuts (*Castanea mollissima*) are highly blight resistant, and several hybrids of American and Chinese chestnuts have been created as part of the breeding program coordinated by The American Chestnut Foundation. Among the parent trees are two Chinese chestnut trees, 'Mahogany' and 'Nanking', which both have high blight resistance. This project will analyze the segregation of the inhibitory properties of Chinese chestnut bark against *Cryphonectria parasitica* (causal agent of chestnut blight) in a 16-year-old full-sib progeny of highly blight resistant Chinese chestnuts 'Mahogany' x 'Nanking'

established in CAES experimental farm. The trees were planted in Lockwood Farm by Dr. Sandra Anagnostakis in 2007-2008. A combination of field phenotyping and bark extract plate assays will be used to study the association of natural blight severity with in vitro inhibitory properties against *C. parasitica*. This unique set of plant material consisting of approximately 150 trees will offer an opportunity to associate natural blight infection and blight severity with the antifungal properties of bark extracts. These experiments will help in identifying the chemical, molecular, and genetic components associated with variation in chestnut blight resistance in Chinese chestnuts.

Figure 2. Dr. Susanna Keriö at Lockwood Farm conducting phenotyping of disease severity for the Chinese chestnuts 'Mahogany' x 'Nanking' progeny established in CAES experimental farm. The trees were planted in Lockwood Farm by Dr. Sandra Anagnostakis in 2007-2008. Top row: Example of a highly resistant and less resistant chestnut tree in the progeny. Bottom row: Example of the bark powder used to prepare the bark extracts.

Impact:

- These experiments will help identify the chemical, molecular, and genetic components associated with chestnut blight resistance in Chinese chestnuts to support tree breeding efforts both on local and national scale.

Impact of mycorrhizal inoculation on tree stress tolerance

Dr. Susanna Keriö in collaboration with Dr. Faisal Qaseem. Assisted by Liberty Bednarz, Susan Yang (Naugatuck Community College), Ana DiMauro (Plant Health Fellow), Eveleen Jiang (UConn student), and Juniper Allen-Cantu (Plant Health Fellow 2022 in Keriö lab). Funding through the Specialty Crop Block Grant Program through the Connecticut Department of Agriculture.

In a project funded through the Connecticut Specialty Crop Block Program, the Keriö lab will partner with Connecticut town tree planting programs to test the impact of mycorrhizal inoculation on tree health for newly planted landscape trees. Transplant shock affects landscape trees both in nurseries and in field planting sites, which increases tree mortality and causes economic losses to nurseries and the stakeholders planting the trees. Mycorrhizal inoculation can reduce sapling mortality, but quantitative data on the benefits of mycorrhizal inoculation for landscape trees is limited. Dr. Susanna Keriö has also conducted a greenhouse experiment where the impact of mycorrhizal inoculation on drought tolerance and pathogen infection was studied in chestnuts (**Figure 4**).

Figure 4. Photos from an experiment studying the impacts of mycorrhizal inoculation on tree health by Dr. Susanna Keriö's lab. Chestnut trees either inoculated with mycorrhizae or left as untreated controls were maintained in a greenhouse. The one-year-old trees were challenged with drought and chestnut blight infection, and the combined impacts of abiotic and biotic stress on plant biomass and physiology were measured. Success of colonization was determined from fine roots through microscopical analysis.

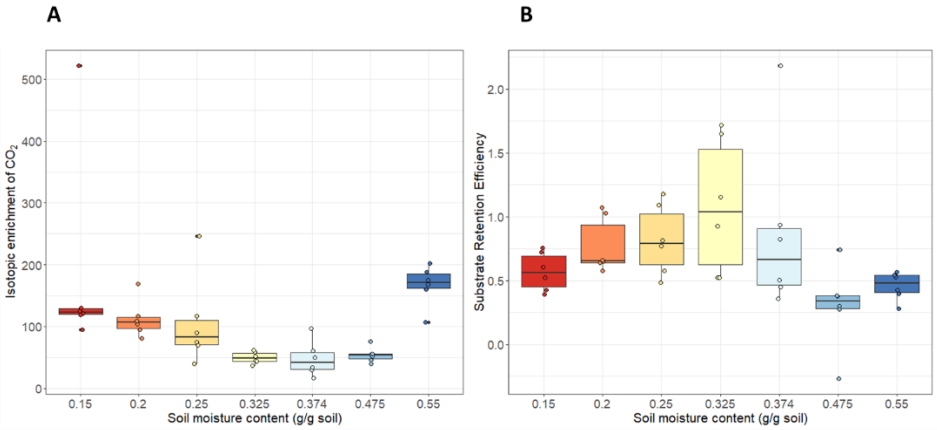
Impact:

- The project provides quantitative data on how abiotic and biotic stress affects tree health, how mycorrhizal inoculation affect landscape tree health, and potential diagnostic tools for monitoring landscape tree health in Connecticut.

Impact of soil water potential on microbial C cycling

Dr. Itamar Shabtai, Dr. Blaire Steven, and collaborators from the University of Connecticut

Soil organic matter represents a critical component of global carbon (C) cycling. Carbon primarily enters the soils as plant biomass but microbial decomposition of this biomass converts organic plant-C into biosynthetic molecules that may continue to be recycled, become stable soil organic carbon (SOC) resistant to decay, or lost from soil as carbon dioxide (CO_2) via respiration. Understanding the conditions which drive this partitioning can help to forecast changes to SOC stocks and CO_2 efflux, particularly as climate stressors such as warming, and drought alter rates of microbial activity. Here, we investigated the understudied effect of water content on microbial cycling of SOC. We hypothesized that under stress conditions (i.e, very low or high soil water contents) C cycling efficiency would decline, reducing the amount of C retained in the soil. We collected soil from an uncropped location in Lockwood Farm and preincubation it at seven different water contents in gas-tight microcosms. Next, ^{13}C isotopically labelled glucose was added to the soil microcosms. The ^{13}C label allowed us to track the added C as it cycles through the microbial biomass, CO_2, and soil. We found that the isotopic enrichment of the respired CO_2 was lowest at medium water contents and highest at extreme water contents. Concomitantly, substrate retention efficiency (SRE), defined as mass of C retained per mass of C added, was highest at medium water contents and decreased under both extremes. Taken together, these results suggest that at extreme moisture conditions microbes utilized C less efficiently, resulting in more C lost to respiration and less C retained in the soil. This suggests that climate extremes associated soil moisutre may significantly impact C cycling and stocks. Ongoing efforts will shed light on how the microbial community responded to these soil moisture conditions.



Isotopic enrichment of respired CO_2 (A) and ^{13}C substrate retention efficiency (B) under a range of soil moisture contents.

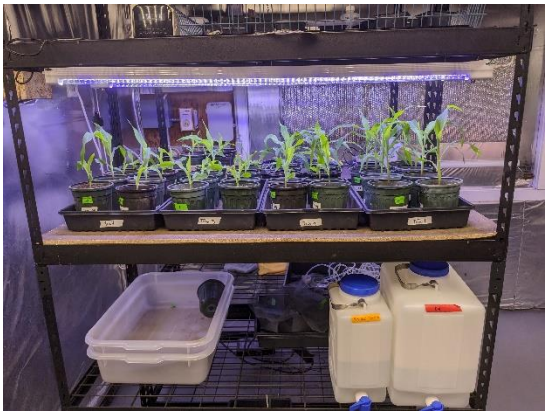
Impact:

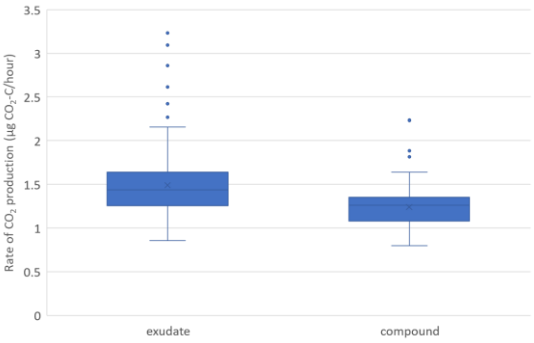
- These results suggest that extreme soil moistures associated with climate change may negatively impact the sequestration of C and securing current C stocks, which is critical for soil functions.

Assessing the appropriateness of single compounds as model root exudates in rhizosphere carbon studies

Dr. Itamar Shabtai

Plants exude organic compounds to manipulate their belowground habitat. The higher release of C (as CO_2), compared to unplanted soil, resulting from root activity in the rhizosphere (root-soil interface) is termed rhizosphere priming. Most studies on rhizosphere priming employ single molecules (e.g., sugars, organic acids, amino acids, and phenolic acids) hypothesized to mimic single possible functions of root exudates, each driving different chemical reactions (reduction, chelation, mineralization). However, root exudates are a complex mixture and therefore their chemical and biological influence on C and NP cycling may significantly differ from what is observed for single molecules. In this project, we grew corn plants and collected their root exudates using a hydroponic approach. A root exudate solution, or a single or combination of model compounds were added to soils and the CO_2 evolved was measured.





CO_2 production rate in soils amended with a root exudate solution or single model compounds (glucose, oxalic acid, catechol)

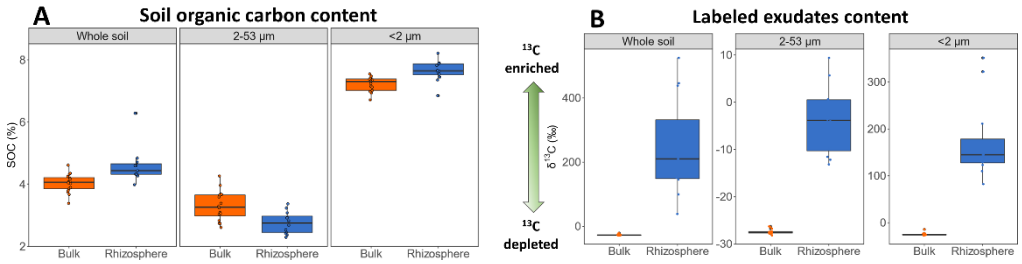
Impact:

- These findings indicate that the current methodology for studying how root exudation impacts microbial C cycling in the rhizosphere does not capture accurate magnitudes of C fluxes. We encourage the use of more realistic root exudate solutions to investigate exudate-induced processes.

Formation of mineral-associated organic matter from root exudation

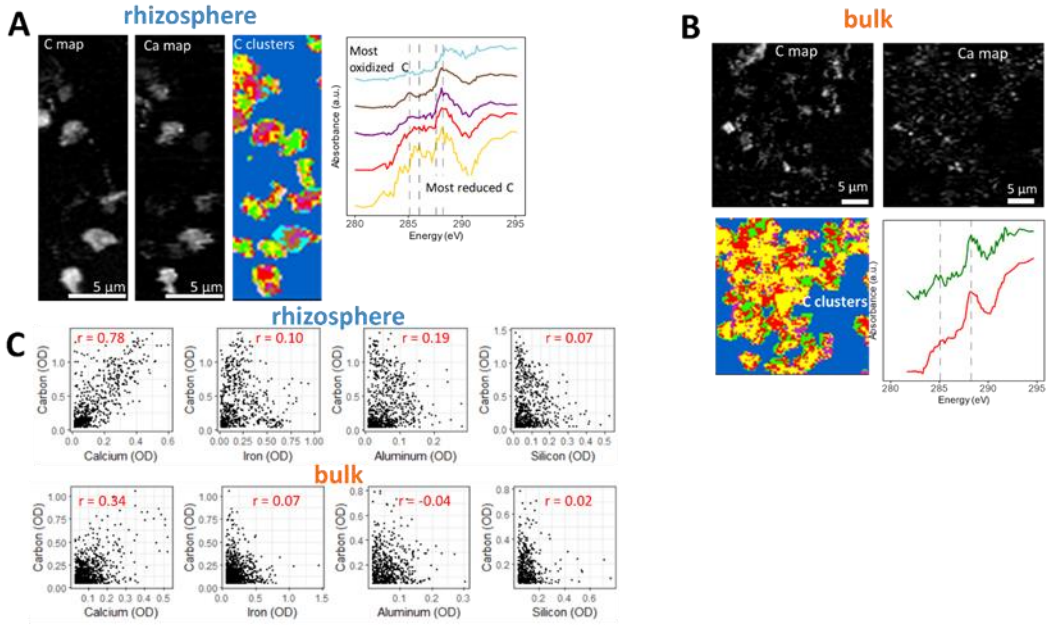
Dr. Itamar Shabtai and collaborators from Cornell University and Technical University of Munich

Plants exude organic compounds from their roots into the rhizosphere (soil-root interface), making it a hotspot for soil organic carbon (SOC) formation. However, there is little information on how root-zone conditions might impact exudation patterns, and subsequently rhizosphere SOC dynamics. We continue this project which seeks to understand how root exudation affects SOC formation in the rhizosphere. We grew maize well-watered and water-stressed conditions and pulse-labeled the plants with $^{13}CO_2$ to trace the root exudate C in the soil. We then isolated the clay-sized fraction from rhizospheres and investigated the chemical and spatial characteristics of the organo-mineral interactions using stable isotope ratio mass spectrometry (IRMS) and synchrotron radiation spectromicroscopy (STXM-NEXAF). We found that exudates were preferentially accumulating in < 2 um size fractions, resulting in a greater C content in the rhizosphere compared to the bulk soil.



Elemental and isotopic analyses showing that (A) carbon, and (B), specifically exudate-derived carbon, accumulate in the rhizosphere on < 2 µm particles

Then, applying STXM-NEXAFS analysis on the <2 um fraction, we found that the rhizosphere carbon was more diverse in terms of types of C functional groups compared to the bulk soil. This is likely due to continuous inputs of a mixture of compounds present in root exudates. We also found a higher co-localization of C with minerals, specifically with calcium in the rhizosphere than in the bulk soil, reflecting preferential formation of mineral-associated organic matter in the rhizosphere. Ongoing work is focused on understanding the effects of growing conditions on rhizosphere C dynamics as well as the stability of C in the rhizosphere compared to C in the bulk soil.



Spectro-microscopy (STXM-NEXAFS) images of clay-sized particles (< 2 µm) showing spatial distribution of C and Ca, and diverse C forms in the rhizosphere (A); lower C-Ca co-localization and C form diversity in the bulk soil (B). Spatial correlation analysis of carbon (C), with calcium (Ca), iron (Fe), aluminum (Al), and silicon (Si) showing C is most strongly co-localized with Ca, and to a greater extent in the rhizosphere than in the bulk soil.

Impact:

- These observations of sub-micron scale processes reveal little known mechanisms of C cycling in the rhizosphere, which fuels plant nutrient cycling.

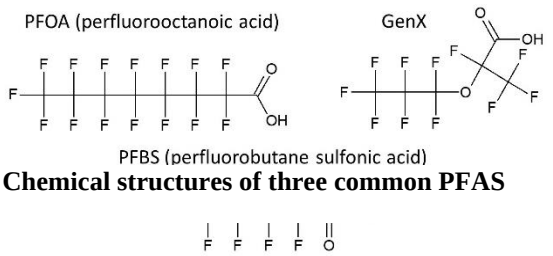
<u>Per- and Polyfluoroalkyl Substances</u>

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.

Phytoremediation of PFAS

Dr. Sara Nason, Dr. Nubia Zuverza-Mena, Dr. Sara Thomas, Jasmine Jones, 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 Mi'kmaq Nation (Aroostook County), an indigenous group. 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.



Chemical structures of three common PFAS

Uplant Grassroots, an organization formed by 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.

The Burn House at the former Loring Airforce Base.

We have assisted with 3 years of phytoremediation trials (2019, 2020, and 2022) where industrial hemp was used to remove PFAS from the soil. Hemp is a promising plant for phytoremediation due to its large size, fast growth rate, and high water usage. In 2022, we tested 5 hemp varieties, and determined that ChinMa was the variety that performed the best in the local climate (pictured below). We quantified 10 PFAS taken up by the hemp plants and found that some PFAS were more than 10 time more concentrated in the plants than in the soil.

Hemp growing at the former Loring Airforce Base in summer 2022. Upland Grassroots member Chelli Stanley is pictured monitoring the hemp growth.

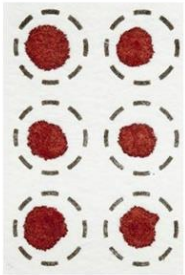
Additionally, we are collaborating with the Liang lab at SUNY Albany and the Jaffe lab at Princeton University to investigate options for degrading the PFAS that remain in the hemp plants after they are removed from the soil. Hydrothermal liquefaction and microbial degradation have both shown promising preliminary results. We are also collaborating with the Haynes lab at the University of Minnesota and the Vasiliou lab in the Yale School of Public Health to develop novel materials that can be used as soil additives to enhance plant uptake of PFAS for phytoremediation.

Impact:

- Phytoremediation has the potential to be an effective and low-cost method for removing PFAS, a class of highly toxic chemicals, from soil.

Measuring PFAS to assess human exposure

Dr. 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. This year, we published a newly validated method for measuring PFAS in dried blood spots and whole blood in *Science of the Total Environment*. We also

finalized our data for a study relating PFAS to thyroid hormone levels in infants, and submitted a study to *The Journal of Exposure Science and Environmental Epidemiology*.

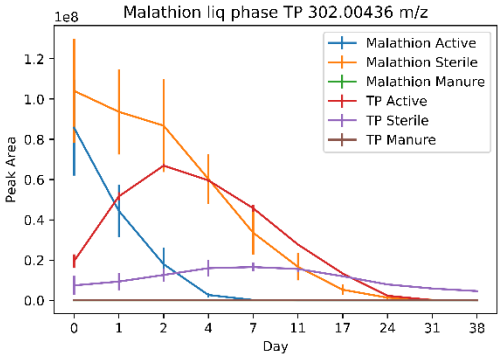
Impact:

- Methods for measuring PFAS in current and archived human blood samples are important for monitoring the presence of and investigating the health effects of these toxic contaminants.

Organic Microcontaminants (OMCs) in waste related matrices.

Contaminant transformation during anaerobic digestion

Dr. Sara Nason and collaborators at Johns Hopkins University



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.

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. We published this work in the journal *Science of the Total Environment*.

Impact:

- Anaerobic 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. Understanding contaminant transformation processes is important to identify potential environmental and human health risks.

Assessing the impacts of reclaimed wastewater reuse for agricultural irrigation

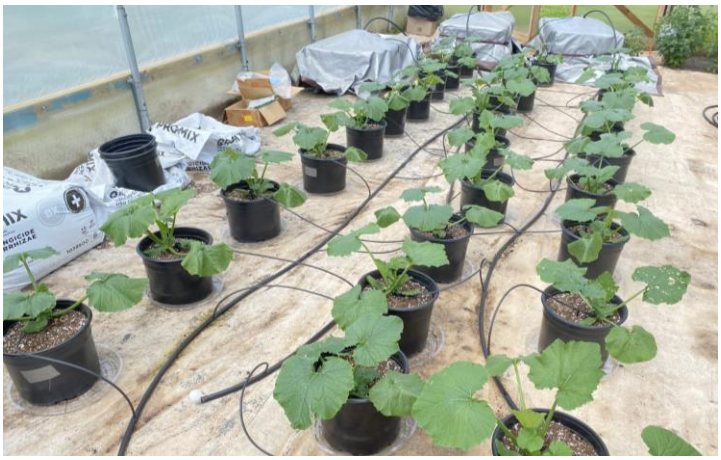
Dr. Sara Nason, Dr. Nubia Zuverza-Mena, Dr. Peiying Wang, Dr. Jingyi Zhou, Jasmine Jones, Simon Duggan, and collaborators from the University of Maryland Baltimore County

CAES researchers visit the New Haven Water Pollution Control Authority.

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. Variability in wastewater composition is another factor that must be considered for determining the safety of reusing effluent for irrigation. While stormwater infiltration can dilute the concentrations of some contaminants, it may also introduce additional chemicals of concern into wastewater systems.

The first goal of this project is to assess 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 conducted a sampling campaign that included six storm events in New Haven, CT and corresponding dry weather samples. Method validation for our sample analysis plan is in progress. The results will help us to understand how the variability in wastewater effluent composition may affect the safety of using recycled wastewater for irrigation.

Additionally, we grew zucchini plants (pictured) using three different irrigation treatments: fresh water, wastewater effluent collected in dry weather, and wastewater effluent collected in wet weather. Moving forward, we will analyze these plants for contaminants derived from the wastewater.



Zucchini plants grown using reclaimed wastewater for irrigation.

Impact:

- Wastewater effluent reuse for agricultural irrigation is an important strategy to reduce demand from surface and ground water sources but can introduce harmful contaminants to crop plants. Investigating factors that affect the presence of these contaminants and bioaccumulation of contaminants in plants is important for identifying potential health risks.

Small plastic pools as a model for urban container gardening systems

Dr. Leigh Whittinghill, Assisted by Sofia Shubin, Leo Babicz (Plant Health Fellow), the 2022 Plant Health Fellows: Oliver Mackinnon, Aaliyah Walker, Brooke Issacson, Renee Smith, Naomi Allen, Mia Varney, Emilie Kendrick, Conor Bendett, and Juniper Allen-Cantu; and the 2023 Plant Health Fellows: Ananda Turner, Karena Kulakowski, Eva Rodriguez, Talia Traction, Oliver Kelsey, Charles McLean, Alexandra Carabetta, Aoife Collier-Clarke, Justice Glasgow, Ana DiMauro, and Tessa Lancaster.

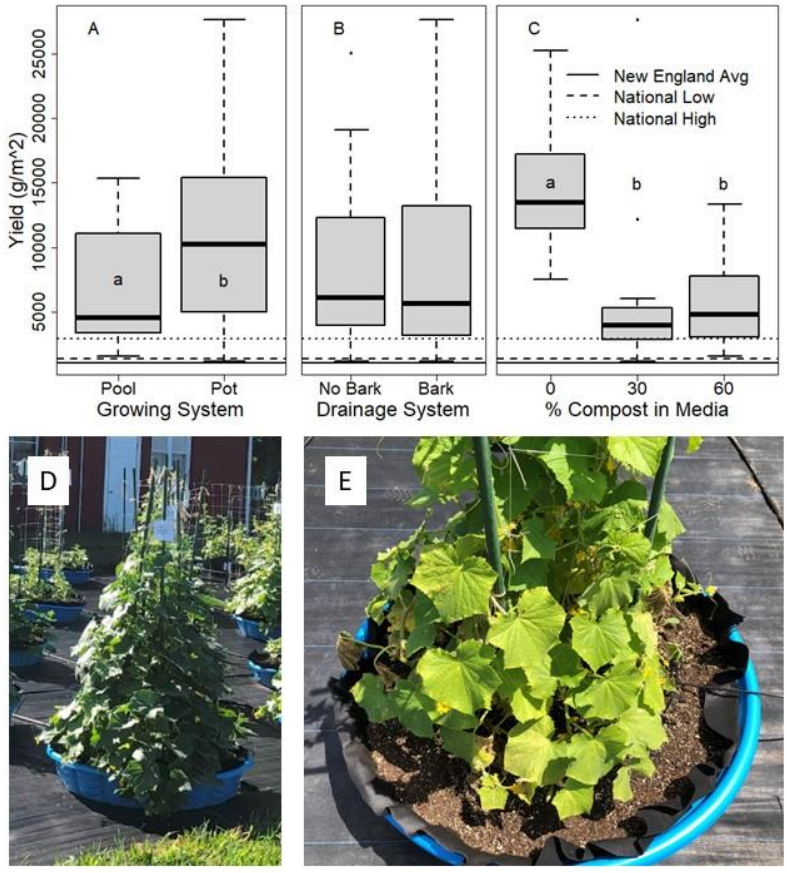
The use of small plastic pools as containers, for example, could help expand urban production to spaces with contaminated soils or otherwise unused surfaces such as parking lots and rooftops. These pools have a relatively low cost compared to other growing systems of similar size and lower cost per growing 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.

A controlled experiment was set up in 2022 at Lockwood Farm to examine two different drainage strategies for the pools (drainage holes in the bottoms of the pools and no drainage holes in the bottom of the pool with a pine bark mulch water reservoir) and three different media combinations of peat-based media and compost (0, 30, and 60% compost by volume). The small plastic pool system is also being compared to more traditional nursery pot production. Preliminary results from the 2022 growing season show some difference in yield between the pots and pools, no difference between the drainage strategies, and some better yields in the 0% compost media than the 30 or 60% compost medias. The media results were

unexpected, as cucumbers, the chosen crop, have been shown to do well in 60% compost media. Some possible explanations for this difference are being explored. At the start of the 2023 growing season, growth and development were still faster in the 0% compost treatments, but the 60% compost treatment was faster than the 30% compost treatment. This suggests that compost nutrients that may have been relatively unavailable at the start of the 2022 growing season, are available this growing season. Production in 2023 has, however, been affected by the wetter weather resulting in significant fungal disease pressures.

***Impacts*:**

- This project is a first step in developing best practices for small plastic pool container production.
- The proposed research will provide alternative growing methodologies in urban areas that will increase the production of healthy fruits and vegetables near urban markets while circumventing the issues of limited growing space and potential soil contamination.



Preliminary yield results for the 2022 growing season for the (A) growing system types, (B) drainage strategies, (C) media composition. Growth and apperance of the cucumber plants in the same pool on (D) Aug 4, 2022, and (E) July 29, 2023, showing the impact that the fungal disease has had on plant health and vigor.

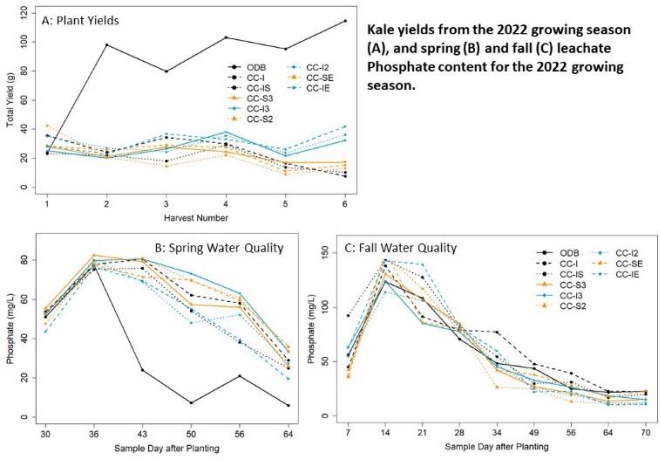
Cut-and-Come-Again Greens: Determining fertilizer application rates to promote higher yields and nutrient content in later harvests.

Dr. Leigh Whittinghill, Assisted by Sofia Shubin, Carlie Carbone (Quinnipiac University Intern), and Leo Babicz (Plant Health Fellow).

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.

A controlled experiment was set up in 2022 in which kale was grown with eight different fertilizer application treatments: no applications after the initial Fertilizer application, a side dressing of nitrogen at three weeks, and additional full fertilizer amounts or side dressings at every third, every other, or every harvest. Two single harvest controls were also used, one set was planted to be harvested at the baby stage alongside the cut-and-come-again kale harvests, and one was planted at the start and will be harvested when fully mature. These controls will help us compare our results to the harvesting practice used in much of rural and large-scale agriculture. Measurements are being taken on yield, crop nutrient content, soil nutrient content, and runoff/leachate water nutrient content. The idea is to find an optimal fertilizer application that will enable high yields and good crop nutrient content but have minimal impacts on runoff/leachate nutrient content.

Preliminary results in 2022 show no increase in yield with increasing nutrient applications. Conversely there also appears to be no increase in leachate nutrient content with increasing nutrient applications. Data from the leaf and soil nutrient content has been obtained, but not yet analyzed. One of these sets of data will likely show an increase in nutrient content with increasing nutrient applications. In 2023 the project was expanded to include collards. So far, Kale and collards production in the spring of 2023 seemed similar to that of 2023, while the fall crop has been delayed by warm weather.



Kale yields from the 2022 growing season (A), and spring (B) and fall (C) leachate Phosphate content for the 2022 growing season.

***Impact*:**

- This project is the starting point for the development of fertilizer recommendations for cut-and-come again harvested greens, which should result in higher yields at later harvests, and more nutritious greens.
- 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 effects of management practices on the nutritional quality of cut-and-come-again greens from urban farms in Connecticut.

Dr. Leigh Whittinghill

This project will fill some of that knowledge gap by working with urban growers in Connecticut who grow greens using cut-and-come-again practices. A small amount of information will be gathered about the farm to characterize their production practices, including irrigation and nutrient management. Leaf material from successive harvests of greens will be collected and analyzed for mineral nutrient content and nitrate content. Comparison of crop quality among farms with different management practices should identify practices that promote greens with higher nutritional quality, especially in later harvests. Information from this project will be used in conjunction with data from the other cut-and-come-again project to create nutrient management guidance for cut-and-come-again greens. Data from this experiment will also contribute to the design of future controlled experiments.

This project was started in the Spring of 2023. We had three regularly participating farms for the spring season. Further recruitment efforts in the Fall will bring these numbers up for the 2024 growing season.

Microbial ecology and wildlife conservation

Dr. Blaire Steven assisted by Ms. Jackie LaReau in collaboration with Dr. Chris Elphick, University of Connecticut

Salt marshes are changing globally, with increasingly wet conditions as sea levels rise. This results in habitat and species losses. The saltmarsh sparrow has received much attention due to the estimated loss of >70% of the world population since the 1990s, and predicted extinction by the mid-21st century. Sediment addition, which raises the elevation of the marsh, has garnered interest from many conservation practitioners given its potential to protect services and improve coastal resilience. Yet we do not understand how restoration affects other ecosystem processes of salt marshes, such as the multitude of functions provided by the sediment microbial populations. In this study we are investigating how wildlife conservation intersects with microbiology and biogeochemistry.

A saltmarsh sparrow and an image of sediment addition to a coastal wetland to increase elevation. The goal of this conservation effort is to provide safe habitat for the sparrow to nest in the face of sea level rise. The project will address other influences on salt marsh ecology, including sediment microorganisms.

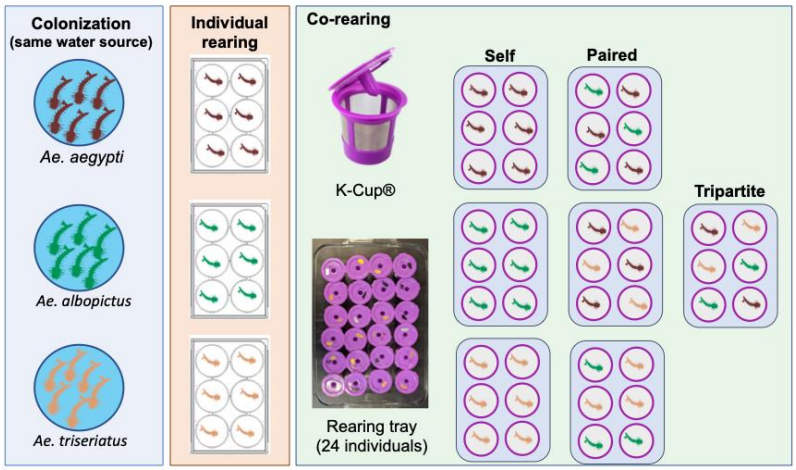
Impact:

- These studies are taking a holistic approach to wetland restoration, ensuring that conservation efforts for a single species do not impact other aspects of coastal wetland ecology including vegetation, microbes, and carbon cycling.

What bacteria colonize mosquitoes?

Dr. Blaire Steven and Dr. Doug Brackney

We have designed a method to perform a common garden experiment to characterize the bacteria that three species of axenic (microbe-free) larvae assemble from their surroundings. We found all three species recruited a common core of bacteria from their rearing water, with a large contingent of rare and sporadically detected bacteria. We also show that co-rearing of mosquito larvae leads to a coalescence in the composition of their microbiome, indicating that host-species interactions potentially influence the composition of the microbiome. These data suggest that there are common bacteria in the environment that can potentially colonize a wide range of mosquito species. This suggests certain bacteria in the environment could be a potential mechanism for wide-range mosquito control.



Schematic diagram of a common garden experiment. Three species of mosquito larvae are made axenic by surface sterilization of their eggs. The microbe-free larvae are exposed to the same environmental water source and reared alone or in combination. In this manner we can investigate which bacteria are recruited to the microbiome and how co-rearing influences which bacteria are present.

Impact:

- Through characterizing the bacteria that are best adapted for colonizing mosquitoes, we will better understand how bacteria influence mosquito development and possibly identify strains capable of biocontrol of an insect of global public health concern.

The Department of Plant Pathology and Ecology is led by Vice Director and Chief Scientist, Dr. Lindsay Triplett, and has had six research scientists and one active emeritus scientist who were supported by one full-time technician. The Plant Disease Information Office serves 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.

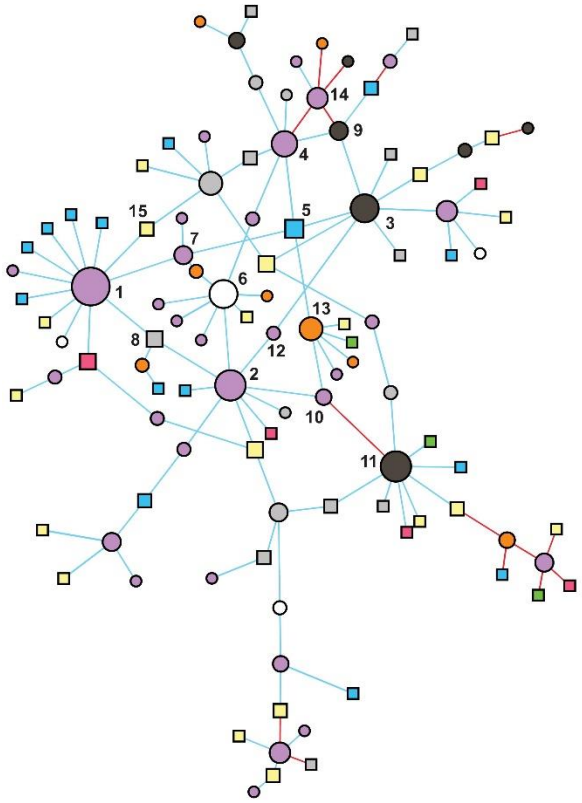
RESEARCH ACTIVITIES:

The role of protists in promoting rhizosphere bacteria

Protists are single-celled organisms that prey on bacteria. Protists can impact plant health by changing the community of bacteria that live on root surfaces; by feeding on bacteria that lack predation defenses, they can increase the growth of predation resistant bacteria, including some beneficial colonists of plants. Drs. Lindsay Triplett, Stephen Taerum, and Blaire Steven have previously characterized the protists living on plant surfaces, and identified how roots and leaves shape the protist community. In a new $819,000 USDA-funded project, the team is seeking to understand which bacteria are helped by protists in the rhizosphere, and how protist-bacterial partnerships could benefit crops. In the first year of this project, the team has identified 21 groups of root-associated bacteria that survive during long term passaging with protists and on the root surface, with 13 species enriched on the root after protist inoculation. Different bacteria were found in association with different protists, but a mixture of protists enriched all the bacteria at the same time. However, only a few single protists had a positive effect on plant growth, while a mixture did not. We sequenced the metagenomes of the protist cultures, and genome assemblies indicated that the protists selected for several bacteria with potential plant beneficial properties. In the next two years the team will test whether the protists are internalizing the bacteria or affecting their activity and behavior.

Impact: Understanding the patterns and mechanisms of protist selection of bacteria will help us predict the survival of beneficial bacteria in different soils, and help formulate inoculants with improved survival capacity.

Figure Caption: The Triplett lab is investigating why bacteria (circles) form largely positive associations (blue lines) with protists (squares) on maize roots.



Contribution of Toxin Antitoxin Systems to plant pathogen survival of disease controls.

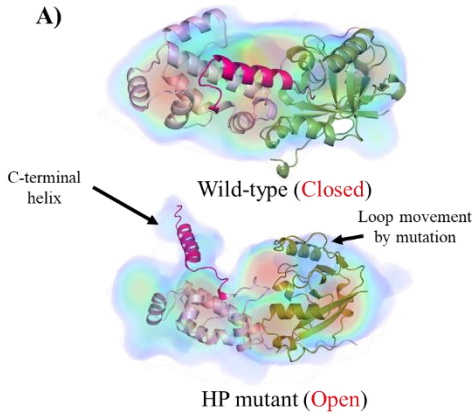
Investigators: Lindsay Triplett, Ravikumar Patel, and Penn State University Collaborators

Summary: 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 previously demonstrated that a novel bacterial self-poisoning toxin is a key requirement for the streptomycin survival state in *P. syringae.* In the past year, they demonstrated that toxin mutants causing increased streptomycin survival have a weakened bond with an antitoxin chaperone protein, suggesting that either extra free toxin or different toxin expression is the cause of increased persistence. Toxin gene mutants also have increased fitness during bean plant infection, which indicates that the self-suppressing mechanism can help pathogen success in a stressful plant host.

Impact: Understanding genes that affect antibiotic survival 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.

Figure Caption:

Triplett, Patel, and collaborators found that naturally occurring mutations that change the conformation of a specific bacterial protein the cause of increased antibiotic tolerance in plant pathogenic bacteria.



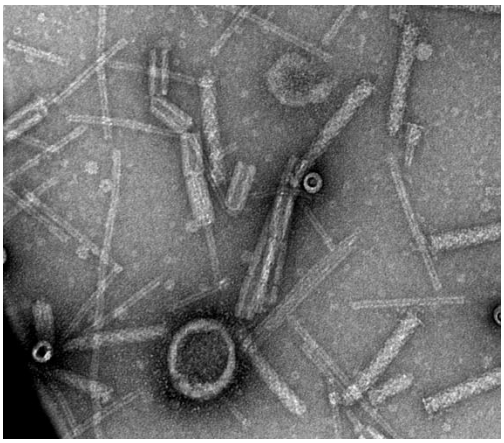
Physiological survival of bacteria to membrane-active antimicrobials

Investigators: Lindsay Triplett, Ravikumar Patel, and collaborators at Penn State and Montana State Univ.

Summary: Bacterial pests represent significant threats to crop production, but options for controlling plant bacterial diseases are very limited. Membrane-targeting antimicrobials such as bacteriocins and antimicrobial peptides are attractive candidates because they are biologically derived, have a narrow target range, can kill dormant or starved cells, and may even be engineerable to target specific pathogens. However, the Triplett lab recently found that a few bacteria can survive membrane disruption by bacteriocins, possibly by temporarily changing the structure of their cell envelopes. To determine the impact of this phenomenon on future bacterial control and find its mechanism, the team this year embarked on a $680,000 project funded by the USDA. In its first year, the team asked whether bacteria used the same strategy to survive different membrane-puncturing agents. First-year results show that bacteria surviving a plant-derived antimicrobial peptide have increased tolerance to a bacteriocin called tailocin, which indicates that bacteria survive the pepide and bacteriocin through the same mechanism. However, the survivors do not have increased survival to the medical antibiotic colistin, which indicates that bacteriocin use will not select for strains that are tolerant to last-resort human drugs.

Impact: Membrane-targeting antimicrobials are one of our best emerging options for organic biocontrol against many bacterial plant pathogens. By identifying how pathogens can survive these treatments, we may be able to design complementary treatments that prevent the emergence of resistance.

Figure caption: Micrograph of purified tailocins, protein structures that act as antibacterial missiles against pathogens. CAES researchers are identifying factors in pathogens that could weaken tailocin effectiveness (Credit: David Baltrus, University of Arizona)



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

Investigators: **Washington da Silva,** Nubia Zuversa-Mena, and collaborators from the University of Minnesota

Summary: Plant viruses cause an estimated $30 billion in crop loss every year worldwide. Since no viricide is available for direct control of these pathogens, there is an increasing demand for innovative and sustainable ways of managing virus epidemics in agricultural systems. Scientists at CAES have identified specific ribonucleic acid (RNA) molecules that induce RNA interference (RNAi), an evolved plant defense mechanism that we are seeking to activate or enhance, in plants and this can prime plants to successfully resist viral diseases. As part of a USDA-NIFA grant of $636,000.00 recently awarded by our research group, CAES scientists are now working on the last step of this multidisciplinary project, which aims to develop a delivery system for these RNA molecules to protect crops against these devastating pathogens.

Impact: 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 designed and synthesized several nanoparticles to act as nanocarriers for the sustainable delivery of dsRNAs to suppress plant virus infections in plants (Fig. 1) and are now testing their efficacy in protecting crops in the greenhouse and in field experiments.

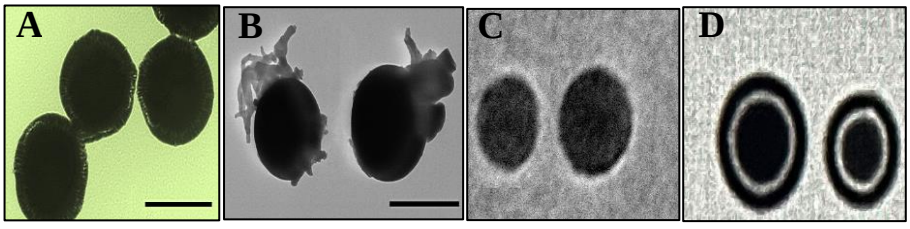


Figure 1. Different nanocarriers have been synthesized in the da Silva Lab and are currently being tested on plants to deliver dsRNA for plant virus control. A) A TEM image of silica-based nanoparticles without dsRNA; B) A TEM image of dsRNA molecules encapsulated by silica-based nanocarriers; C) A TEM image of zein-based nanoparticles without dsRNA; and D) A TEM image of dsRNA molecules encapsulated by zein-based nanocarriers.

RNAi-based control of fungal phytopathogen

Investigators: **Washington da Silva** and collaborators from the University of Maryland and the Universidade Federal Rural do Semi-Arido in Brazil.

Summary: Fungi are the most important group of pathogens of food crops

worldwide. The intensive chemical applications to control those pathogens have resulted in the development of fungicide resistance in the pathogens and also have negative effects on public health and the environment. Therefore, the development of efficient and sustainable fungal control alternatives is much needed. Dr. da Silva from CAES is partnering with scientist from the University of Maryland and the Universidade Federal Rural do Semi-Arido in Brazil to develop fungal control measures based on the application of RNA molecules – a technology being researched at the da Silva Lab to fight plant viruses infections.

***Impact**:* This research will potentially have a significant impact on the food and agriculture sector by advancing sustainable disease management strategies that will enhance the health of the environment, the public, and the economy. Preliminary data from our group indicate that this approach has the potential to inhibit fungal growth and development *in vitro* (Fig. 2), future research will determine if similar results can be accomplished when the pathogens are infecting crops.

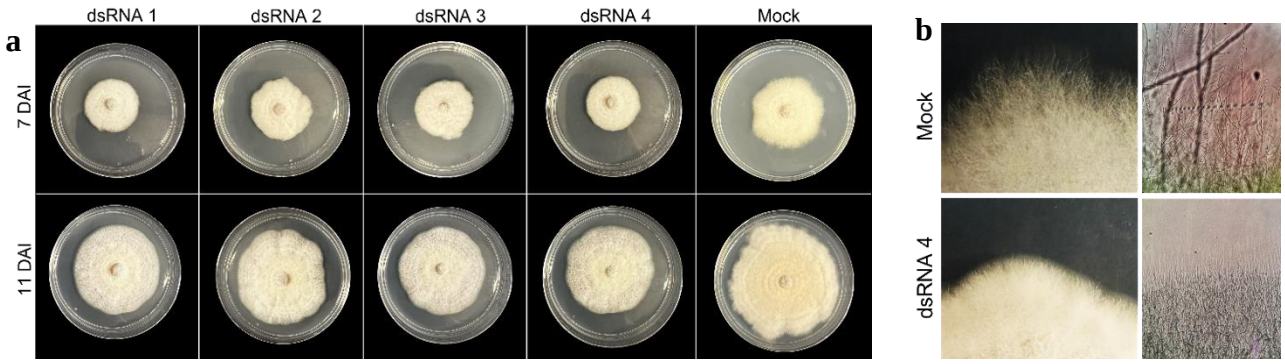


Figure 2. Fungal growth and development inhibited by the application of dsRNA molecules. (a) Fusarium oxysporum f. sp. niveum (FON) colonies on PDA media treated with dsRNA from different regions of the FpPPR1 gene and incubated for 7 and 11 days; (b) Comparison of mycelial growth morphology at the edges of the colonies.

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* multiplies epiphytically 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. Susanna Kerio, Dr. Zeng and his colleagues Dr. Hassani, Dr. Mukhtar, Ms. Huntley and Mr. Standish, characterized the composition and dynamics of the mycobiome on hypanthium of apple flowers. First, a cultural independent method was carried out to determine the composition of the fungal microbiome on apple flowers, cultured under different regimes (Organic, Conventional). Second, the team established a large culture collection of flower colonizing yeasts using 3 different media. A total of 783 yeasts isolates have been obtained (230 from 2022 and 553 from 2023). These yeasts were sprayed to flowers and tested for the immune induction function upon treatment. 23 yeast isolates were identified for the strong induction for the expression of *PR-1* and *PR-2*. Mr Standish developed an Agrobacterium mediated T-DNA mutagenesis of some of the candidate yeasts to functionally characterize the

mechanism for the plant immune induction in such yeasts. Arabidopsis plants carrying a PR1 promoter-GUS gene will be used for this screening.

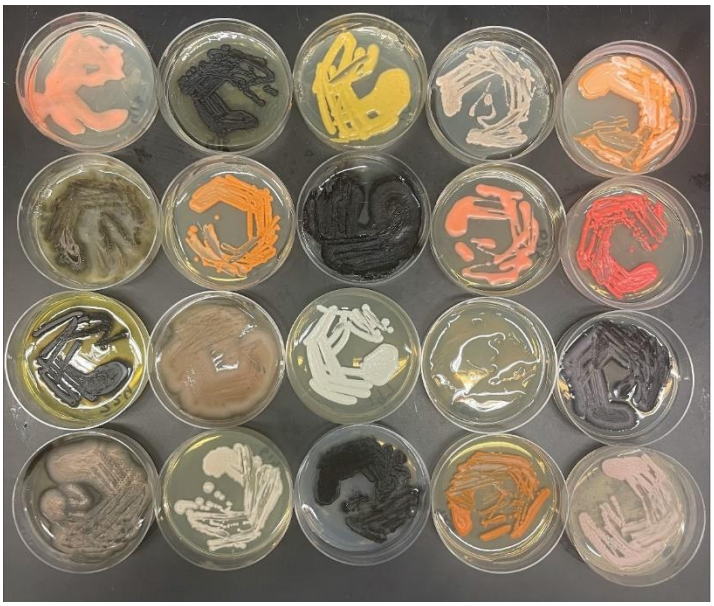


Figure 1. Different yeast species isolated from apple, crab apple and pear flowers collected in CT and OR.

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. Information gained in this project has yielded a scientific paper in Phytopathology. Relative information was also summarized into a trade journal article (Good Fruit Grower) and is disseminated to apple growers nation-wide. A USDA-NIFA grant was funded to further support this line of research.

Role of pollinators in microbiome development on apple flowers

Microbiome on flowers are relatively less studied as compared to that on roots and leaves, yet it plays important roles in pollinator interactions and resistance to plant diseases. During petal open, the nutrient rich, internal flower parts are exposed to the environment thus providing a good model to study microbiome assembly and succession. To determine the original source of the microbiome, we compared the microbiome assembly on apple flowers in the presence and absence of the pollinators using insect exclusion netting. A higher diversity was detected in microbiome on natural flowers as compared to on flowers with no pollinator access, suggesting that pollinators are indeed an important source of the flower microbiome. Analysis of the relative abundance of microbiome members identified OTUs that are potentially plant originated (mostly Pseudomonas and Pantoea) and pollinator dispersed (Erwinia). Despite the role of pollinators in microbiome dispersal, microbiome on flowers ultimately stabilizes to a similar structure at later stage of bloom regardless of their pollinator access. Findings suggest that pollinator-dispersal contributes to the initial diversity, but do not affect the core members of the flower microbiome. Finally, we performed wet lab experiment testing the observed phenomenon in the microbiome which suggests the fire blight pathogen *Erwinia amylovora* is indeed transferred by bees.

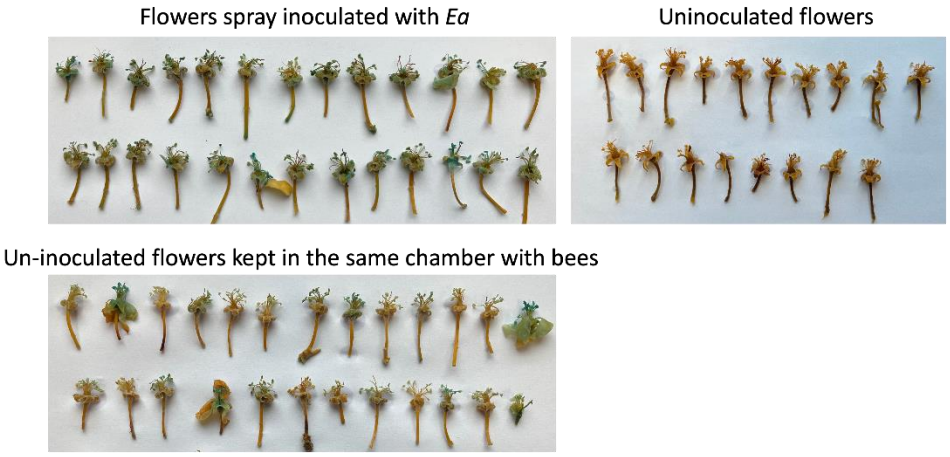


Figure 2. Presence of Erwinia amylovora (indicated by blue color from GUS staining) on apple flowers as a result of bee visitation.

Impact: This research provided knowledge foundation about how plant recruit microbes to establish its microbiome. It may also have implications for the fire blight epidemiology and control, as it clearly demonstrated the pollinator-mediated dissemination of *E. amylovora*.

Quorum Sensing Mediated Bacterial Interspecies Communication in Soybean Rhizosphere

Rhizosphere harbors a diverse group of microbes including bacteria belonging to different species and families. These diverse bacteria co-colonize in the same ecological niche, prom the questions whether and to what extent bacteria of different species communicate with each other, and what biological consequence it confers to the plant fitness and health. Quorum sensing (QS) is an important microbial communication method in which bacteria produce diffusible auto inducer signaling molecules to the environment and can be perceived by QS receptors and alter gene expression once its concentration is above a threshold. Most research on QS focused on its function in controlling bacterial behavior within a single species and there is a knowledge gap whether bacteria belonging to different families and species can communicate through QS. Using shotgun metagenomic sequencing, we identified that several QS systems such as AHL, HSQ, and COM class in soybean rhizosphere. Interestingly, the detected QS systems is enriched in rhizosphere as compared to the bulk soil, suggesting that plants are recruiting bacteria with QS to colonize on them. Using analytical approaches, a diverse group of AHL molecules were identified within soybean rhizosphere, including C4, C6, C8-AHL and 3-oxo-C8, 3-oxo-C10-AHL which are also enriched in soybean rhizosphere as compared to bulk soil. LC-HRMS analysis and genome sequencing of individual bacterial strains isolated from the soybean rhizosphere identified both AHLs and QS genes that are shared among bacteria (such as C4, C6 and C8, LasI, RhlI, PhzI, CepI and TofI genes) and AHLs and QS genes that are unique to individual species and strains (such as 3-oxo-C12 and CinI, EsaI and PqsH genes). Finally we showed that AHL producing bacteria Pseudomonas LFS074 and Burkholderia LFS061 with C6, C8 and C14-AHL molecules induced the phosphate solubilization and siderophore production in AHL negative strains Bacillus LFS077 and LFS086. Findings from this study suggest that bacteria of different species indeed communicate with each other through QS, and such communication may have important implications to plant growth and fitness.

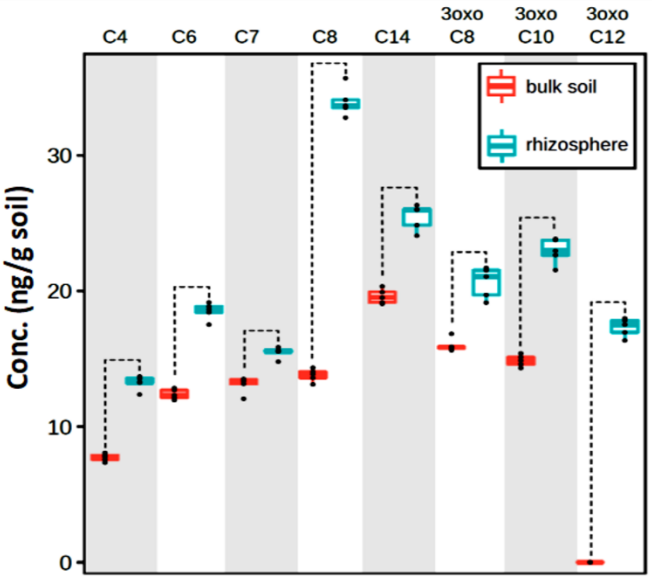


Figure 3. The quantity of different QS signaling molecules present in bulk soil and in rhizosphere.

Impact: This research provided evidence suggesting that bacteria belonging to different groups, sharing the same environmental niche, can communicate to each other through quorum sensing. By supplying the matching QS signals, we are able to enhance the plant growth promotion traits of the beneficial microbes.

Metabolic interactions of *Erwinia amylovora* and Apple in the establishment of Fire blight (Schultes lab)
Schultes ROY 22-23

Metabolic interactions of *Erwinia amylovora* and Apple in the establishment of Fire blight

Dr. Schultes investigates the metabolic requirements of *Erwinia amylovora* to establish disease. The bacteria *E. amylovora* is the causal agent of fire blight, a devastating disease of apples and pears. Successful plant pathogens enter, evade, and disarm the host and host defenses and then travel to and propagate in different plant locations. Virulence genes direct the early invasion process, while genes in nutrient acquisition from the host or *de novo* synthesis in the pathogen are essential for pathogen propagation and disease establishment. *E. amylovora*, has several attributes that make it a "model" for studying pathogen-plant interactions. First, this bacterium is easily manipulated in laboratory and amenable to genetic alterations and mutagenesis. Second, the fire blight disease cycle *E. amylovora* occupies different plant locations each presenting the pathogen with unique nutrient landscapes. Nutrient acquisition strategies require pathogens to be biochemically nimble and adapt to changing nutrient landscapes. This 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.

Auxotrophic *E. amylovora* mutants have been used to probe pathogen/host interactions with host plants during disease establishment, employing mutants deficient in amino acid, nitrogen, and carbohydrate utilization pathways. Host sugar resource utilization by *E. amylovora* is an essential process of disease establishment. During the past year we have assessed the virulence of *E. amylovora glyceraldehyde-3-phosphate dehydrogenase* (*gapA*) mutants, which are defective in sugar utilization through both glycolysis and the phosphogluconate pathway. GapA is interesting to study for pathogen-host interactions as it is involved at different regulatory levels between metabolic pathways and virulence. In *Eschericha coli* GapA is a multifunctional enzyme. GapA is central in regulating the glycolysis/pentose phosphate pathway flux during oxidative stress. In *E. amylovora, the GapA locus* is among genes transcriptional controlled by nucleotide second messengers [(p)ppGpp and cyclic di-GMP], that are associated with virulence, host colonization or biofilm formation. GapA is also post-translationally regulated via lysine acetylation, a process associated with enzymes at control points in metabolic flux as well as being associated with plant-pathogen interactions. In this report, we generated two different *E. amylovora gapA* mutant alleles and characterized their disease severity on apple fruitlets.

The first step was to determine if the *EaGapA* gene is expressed in diseased tissue. Immature apple fruitlets inoculated with wild type *E. amylovora* develop disease symptoms that include browning and ooze formation. Wildtype *E. amylovora* was used to inoculate fruitlets and the resulting bacterial filled ooze was collected and RNA extracted for analysis. A reverse transcriptase-polymerase chain reaction assay was performed and reveals that the *EaGapA* gene is expressed during fire blight disease as seen by the 462bp *GapA*-specific DNA fragment (Fig 1A).

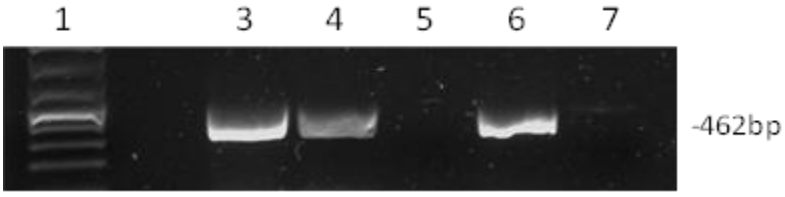


Figure 1 *GapA* expression analysis

Expression of *gapA* in ooze isolated from independent 'Gala' fruitlets inoculated with WT *Erwinia amylovora*. Lane 1: DNA size marker

(Gene Ladder 1kb Plus, Thermo Scientific); lane 2: empty; lane 3: WT genomic DNA yielding *gapA*-specific 462 bp product; lanes 4 & 6: total

RNA from ooze subjected to reverse transcriptase PCR analysis; lanes 5 & 7: total RNA from ooze subjected to PCR analysis without reverse transcriptase.

To determine if GapA plays a role in the endophytic growth and virulence of *E. amylovora* in developing fruit, two different *gapA* mutant alleles in *E. amylovora* were generated – a stable *DgapA* allelic exchange mutant in which the *gapA* open reading frame was replaced with a chloramphenicol resistance gene and a revertible plasmid insertion allele (pKNOCK). Multiple independent alleles are needed to verify that a second site mutation generated during mutagenesis is

not responsible for the phenotype. The allelic exchange mutation results in a stable deletion of part or all or a gene and replacement with an antibiotic selectable marker. In plasmid disruption alleles a pKNOCK plasmid derivative containing *EaGapA* DNA sequences integrates into a locus via homologous recombination. At a low frequency, the plasmid insertion can re-excise via homologous recombination, restoring the wildtype locus. Analysis of such revertant events can also be used to verify that strain phenotype is due to gene of interest genotype and excludes the possibility that an unlinked second site mutation is responsible for phenotype. A diagram detailing the mutant constructions are shown in Fig. 2A (for the *DgapA* allele) and Fig. 2B (for the *pKNOCK:gapA* allele).

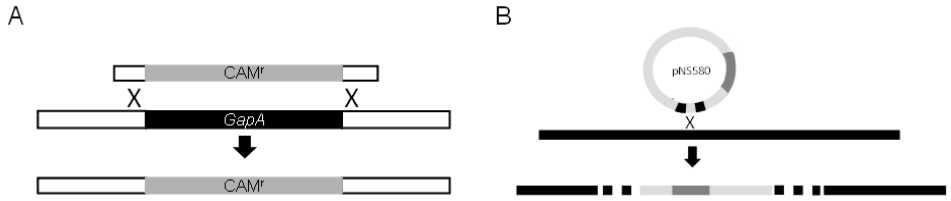


Figure 2 Mutant allele construction

A Diagram for construction of the D*gapA* allelic exchange mutant by targeted recombination with the chimeric *EaGapA* 5' – Cam^R – *EaGapA* – 3' DNA fragment, replacing portions of the *gapA* ORF with a Cam resistance cassette, and locations of PCR primers with corresponding expected PCR product sizes; wild-type product size is indicated by dashed line. (B) Diagram for construction of the pKNOCK:*gapA* plasmid insertion mutant allele by targeted recombination of plasmid pNS580 into the *gapA* ORF, and PCR primer locations with corresponding expected PCR product sizes.

Immature apple fruitlets (Gala variety) were inoculated with wild type *E. amylovora* and strains carrying either the *DgapA::Cam^R* and *pKNOCK:gapA* allele and scored for disease severity phenotypes after seven days. As seen in Fig. 3 fruitlets inoculates with wild type *E. amylovora* strain develop symptoms, while fruitlets inoculated harboring the *DgapA* allele and mock controls display no disease symptoms (ooze droplets and brown necrotic areas). *E. amylovora* strains carrying separate *gapA* mutant alleles both fail to develop disease symptoms and show that a functional *GapA* locus is required for disease.

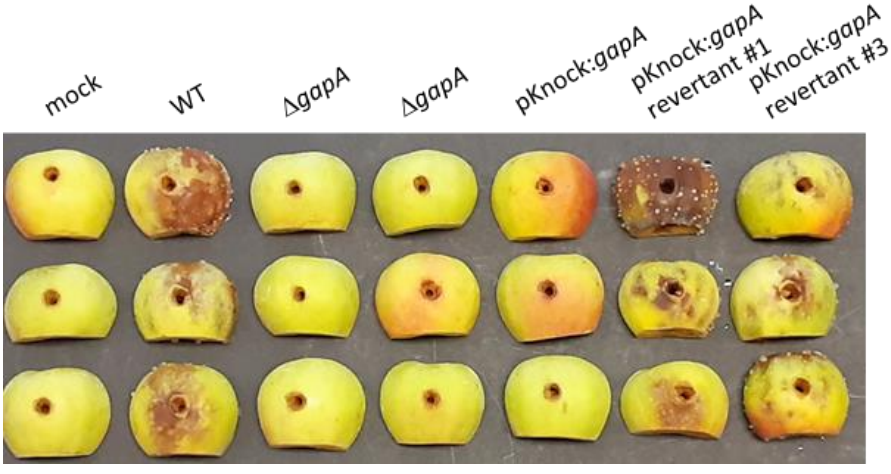


Figure 3 Virulence and growth in culture of *gapA* mutants. Symptoms in immature 'Gala' fruitlets seven days after inoculation with the indicated strains.

To further link disease phenotype to *GapA* genotype we exploited the unstable nature of the pKNOCK:gapA allele. At a low frequency, the pKNOCK insertion can re-excise via homologous recombination, restoring the wildtype locus. *GapA*+ revertant strains were grown on rich media in petri plates that do not sustain *gapA*- strain growth. DNA sequence analysis reveals restorations of the wild type *GapA* genotype. When such *in vitro* derived revertants were inoculated into fruitlets wildtype disease phenotype is observed (Fig. 3 revertant #1 & 3).

Quantitative scoring of disease and virulence symptoms of apple fruitlets inoculated with *DgapA* or *pKNOCK:gapA* compared to WT reveal a low disease severity rating compared to the revertant strains (Fig. 4). However, the disease severity for *pKNOCK:gapA* have a significantly higher rating that the *DgapA* strains indicating that occasionally disease symptoms arise in *pKNOCK:gapA* inoculated fruitlets (Fig. 5A). PCR analysis of ooze collected from fruitlets inoculated with pKNOCK:gapA reveals that the ooze contains WT GapA genotype (Fig 5B).

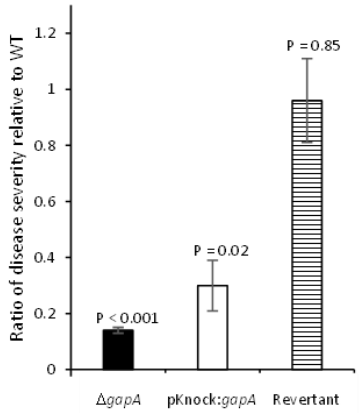


Figure 4 Disease severity ratios in immature 'Gala' apples 7 days after inoculation with the indicated strains; significant differences from WT disease severity as determined by Student's T test are indicated.

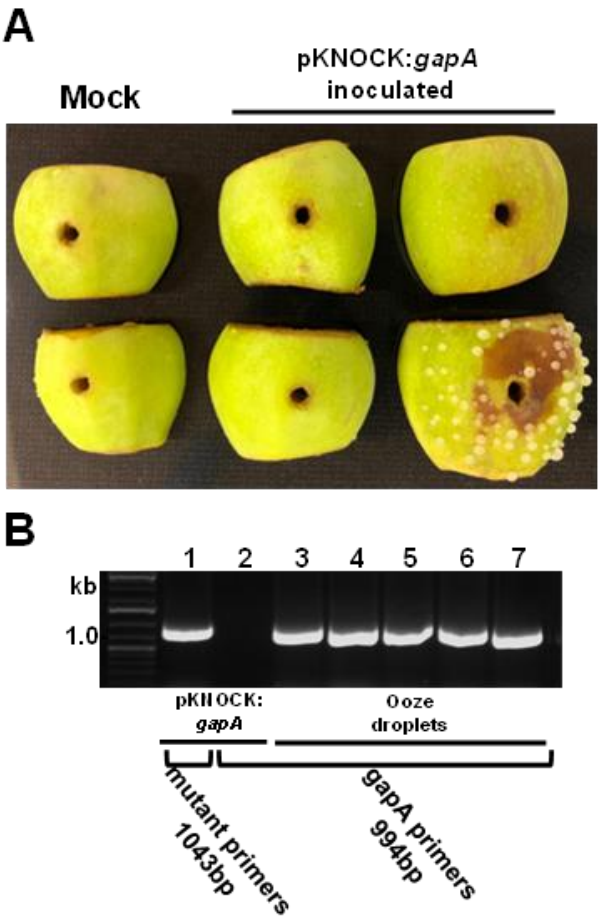


Figure 5 pKNOCK:*gapA* revertant phenotype and genotype

(A) Four representative immature 'Gala' fruitlets seven days after inoculation with pKNOCK:*gapA* and two control fruits treated with water (mock). (B) PCR amplification of gDNA from the pKNOCK:*gapA* mutant used to inoculate fruitlets, using a mutant-specific primer pair (see Fig. 1D) generated the expected 1043 bp amplicon (lane 1), while amplification with a *gapA*-specific primer pair (Fig. 1B) did not produce the 994 bp WT amplicon (lane 2). The *gapA*-specific primer pair produced the 994 bp WT amplicon upon PCR amplification of gDNA from five distinct ooze droplets (lanes 3-7).

The data show that a WT *GapA* locus is required for disease progression and development of virulence symptoms. Two independent *gapA* mutant strains both show severely reduced disease and virulence symptoms in laboratory infected apple fruitlets. Further, *pKNOCK:gapA* revertant strains, selected *in vitro* in petri plates or arising from *in vivo* from *pKNOCK:gapA* inoculated fruitlets result in WT disease symptoms and as wild type *GapA* genotype. The use of the pKNOCK mutagenesis system offers a means to verify mutant phenotype with mutant genotype due to reversion of the pKNOCK insertion. This method provides an alternative to complementation of mutant strains via reintroduction of a WT gene plasmid construct.

Impact: Comprehending how *Erwinia amylovora* sugar and carbohydrate needs in disease establishment will contribute to devising new strategies for fire blight control.

Oak Wilt (Marra Lab)

Oak wilt, a devastating vascular wilt disease that kills trees in the red oak group (red oak, scarlet oak, black oak, pin oak, bear oak, in Connecticut) within a single season, re-appears regularly in nearby parts of New York State (Brooklyn, Long Island). Caused by the ascomycete fungus, *Bretziella fagacearum*, 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. Because 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, a 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. The fungus spreads rapidly via root grafts and is easily vectored by native sap beetles, making timely diagnosis essential, should *B. fagacearum* be confirmed. Standard practice for regulatory response and intervention in currently affected states, ensconced in state law, involves removal and delimitation; Connecticut currently has no such regulatory response protocols in place.

Dr. Marra continues to educate the public about oak wilt, 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 stocks of trees in the red oak group. 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. This past year, Dr. Marra responded with site visits to two reports suspecting oak wilt; fortunately, both were negative.

Forest Health Monitoring

Beech Leaf Disease (Marra Lab)

First found in Connecticut in 2019 on American beech (*Fagus grandifolia*) in lower Fairfield County, by 2021 beech leaf disease (BLD), caused by the foliar nematode, *Litylenchus crenatae mccannii* (*Lcm*), was confirmed in all eight CT 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 that conform to a plot design implemented in all states cooperating in the plot network. Dr. Marra's CT plots are distributed throughout the state and in all 8 counties, and are

measured by Dr. Marra annually following protocols standardized by the USFS, which is the recipient and user of these data.

The spring of 2023 revealed a level of severity of BLD throughout the state that was the equal, or worse, of the disease's manifestation in 2022: 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. Overall, BLD in New England and New York has been found to be more widely distributed, and of greater severity, than the disease's earliest manifestations, in 2012-2015, in Ohio, western NY and PA, and Ontario, CA. 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).

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. In the fall of 2022, Dr. Marra was awarded a 3-year grant from the International Programs division of the US Forest Service, to focus on identifying the origin of Lcm, with a focus on Japan, where the very closely related *L. crenatae crenatae* (Lcc) has been found on Japanese beech (*F. crenata*), causing similar but very mild symptoms on foliage, but no decline or mortality, indicative of a co-evolved pathosystem. The grant will be used by Dr. Marra, along with a collaborator from USDA-ARS and two collaborators from the USFS, to travel to Japan in 2024 and 2025 to study the pathosystem there, and to survey for the origin of Lcm, the North American subspecies. The team has engaged with collaborators – nematologists and pathologists – in Japan, who will host them on their 2024 and 2025 expeditions. The grant also covers Dr. Marra's ongoing research using a DNA fingerprinting system to study the population genetics of Lcm in North America, and to develop an analogous fingerprinting system for Lcc, in order to study its genetic and genotypic diversity in Japan.

Dr. Marra has been using DNA samples extracted from Lcc in Japan, provided by Japanese collaborators, to sequence a large region of the mitochondrial cytochrome oxidase gene (CO-1) to determine the extent of differentiation between Lcc and Lcm. Dr. Marra has also used the CO-1 gene to develop a highly sensitive, specific, and quick qPCR assay that is currently being tested for its ability to distinguish between Lcc and Lcm. The assay has also 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). Most recently, Dr. Marra used the CO-1 qPCR assay to identify the possible presence of Lcm in foliage of *Carpinus betulus* (European hornbeam); however, confirming this species as an alternate host will require more substantive follow-up.

For purposes of studying pathways of spread of the BLD nematode, Dr. Marra identified 18 candidate microsatellite loci using a whole-genome sequence obtained from the nematode the previous year. During this past year, Dr. Marra tested these markers against a screening population consisting of DNA from single nematodes collected from CT, NH, OH, PA, VA, and WV. Thirteen loci were polymorphic among these 48 nematodes, with 2-5 alleles per locus; four loci were monomorphic across all 48 nematodes. Twenty-two of the 48 nematodes had unique genotypes, with the remaining 26 belonging to one of four clonal genotypes, each of which was found in more than one state. There was a very high level of

homozygosity, with heterozygosity found in only eight of the 13 polymorphic loci; this is, according to scientific literature, not unusual for nematodes. Private alleles – those unique to a single location – were found in eight loci. These preliminary data, and the finding of a large number of unique genotypes from a relatively small initial sample of 48 nematodes, suggest that Lcm may have been introduced several times, though testing this hypothesis will require DNA fingerprints from a much larger samples; this is one objective supported by the USFS-IP funding.

Disease Survey

During the year 2022-2023, Dr. Yonghao Li assisted by Ms. Felicia Millett and Ms. Katherine Dugas in the Plant Disease Information Office (PDIO) diagnosed a wide range of fungal, bacterial, viral, nematode, and abiotic diseases on trees, shrubs, herbaceous ornamentals, lawn grasses, fruits, and vegetables.

Woody Ornamentals:

Beech leaf disease remained the most concerned problem for beech trees because the disease has been reported in all counties in Connecticut. Distorted leaves and unopened dead leaf buds caused severe diebacks and decline of affected trees that were infected by the pathogenic nematodes. Extreme cold temperatures on February 3-4 caused severe winter damages on arborvitae, juniper, bigleaf hydrangea, and boxwood. Summer heat and drought stress in 2022 might also contribute to the death or declining of arborvitaes and boxwoods. Late frost on May 18 resulted in severe freezing/frost damages on warm-season vegetable transplants, fruit trees, and woody ornamentals (newly opened leaves of Japanese maple and redbud trees). Boxwood blight was confirmed in a few landscapes and nurseries but was not prevalent. Botryosphaeria leaf spot was found on rhododendron bushes from a nursery. Powdery mildew was found on dogwood, Japanese maple, hickory, lilac, serviceberry, and ninebark. Rhizosphaera needlecast and Stigmina needlecast remained two major foliar diseases on spruce trees. Cool and wet spring weather conditions were favored for some foliar fungal diseases, such as Exobasidium leaf gall on azalea and rhododendron, Gymnosporangium rust diseases on various host plants, such as apple, pear, serviceberry, and cedar trees, anthracnose on dogwood, hickory, maple, beech, hornbeam, and oak, fungal leaf blight on witch hazel.

American beech trees that are heavily affected by beech leaf disease showing significant diebacks and thin canopies

Copper beech trees that show moderately resistant to beech leaf disease

Botryosphaeria leaf spot of rhododendron

Leaf gall of azalea

Phytophthora root rot of butterfly bush

Downy mildew of butterfly bush

Herbaceous Ornamentals:

Volutella blight/canker of pachysandra was prevalent, which was contributed from severe drought and heat stress in the summer 2022. Alfalfa mosaic virus was another common disease of pachysandra although the disease does not cause severe damages on the plants. A lobelia plant collected from a nursery was tested positive for cucumber mosaic virus. Downy mildew was found on a Agastache plant and a phlox plant that were collected from nurseries. Southern blight and anthracnose were two common fungal diseases of hosta. Phytophthora root rot was found on lavender and wild ginger plants in nurseries and landscapes, respectively. Powdery mildew was prevalent on peony, beebalm, and rudbeckia. Fungal leaf spot remained a common disease on iris. Botrytis blight was found on phlox, hosta, dianthus, tulip, and impatiens. Bacteria

leaf spots were found on greenhouse-grown zinnia and salvia,

A lobelia plant infected with cucumber mosaic virus

Downy mildew of Agastache

Downy mildew of phlox

Downy mildew of phlox

Volutella blight of pachysandra

Alfalfa mosaic virus on pachysandra

Vegetables and crops:

Botrytis blight/canker was found on a greenhouse basil plant. A severe outbreak of tomato spotted wilt virus on tomato plants was reported in a farm, which was resulted from the infection of tomato seedlings in a greenhouse where mixed bedding plants were grown. Septoria leaf spot remained a major disease of garden tomatoes. Fusarium wilt of tomato became prevalent in farms and home gardens. Herbicide injury on tomatoes and cabbages was reported in home gardens.

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. Bacterial black rot was prevalent on cabbages and kales. Verticillium wilt was a major disease on eggplant.

Botrytis blight of basil

Tomato spotted wilt virus on a tomato plant

Tree and Small Fruits:

Peach leaf curl was widely reported in home orchards. Black knot disease was prevalent on cherry and plum 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. Black rot, powdery mildew, downy mildew, and anthracnose were commonly found on grapevines. Rust of raspberry was found on both leaves and stems. Phomopsis canker, Botryosphaeria canker, and mummy berry were major diseases of blueberry. Anthracnose crown rot was problematic in strawberry farms.

Cane rust of raspberry

Leaf rust of raspberry

Anthracnose of strawberry – on petiole and runner

Anthracnose of strawberry – in crown

Turf:

Dollar spot was prevalent in the summer 2023 because of humid and warm weather conditions. Other diseases that were common in lawns were brown patch, summer patch, red thread, pink patch, Pythium blight, anthracnose, Bipolaris leaf spot, powdery mildew, and rust. Slime mold and mushrooms in lawns also raised residence's concerns.

Dollar spot and red thread on grasses

Damages of grasses from dollar spot and red thread

Weeds:

Spotted water hemlock, an invasive and poisonous plant, was identified in a residential property, which raised a big concern for human health and public safety in the neighborhood. Control and removal of running bamboo, poison ivy, and Japanese knotweed continued to be an issue between residential properties. Controlling of oriental bittersweet, Virginia creeper, garlic mustard, mugwort, mullein, spurge, Japanese stiltgrass, thistles, and sumac in residential properties and gardens is a frequently asked question. Crabgrass, annual blue grass, bittercress, creeping bentgrass, common chickweed, mouse-ear chickweed, clover, ground ivy, yellow nutsedge, purslane, red sorrel, wild garlic, and wild violets were common weeds in lawns are. Increased numbers of inquiries about perennial grassy-weed identification and control in lawns were received.

Spotted water hemlock

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 plant health 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 Connecticut Agricultural Experiment Station, an official seed testing laboratory for Connecticut.

In 2022, a total of 333 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 327 samples were tested for seed germination rates because the other six samples did not have enough seeds for the test. Among the tested vegetable seed

samples, two hundred ninety-six samples passed the germination test, but the other 31 samples did not meet their label claims and the Federal standard. Summarized by seed sources, all seed samples from four companies passed the germination test, but one or more seed samples from the other six companies failed germination rate tests. Among 52 tested vegetable species, all samples in 37 species passed the germination test; the other 15 species had one or more samples failed the test. 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 12 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 Felicia Millett and Katherine Dugas answered 3,300 plant health and plant related inquiries from Connecticut citizens. Most inquiries were on ornamentals, trees, and shrubs (75.2%), but other categories, such as food crops (9.2%) and turf grasses (4.0%), were also well represented. A moderate percentage of inquiries fell into the miscellaneous category (11.6%), 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 (35.5%) and Connecticut homeowners (58.9%). Other sources of inquiries include UConn cooperative extension (0.5%), CAES (1.8%), and others (health departments, news, municipals, other agencies, and organizations) (3.3%). A further breakdown of inquiries showed that 28.0% of the questions came in by phone, 20.7% came in by mail, 21.6% came by email, and 29.7% were brought in person. To respond to inquiries, 1,722 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.

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 1920's

Activities on the Farm

There were a total of 32 experimental plots at the Valley Laboratory Research Farm during the past year. Eight CEAS scientists (Five VL scientists, three New Haven scientists) and one UCONN extension faculty member are using 26 plots. Additional six plots were maintained by the Farm Manager as rotation crops, vegetable for foodbank 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. Li 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

Project: Development and evaluation of strategies for protecting and sustaining the essential eastern hemlock resource in Connecticut

Type of research: McIntire-Stennis (CONH00820)

Grant funds to support project: NIFA, Farmington River Coordinating Committee, Lower Farmington River and Salmon Brook Wild and Scenic Committee

Eastern hemlock, *Tsuga canadensis*, is the sixth most common tree species, and the 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, protect many diverse native species and are integral to many recreational areas in state lands, land trust, bird sanctuaries and public preserves.

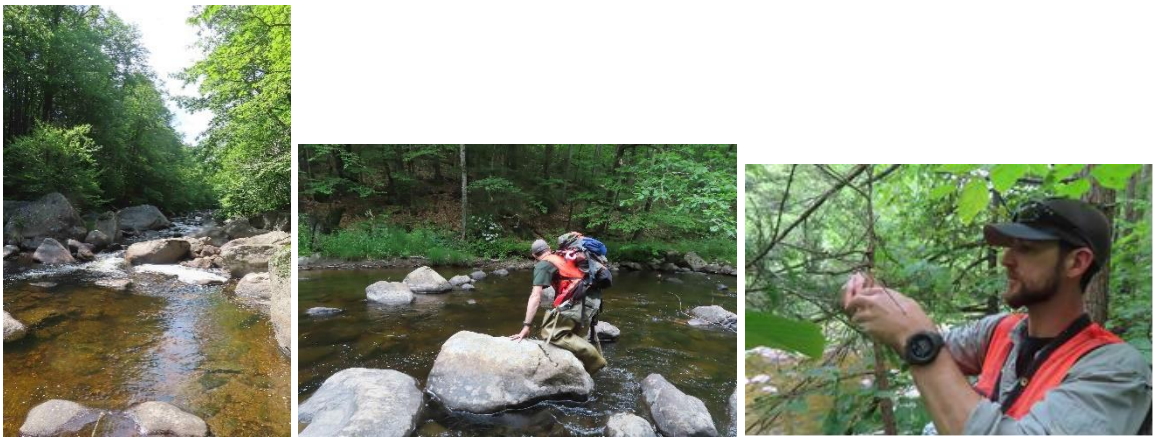
The most serious current threats to eastern hemlock are the invasive non-native pests from Asia: the hemlock woolly adelgid, *Adelges tsugae* (HWA) and the elongate hemlock scale, *Fiorinia externa* (EHS) and these periodically infest and cause serious damage to Connecticut hemlocks. Connecticut's major strategy to mitigate HWA damage in our hemlock forests since 1995 continues to utilize the introduced specialist ladybeetle HWA predator, *Sasajiscymnus tsugae*, for biological control of HWA. This species is still the only biological control agent for HWA widely available to the public through the sole commercial company rearing *S. tsugae*, Tree Savers from Pennsylvania. The rearing methods for *S. tsugae* used by Tree Savers are based on the original research on biology and life cycle of *S. tsugae* and rearing methods developed

by Dr. Cheah at the Valley Laboratory and represent technology transfer from original research to the commercial sector. Connecticut's experience using *S. tsugae* as the sole HWA biological control agent since 1995 has helped sustain the state's hemlock resource with minimal hemlock mortality over three decades. Conservation and protection of hemlocks are especially important in watershed forests and riparian corridors. Watershed forests around reservoirs have important hemlock components which also filter and shade feeder brooks and the use of chemical applications to control HWA in these forests is prohibited by law in Connecticut. Biological control releases with *S. tsugae* provide a critical, important, alternative strategy to manage HWA infestations, especially in sensitive wetland and riparian corridors. This biological control strategy is also very popular with homeowners and the general public who do not want to use chemicals to control HWA. As most of Connecticut's hemlocks occur on private lands, expansion of biological control with *S. tsugae* beyond state lands is an important mission to target other Connecticut hemlock forests threatened by HWA resurgence and spread. Dr. Cheah has developed and coordinated a network of state and private collaborators, town conservation commission members, land trusts, volunteers from the public, bird sanctuaries, private lake associations, water companies and funding sources to achieve this.

Views of the Upper Farmington River, Hartland, and the Lower Farmington River, Bloomfield in 2023

The Farmington River is Connecticut's first federally designated Wild and Scenic River. The Upper Farmington Wild and Scenic designation, spanning 5 towns in Northwest Connecticut, was achieved in 1994 and expanded in 2019. In 2023, through funding from the Farmington River Coordinating Committee (FRCC), 5,000 *S. tsugae* were purchased and strategically released along the Farmington and expanded to its tributaries to control HWA. Partners in 2023 for the Upper Farmington River biological control program are FRCC, Dr. Cheah, CT DEEP Foresters (for state forest sites), Hartland Land Trust (LT), Canton Conservation LT, New Hartford LT and Town of New Hartford, Metropolitan District Commission (MDC), Friends of American Legion and Peoples State Forests (FALPS), and Roaring Brook Nature Center, part of the Childrens Museum Group. Biological control releases of *S. tsugae* through FRCC to protect hemlocks in this watershed now total 11,250 from 2020 – 2023. All 5 member towns (Canton, New Hartford, Barkhamsted, Hartland and Colebrook) had HWA biocontrol releases implemented along the Farmington River and its tributaries at 6 state forests (Nepaug,

Werner's Woods, American Legion, Peoples, Tunxis and Algonquin State Forests), 4 town and land trust preserves, and MDC watershed forests. Of special note is the implementation of *S. tsugae* along Sandy Brook in Algonquin State Forest in Colebrook to protect the Sandy Brook Natural Area Preserve and the Kitchel Wilderness Natural Area Preserve, which are preserves of special recognition in Connecticut.



Releasing *S. tsugae* along Sandy Brook, Algonquin State Forest, Colebrook

CT DEEP Foresters and FALPS and FRCC volunteers releasing *S. tsugae*

The Lower Farmington River and Salmon Brook was also designated Wild and Scenic in 2019 and spans 9 towns from Burlington and Hartland to Windsor. The recent Connecticut collaborative program for biological control of HWA, launched by Dr. Cheah in 2020, was expanded to include the Lower Farmington River and Salmon Brook. Funding in 2023 was provided by the Lower Farmington River and Salmon Brook Wild & Scenic Committee (LFSWS) to purchase 10,000 *S. tsugae* for implementation. Partners here are LFSWS, Dr. Cheah, the Farmington River Watershed Association, McLeans Game Refuge, CT DEEP Forestry, State Parks and Wildlife Division; Simsbury LT, Towns of Bloomfield, Windsor and East Granby, East Granby LT, Wintonbury LT (now combined as Traprock Ridge Land Conservancy), Trees for Bloomfield, and Galasso Materials, LLC in East Granby. This collaborative program has now implemented biological control of HWA for the entire Farmington River and Salmon Brook from rural towns such as Hartland and Barkhamsted to suburban and urban towns such as Bloomfield and Windsor. Towns which have received releases include Burlington, Avon, Simsbury, Granby, East Granby, Bloomfield and Windsor at 6 state forests and other state properties, 3 town parks, 2 land trust preserve and 1 commercial property.






Dr. Cheah continues to publicize and educate the public on the availability of this biological control strategy, train and help with HWA scouting and guide optimal implementation of *S. tsugae*.

Dr, Cheah also documented and sampled for HWA winter mortality after a sudden and sub- zero incursion of arctic air in early February 2024. On Feb 4, the entire state experienced a polar vortex event which brought extreme arctic air over much of the state for a few hours in the early morning. The minimum subzero temperatures that were reported early morning hours of Feb 4, 2023 ranged from -12 to -17 F in northern CT to -4 to -5 F down by the coast. These temperatures were indicative of critical low temperature thresholds for 90% or more kill of HWA that were determined 5 years ago in Dr. Cheah's model for predicting HWA winter mortality from field winter temperatures. Over 40 sites all over Connecticut

were sampled and assessed by Dr. Cheah for HWA kill from the polar vortex in mid-winter to early spring. As predicted from the Cheah model. in most areas of Connecticut, around 90% or more of HWA kill was recorded after the polar vortex of 2023. With this dramatic natural reduction of HWA, hemlocks are getting a very beneficial reprieve from recent HWA invasions and resurgence. As HWA survival was slightly higher along water courses, this finding was used to strategically target multiple releases of *S. tsugae* in these scattered pockets of viable HWA for an effective strategy to further reduce HWA populations to maintain and sustain long term recovery of Connecticut's hemlocks. Dr. Cheah also used these results to guide implementation of *S. tsugae* at other town and private hemlock forests such as the Bent of the River Audubon Sanctuary, Southbury; Platt Park, Town of Southbury; Nonnewaug Falls, Town of Woodbury, Whittemore Sanctuary, Flanders Nature Center and Land Trust, Woodbury; East Granby Land Trust properties, Hartland Pond Association, Great Mountain Forest and other private lake properties in Norfolk and also advised several citizens on homeowner properties. The ladybeetle was also implemented at 2 water company forests in northern and southern Connecticut.

As of June 30, 2023, this collaborative program had released over 31,000 *S. tsugae* in 115 Connecticut towns in 2023. The total number of *S. tsugae* officially released in Connecticut exceeds 250,000 from 1995-2023, excluding smaller homeowner releases.

Dr. Cheah also continues to address numerous enquiries on the invasive Mile-a-Minute (MAM) weed, tracks weevil dispersal and establishment from reports and provides outreach on the biological control program for MAM, which was implemented and monitored in collaboration with Donna Ellis, retired 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. Weevils continue to be reported from non-release areas indicating dispersal and further establishment, 4 years after releases ceased. 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:

- The 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 28 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

Dr. Richard Cowles: 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

Dr. Richard Cowles 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:

Growers are adopting the use of pyriproxyfen to manage armored scales. Early adopters have seen dramatic improvement in tree appearance and salability, due to effective management of scale insects.

Weed Science (Dr. Jatinder Aulakh)

1. **Christmas tree tolerance and weed efficacy of Frequency (topramezone) and Mission (flazasulfuron) herbicides (New trial):**

A weed species shift towards herbicide tolerant and perennial weeds is happening in Connecticut Christmas tree plantations: many annual, biennial, and perennial weeds have become adapted to the current weed management practices. This is happening because of a mainly herbicides-based weed control, a lack of herbicide rotation, and limited availability of safe, alternative postemergence herbicides Dr. Aulakh is conducting several field research trials to evaluate two new herbicides; Frequency (topramezone) and Mission (flazasulfuron) for Christmas tree tolerance and postemergence weed control.

Picture 1. Frequency and Mission herbicide safety trials in field planted firs (left) and Balsam fir transplant beds (right) and in Windsor, CT.

Findings and Impacts: Nothing yet to report.

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

Horsenettle (*Solanum carolinense*) 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. Field experiments are in progress since summer 2022 at two locations in Connecticut for evaluating two HPPD-inhibitor herbicides: Tenacity (mesotrione) and Frequency (topramezone) for horsenettle control in established Fraser fir plantations.

Picture 2. Horsenettle control with Tenacity 15 fl.oz/ac (left) and Frequency 8 fl.oz/ac (right) at Koguts' Christmas tree farm, Enfield, CT in 2023.

Findings and Impact: In 2022, woodchips and preemergence herbicides did not provide satisfactory control. Horsenettle control was excellent (>80%) with Tenacity postemergence (POST) at 15 fl oz/a and Frequency POST at 8 and 16 fl oz/a. Experiments are in progress in 2023 at Koguts' tree farm in Enfield (repeat trial) and at Jones family farm in Shelton (new trial) for further evaluation.

3. **Ornamental Plant Safety Trials (new trials)**:

Ornamental plant safety and weed control efficacy of new herbicides are being evaluated on multiple ornamental plants that include balloon flower, big bluestem grass, cotoneaster, Joe-pye weed, thyme, Virginia rose, winterberry, Alberta dwarf spruce, and many other 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 3: Ornamental plant safety trials 2023 at Valley Lab Windsor, CT.

Findings and Impacts: The 2022 ornamental plant safety trials resulted in the discovery of several safer chemical weed control options for Christmas Trees, *Euonymus* (Gemini G, Fortress, and Fuerte), *Gomphrena* (Pennant Magnum), and *Portulaccaria* (Tower EC). Herbicide Dimension 2 EW was found unsafe on Ornamental nightshade and *Gomphrena*. The 2023 trials are in progress for weed efficacy and crop safety in multiple ornamental plant species.

4. Evaluation of Different Types of Mulches for Mugwort Control (Continuing trial):

Mugwort (*Artemisia vulgaris*) is a serious threat to the diversity of native flora, especially the 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 etc. However, there is a growing demand for non-chemical control for mugwort management. A field experiment is in progress since summer 2022 at Windsor Valley laboratory to evaluate the effectiveness of Clear and black plastic mulches and woodchips.

Picture 4: Mugwort research plots using different types of mulches at Windsor Valley Lab. CT.

Findings and Impacts: Mugwort was controlled 95% or higher with black plastic mulch that resulted in > 93% elimination of rhizome biomass (picture 5). Clear plastic was more effective than woodchips mulch with 73% reduction in aboveground mugwort shoot biomass and 65% reduction in below ground rhizome biomass. Woodchips mulch was not very effective because of less than 50% mugwort control.

Picture 6: Mugwort in no-mulch control plot (left) and in black plastic mulch plot (right) at Windsor Valley Lab. CT.

Plant Disease Research

Dr. James 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. D1 and D2 have been

recently released as new cultivars with resistance to wilt, TMV and black root rot. The B1, B2, D1 and D2 cultivars have been licensed to a local seed company. Additional breeding lines with resistance to target spot, black shank, brown spot, and bacterial wilt are being evaluated for disease resistance and agronomic characteristics.

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 has collaborated with researchers across the United States to create a standard protocol for boxwood evaluations that can be conducted across institutions. This includes 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 are being 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

Boxwood blight, caused by *Calonectria pseudonaviculata* (*Cps*), is a disease affecting both nursery production and landscape boxwood plantings. Drs. Kodati and LaMondia conducted this study to estimate the duration of protection offered by combination of fungicides with different modes of action on cultivars with low and high susceptibility. *Buxus microphylla* 'Tide Hill' (less susceptible) and *Buxus sinica* var. *insularis* 'Justin Brouwers' (highly susceptible) plants were left untreated or sprayed with TopBuxus, Actigard, ProConZ and mixtures of the products in all possible combinations. Leaves were collected at 5, 12, 19, 26-days post treatment (DPT). These leaves were inoculated with a drop (50µL) containing 200 *Cps* conidia. Infection and sporulation data were collected after 7 days of incubation at 25°C and RH >95%. There were no significant differences between any of the treatment combinations for infection except when the SAR was applied alone, which had reduced efficacy. There were no significant differences observed between any treatments for sporulation. The factors cultivar, treatment, and DPT were highly significant ($P<0.001$), and interaction of cultivar and DPT were significant for both infection and sporulation ($P=0.01$). We observed that cultivar susceptibility was very important as the fungicide treatments provided a shorter duration of protection for the highly susceptible cultivar, a maximum of 12-days, whereas they provided significantly longer protection on the less susceptible cultivar, up to 26 days.

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 morel mushrooms in Christmas trees: This project is a new 2-year project to develop a new intercrop, morel mushroom for Christmas tree farms started in May 2023. The cultivation is being conducted at Valley Lab, Humming Grove Farm and Jones Family Farms. A white pine Christmas tree plot has been set up at VL this past spring. Four small hoophouses have sent built for the study. Inoculation will be carried out in the fall. A big one will be built in September for more experiments. Inoculum preparation is underway.

Impact: Morel is a high-value gourmet mushroom. This study is to help Christmas tree farmers to develop a new crop: morel mushrooms. It can be marketed as fresh and dried produce. Fresh wine cap mushrooms have been sold at $35-50/pb. Grocery stores, restaurants and farmers' markets are potential venues for this produce. The new crop will increase their profit in the future.

Fungal taxonomic study. This collaborative study with James LaMondia, Neil Schultes, Rich Cowles and mycologists from several countries: Brazil, Canada, China, Cuba, Mexico, has led to discovery of 10 new fungal species: *Colletotrichum anhuiense*, *C. osmanthicola*, *Diaporthe foliicola*, *D. monospora*, *D. nanjingensis*, *Fistulina americana*, *F. orientalis*, *Neofusicoccum cryptomeriae*, *Phaeolus asiae-orientalis* and *P. yunnanensis*, among which six are plant pathogens and four, wood decay fungi.

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, aeromycology, fungal ecology and fungal biology. Determination and identification of fungal plant pathogens, which cause significant losses to farmers, are 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 add new information to fungal diversity, resources and conservation and utilization.

Fistulina americana discovered from CT and MA:

Figure 1. Basidiocarps of *Fistulina americana* (DL-22-189).

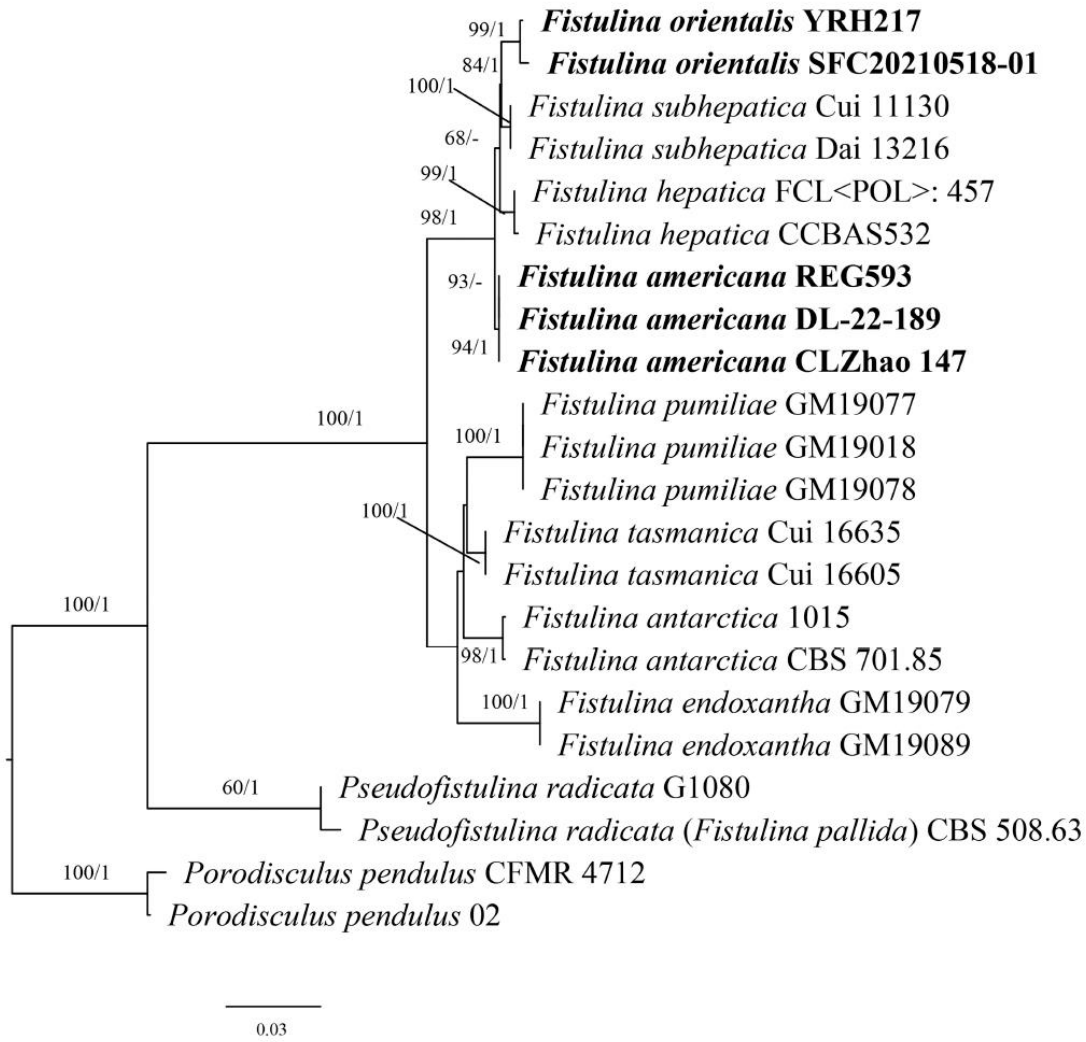


Figure 2. Maximum likelihood analysis of *Fistulina* based on the dataset of ITS + nLSU. New species are mentioned in bold.

Study on new plant diseases. A number of newly emerged diseases: Leaf spots of *Salix babylonica* caused by *Colletotrichum gloeosporioides* and *C. siamense*, *Diaporthe eres* and *D. unshiuensis* causing leaf spots on *Sapindus mukorossi*, top blight of *Cunninghamia lanceolata* caused by *Diaporthe unshiuensis* and *Diaporthe hongkongensis*, leaf spot of *Ligustrum japonicum* caused by *Diaporthe eres, Colletotrichum fructicola* causing leaf spots of *Liriodendron chinense* × *tulipifera*, *Erysiphe magnoliicola* causing powdery mildew of *Magnolia* × *soulangeana*, and *Colletotrichum* species causing anthracnose on *Cunninghamia lanceolata*. 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 fungal plant pathogens are imperative for disease management and future studies for fully understanding life cycles of the diseases to determine proper methods to control these diseases.

VALLEY LABORATORY SERVICE ACTIVITIES

Requests for Information

A total of 5,530 inquiries were answered at the Valley Laboratory during the past year. Nearly 46% of these queries were answered by Ms. Rose Hiskes in the inquiry office (66% of these from the public sector) and remainders were answered by the scientists. The majority of inquiries answered by Ms. Hiskes concerned arthropod (24%), diseases (18%), pesticides (12%), horticulture (8%) and weeds 7%. Most concerned landscape and nursery (49%), 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 71 presentations to grower, professional and citizen groups (about 3,302 people), were interviewed 3 times and made 201 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 79 nematode diagnostic tests and conducts testing as an APHIS certified pinewood nematode export testing facility.

Soil Testing

A total of 4,831 soil tests were expertly performed by Ms. Diane Riddle during the past year. About 45% were performed for commercial growers and 55% for homeowners. Of the commercial samples submitted, 35% were for landscapers; 4%

for tobacco growers; 0.8% for vegetable growers, 1.6% for municipalities, 0.7% for golf course superintendents; 0.01% for nursery growers; 0.03% for small fruit, and 1% for research. Thirty 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. The Conference Room was closed to the public due to the COVID-19 protocols until this spring. Three different groups used the room on 4 occasions in 2023. This room has been temporarily converted to Dr. Nate Westrick's office.

Valley Lab Diagnostic Office Insect, Disease and Plant Health Survey, 2022 – 2023

Ms. Rose Hiskes 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. The Valley Lab Diagnostic Office was staffed full time again starting July 1, 2022. Citizens, pest control operators and landscapers are returning to make use of this service.

Insects

Landscape plants in Connecticut are attacked by many insects. Rhododendron shrubs were fed on by cranberry rootworm adults at night during June and July (Figure 1). Young foliage is fed on from the lower leaf surface by this 1/5" long beetle. As the leaves grow, the elongated, irregular feeding sites become larger. Adults hide in the leaf litter below the shrubs during the day. Mating occurs and eggs are laid on the soil surface. Newly hatched larvae burrow into the soil and begin feeding on plant roots. Feeding continues into the fall. Most plants that are hosts for adults are also hosts for the larvae, though larvae are so small they are rarely encountered. Culturally, removing any mulch or leaf litter from below host shrubs may reduce the feeding of adult cranberry rootworms. Chemical management would involve spraying young foliage with insecticides such as seven, malathion or pyrethrin during the time adults are feeding.

A homeowner with many ornamental spruce cultivars in their landscape, brought in damage from the Norway shoot gall midge. This insect was identified by an employee of Bartlett Tree Experts, Lorraine Granney in 2011 from southwestern Connecticut. It has spread throughout the state and has even been seen on white spruce in the Belding Wildlife Refuge in Vernon. No effective controls are known at this time.

Figure 1. Cranberry rootworm adult damage on rhododendron.
Image by Susan Luukko. Used with permission.

Lawns in Connecticut are attacked by many insects. Many lawns suffered damage from chinch bugs during the summer months. Small black insects can be seen on the soil at the edges of dead patches. An oddity this year involved sunflower moth larvae that were found feeding on a home lawn in late July. This moth usually feeds on the flowers of plants in the aster family.

Delusions of infestation is the sensation that your body is being fed on by insects. Thirteen people came in during the past year with this problem. Showing them through a video camera that there are no segments on a paint chip, or legs on a grass seed can help the citizen adjust to reality.

Diseases

Landscape plants in Connecticut also suffer from fungal, bacterial or viral diseases. Beech leaf disease, caused by the nematode *Litylenchus crenate* subsp. *mccannii* and first found in Southern Connecticut in 2019, is now widespread in the Hartford area. Five years of research in Ohio showed that treating trees twice between May and August with a soil drench of Polyphosphite 30 fertilizer significantly increased the health of trees compared to untreated trees. CAES scientists Drs. LaMondia and Cowles are researching the use of the insecticide fluopyram applied after leaf maturation but before nematodes migrate out of the leaves and into buds. Nematode numbers drop significantly after treatment. However, a systemic treatment that goes into the buds and kills nematodes there would be more effective.

Landscapers have been mentioning for the past few years that dwarf buddleja plants do not perform well in Connecticut landscapes. This year a nursery brought in dwarf buddleja plants that had severe downy mildew as well as a planthopper and a plant bug. (Figure 2.) With the help of Dr. Li from the CAES Plant Disease Information Office in New Haven, virus infection was ruled out.

Another problem on spruce in Connecticut this year has been *Stigmina* needlecast. Needles brown and drop early depriving the plant of additional chlorophyll production. This disease has almost replaced *Rhizosphaera* needlecast. If needed, fungicide sprays as the candles elongate with manage this disease in the home landscape.

In March a forester brought in a 3" diameter white pine trunk with a rough barked, furrowed canker and dried white sap. Small shiny black cysts of the bast scale were present on the sample. The plot in Union Connecticut was losing many younger white pines. On the advice of Dr. Li from New Haven, I looked for and found the fruiting bodies, also called eyelashes, of *Caliciopsis pinea*. US Forest service literature suggested thinning the stand to allow more light and air movement and less spore production and movement.

Figure 2. Dwarf *Buddleja* showing downy mildew symptoms. © Rose Hiskes

Weather and Plant Health

The weather in Connecticut continues to change. April 13 and 14 were 92 and 95° F degrees. Plants started growing quickly. On the morning of May 18, the temperature in the Hartford area was 32° F. Night temperatures had been in the 50s and 60s the week prior. Many cherries, which are thin barked, suffered cold injury and tip dieback. Evergreen azaleas lost all their flower buds, while vegetative buds, which are generally hardier, survived. Strawberries and peaches in the state lost flower buds.

Many invasive plants such as Japanese knotweed and oriental bittersweet lost stems and leaves, respectively. Citizens were excited to see this. However, this 'light pruning' of the invasives only served to invigorate them. The plants came back quickly.

Many home vegetable gardeners had planted tomatoes and peppers already. The old mantra of not planting these warm season crops until the end of May had not been observed for the past some years with no negative effects.

Rainfall which was below average early in the season by July was above average. Temperatures are breaking record highs.

INFORMATION AND DIAGNOSTIC OFFICE TOTALS

Scientist/Tech	Inquiries	Samples IDed/tested	Visits	Talks	Interviews
Aulakh	500		20	7 (350)	
Cheah	679		140	17	
Cowles	320		28	29 (2568)	1
LaMondia	626	79 nematode samples	8	13	2
Li	121	44	2	3 (331)	
Riddle	742	4831 soil tests			
Hiskes	2542		3	2 (53)	
VL Totals	5530	4954	201	71 (3302)	3

2542 total inquiries answered. Homeowner inquiries: 66%. Commercial inquiries: 30%.

Problems

arthropod	24 %
disease	18 %
pesticide	12 %
cultural	10 %
horticulture	8 %
weed	7 %

Sites

landscape	49 %
lawn	11 %
vegetable	7 %
structural	7 %
fruit	4 %
human	4 %

Impact Statement: Because of my diagnostic work, homeowners are applying fewer fungicides in cases of fungal leaf spots when I explain that this is only an aesthetic problem. When powdery mildew shows up in August on lilac, I explain that the foliage has already done its work of photosynthesizing for the season so there is no need for a fungicide application. Pollinator issues both in flower and vegetable gardens has become an issue. Protecting cucumbers from the stripped cucumber beetle using floating row covers instead of insecticides will help preserve pollinators. When aphids attack swamp milkweed, removing them with a jet of water or running pressed fingers up each side of the stem to kill them will accomplish the goal and leave flowers and leaves for pollinators and monarchs.

Notable Accomplishments: Taught a three session, six hour 'Basic Entomology' course to 16 landscapers and pest control operators at Cabela's, East Hartford and the Valley Lab Conference Room. Pesticide recertification credits were issued in three categories.

For the Connecticut Invasive Plant Working Group (CIPWG) led four Invasive Plant Walk and Talk events in Mansfield, Hebron, Oxford, and New Hartford with 45 attendees. (Image below is of the Hebron event on Earth Day which was covered by the Courant Community Newspaper.)

Ms. Rose Hiskes organized, moderated and participated in the Connecticut Invasive Plant Working Group (CIPWG) Virtual Symposium "*Strategies for Managing Invasive Plants: Assess, Remove, Replace, and Restore"* (419 attendees) (November 3).

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