Station News

The Connecticut Agricultural Experiment Station
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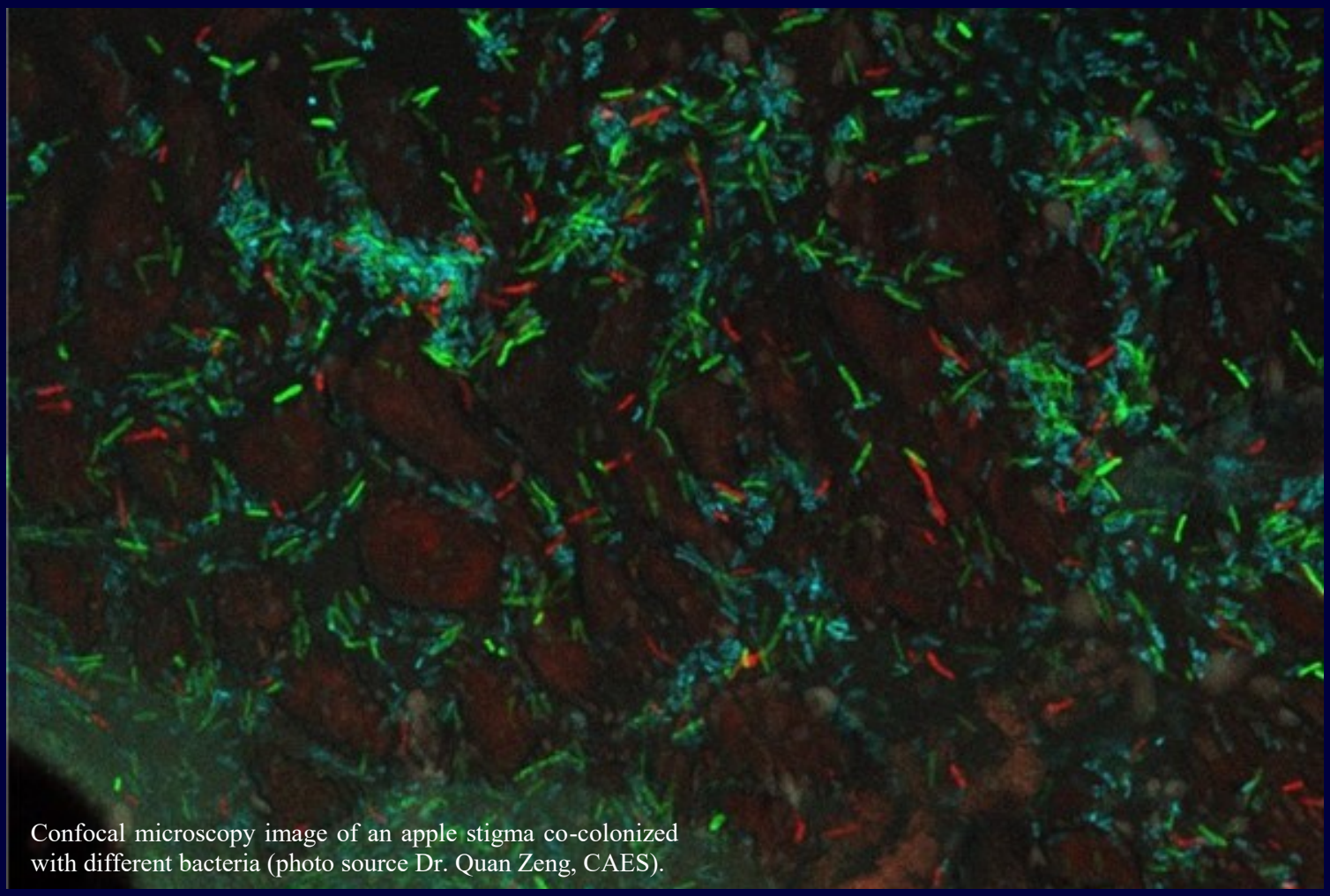


Confocal microscopy image of an apple stigma co-colonized with different bacteria (photo source Dr. Quan Zeng, CAES).

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

CAES

The Connecticut Agricultural Experiment Station

Putting Science to Work for Society since 1875

This Issue

ADMINISTRATION

DR. JASON C. WHITE 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 co-advising (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).

PUBLICATIONS

1. Wang, Z., Wang, T., Wang, C., Yue, L., Lia, J., **White, J. C.**, Cao, X., and Xing, B. (2023). Lanthanum-based nanomaterials suppress bacterial wilt in tomato: Importance of particle morphology and dissolution profile. *Environ. Sci.: Nano*. DOI: 10.1039/D2EN01040B

Abstract: Loss of crop yield to pathogen damage seriously threatens efforts to achieve global food security. In the present work, lanthanum (La) based nanomaterials (NMs) with different morphologies and compositions, including $LaPO_4$ nanorods (NRs, 92.5 × 11.6 nm), $LaPO_4$ nanoparticles (NPs, 110.9 nm), La_2S_3 NPs (38.6 nm), and La_2O_3 NPs (55.5 nm), were investigated for their control of bacterial pathogen *Ralstonia solanacearum* on tomato (*Solanum lycopersicum*). Foliar application of $LaPO_4$ NRs (50–200 mg L^{-1}) significantly suppressed pathogen infection, with 100 mg L^{-1} decreasing disease incidence by 71.4% as compared with infected control. At 100 mg L^{-1}, the disease control efficacy of different La based NMs followed the order of $LaPO_4$ NPs > $LaPO_4$ NRs ≈ La_2S_3 NPs > La_2O_3 NPs. Additionally, disease suppression efficacy with $LaPO_4$ NPs was 4.6-fold greater than the additive equivalent of La and P ions. Mechanistically, $LaPO_4$ NPs could steadily supply low level La ions to pathogen infected tomatoes to bind and activate calmodulin, with subsequent enhancement of phenylalanine ammonia lyase activity by 88.9%, as well as the upregulation of pathogenesis-related gene (*e.g.*, PR1, PR-P2, and P4) expression by 13.3–742.1%. Additionally, La based NMs amendment enhanced the flavonoid and polyphenol content by 13.7–44.8%, and antioxidative enzyme activity by 11.4–124.3%, decreasing the oxidative stress in tomato shoots by 16.4–25.4%. The higher disease control ability of $LaPO_4$ NPs than other La based NMs was due to its greater bioavailability, slow-release ability, and simultaneous P nutrient supplement. The findings highlight the importance of tuning of nanomaterial morphology and composition to optimize sustainability and efficacy.

2. Bonser, C. A. R., Borgatta, J., **White, J. C.**, Astete, C. E., Sabliov, C. M., and Davis, J. A. (2023). Impact of zein and lignin-PLGA biopolymer nanoparticles used as pesticide nanocarriers on soybean growth and yield under field conditions. *Agrosys. Geosci. Environ*. *6*(2). DOI: 10.1002/agg2.20350

Abstract: Nanoparticles in different forms are beginning to be utilized in agriculture as fertilizers, pesticides, and agrochemical-carriers. Biopolymer nanoparticles were developed as an alternative to metallic nanoparticles, which may result in environmental accumulation, leading to potential toxicity. They are designed to be degradable and biocompatible and even though safe-by-design, polymeric nanoparticles must be field-tested prior to largescale use. To evaluate biopolymer nanoparticles in the greenhouse and field, several studies were conducted to determine any detrimental effects to plant growth and yield using soybean, *Glycine max* (L.) Merr., as a model system. Biopolymer nanoparticles made from lignin or zein were applied as seed treatments to soybean seeds or as foliar sprays (zein only) to soybean plants. For biopolymer nanoparticle seed treatments (nano-ST), germination

rates and root and stem growth were evaluated in the laboratory and stand counts, plant height, growth stage, yield, and hundred-seed weight were measured in the field. Foliar treatments assessed nanoparticle impact on flower abortion and pod production. To ensure nano-ST would not compromise the plant's ability to protect itself from insect attack, we assessed herbivore feeding rates using a leaf bioassay for defoliators and a seed damage index for pod feeders. Nano-STs had no impact on growth rate, percent germination, or root length. In the field, nano-STs had no impact on stand counts, heights, growth stage, yield, and hundred-seed weights. Leaf feeding assays and damage indices indicate plant susceptibility to herbivore attack was not increased due to nano-STs. Foliar applications of zein biopolymer nanoparticles did not increase flower abortion or decrease pod set. These results indicate that biopolymer nanoparticles have no negative effects on growth, yield, and herbivore susceptibility and should be suitable for widescale use in agriculture.

3. Sun, K., Van Gestal, C. A. M., **White, J. C.**, and Qiu, H. (2023). Surface defects regulate the in vivo bioenergetic response of earthworm *Eisenia fetida* coelomocytes to molybdenum disulfide nanosheets. *ACS Nano.* DOI: 10.1021/acsnano.2c10623

Abstract: Two-dimensional molybdenum disulfide (2D MoS_2) nanomaterials are seeing increased use in several areas, and this will lead to their inevitable release into soils. Surface defects can occur on MoS_2 nanosheets during synthesis or during environmental aging processes. The mechanisms of MoS_2 nanosheet toxicity to soil invertebrates and the role of surface defects in that toxicity have not been fully elucidated. We integrated traditional toxicity end points, targeted energy metabolomics, and transcriptomics to compare the mechanistic differences in the toxicity of defect-free and defect-rich MoS_2 nanosheets (DF-MoS_2 and DR-MoS_2) to *Eisenia fetida* using a coelomocyte-based *in vivo* assessment model. After organism-level exposure to DF-MoS_2 for 96 h at 10 and 100 mg Mo/L, cellular reactive oxygen species (ROS) levels were elevated by 25.6–96.6% and the activity of mitochondrial respiratory electron transport chain (Mito-RETC) complex III was inhibited by 9.7–19.4%. The tricarboxylic acid cycling and glycolysis were also disrupted. DF-MoS_2 preferentially up-regulated subcellular component motility processes related to microtubules and caused mitochondrial fission. Unlike DF-MoS_2, DR-MoS_2 triggered an increased degree of mitochondrial fusion, as well as more severe oxidative stress. The activities of Mito-RETC complexes (I, III, IV, V) associated with oxidative phosphorylation were significantly inhibited by 22.8–68.6%. Meanwhile, apoptotic pathways were activated upon DR-MoS_2 exposure, which together with the depolarization of mitochondrial membrane potential, mediated significant apoptosis. In turn, genes related to cellular homeostasis and energy release were up-regulated to compensate for DR-MoS_2-induced energy deprivation. Our study indicates that MoS_2 nanosheets have nanospecific effects on *E. fetida* and also that the role of surface defects from synthesis or that accumulate from environmental impacts needs to be fully considered when evaluating the toxicity of these 2D materials.

4. Hussain, M., Shakoor, N., Arslan, M., Zhang, Z., Adeel, M., Xu, M., and **White, J. C.** (2023). Nano-enabled plant microbiome engineering for disease resistance. *Nano Today*, *48*. DOI: 10.1016/j.nantod.2023.101752

Abstract: Nanoscale materials in agricultural systems can enhance plant growth and control phytopathogens. Recent studies have documented that plants form complex interaction

networks with the phyllosphere and root microbiome, and the intricate interactions between host and their associated microbiota can change the microbial composition and enrich specific beneficial species associated with improved crop yield and pathogen resilience. Direct application of nanomaterials enhances host immunity and alters the diversity and composition of plant microbiota; however, critical knowledge gaps exist on the five-party interaction of "nanomaterials-host plant-pathogen-microbiome-environment". We propose that understanding these interactions will enable the use of nanomaterials for microbiome engineering that will yield additive or even synergistic microbial services, resulting in greater plant growth, development, and disease protection in a range of agriculture ecosystems.

Dr. Jason C. White at the International Conference on Food and Nutritional Security in Mohali India, and at the National Institute of Food Technology Entrepreneurship and Management (NIFTEM).

ANALYTICAL CHEMISTRY

NEW STUDENTS, STAFF, AND VOLUNTEERS

DR. NASSIFATOU KOKO TITTIKPINA joined the Station as an Assistant Agricultural Scientist II in January 2023. Dr. Tittikpina obtained 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 her PhD, Dr. Tittikpina obtained a pharmaceutical doctor degree (PharmD) from the University of Lome (Togo). During her PhD, Dr. Tittikpina researched on analytical and biological methods for the study of plants used in traditional medicine. Subsequently, in 2018 she pursued on a postdoctoral fellowship with the Pierre Fabre Foundation at the University Cheikh Anta Diop of Dakar (Senegal) where she worked on analytical methods for the quality control of pharmaceutical products and food, and in that process obtained a Master's in quality control and management of pharmaceutical products and food. Following that, Dr. Tittikpina started a position as an Assistant professor in analytical chemistry and bromatology at the University of Lome, simultaneously with the position of a pharmacist in charge of the restructuration of the National laboratory of quality control of pharmaceutical products at the National Authority of Pharmaceutical Regulation (equivalent to US FDA) in 2019. While at these institutions, Dr. Tittikpina obtained research grants to work on the discovery of new plant-derived compounds with therapeutic effects, identification of nutraceuticals used in West Africa, and the quality control of pharmaceuticals, including herbal products. She has received international recognition as a young leader and a promising scientist from various international organizations and scientific societies such as Women in Africa and Women at Dior, the American Society of Pharmacognosy, and the German Society of Physical Chemistry. Prior to arriving at The CAES, Dr. Tittikpina was a postdoc at the University of Mississippi's National Center for Research on Natural Products in 2022. At The CAES, Dr. Tittikpina will work on food safety, nutraceuticals, and discovery of new compounds with human and animal therapeutic effects.

DR. PAUL AIKPOKPODION joined the Station as a Post-doctoral Research Scientist in January 31, 2023. He obtained a Ph.D. degree in Environmental Chemistry from The Federal University of Technology, Akure, Nigeria in 2014. His Ph.D. research focused on pesticides residue in cocoa plantations with special focus on Cu, Pb and Cd as a consequence of long-term application of Cu-based fungicides in cocoa phytosanitation. In the course of his PhD research work, he used the principle of coordination chemistry to immobilize Cu, Pb and Cd in contaminated cocoa soils via complex formation using phosphate rock. Dr Paul Aikpokpodion obtained a Master of Technology in Analytical Chemistry and a BS in Pure Chemistry from the Federal University of Technology, Akure, Nigeria and Olabisi Onabanjo University, Ago-Iwoye, Nigeria, respectively. He is presently a research scientist in the Department of Soils and Plant Nutrition at the Cocoa Research Institute of Nigeria, Nigeria. Over the years, he has conducted research on the fate of applied agrochemicals and fertilizers in the soil environment using the principle of surface chemistry with emphasis on adsorption/desorption. He has also taught undergraduate courses in chemistry in the University as a lecturer on Sabbatical. He has published several peer reviewed articles in the areas of phosphorus fixation, competitive adsorption of phosphorus, magnesium and other nutrients in soils, heavy metal contamination, soil remediation and fate of herbicides in agricultural soils. At The CAES, Dr. Aikpokpodion will work on the crop fertilization effectiveness of a suite of nanocellulose-based formulations containing phosphate, nitrate, ammonium and essential micronutrients. His work also includes studies to understand the adsorption on and release of nutrients from the nanocellulose materials. Dr Paul Aikpokpodion can be reached via his e-mail address paul.aikpokpodion@ct.gov

ENTOMOLOGY

DR. GOUDARZ MOLAEI 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 Vector-borne 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).

DR. DOUGLAS BRACKNEY presented a short talk titled "Using axenic mosquitoes to interrogate mosquito-microbiota-virus interactions" at the 1st Annual Yale Vector Biology Symposium (January 20); and presented a talk titled "12 Rules to preparing and presenting a professional science talk" to The CAES Postdoctoral Association at their Scientific Writing and Communications Workshop (January 27).

MS. ANGELA BRANSFIELD 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).

MS. JAMIE CANTONI 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).

MR. MARK CREIGHTON presented a talk on honey bee health at The Connecticut Beekeepers 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.

DR. ANDREA GLORIA-SORIA presented a short talk "Population Genetics of Mosquito Vectors" at the 1st Annual Yale Vector-borne and Zoonotic Diseases Symposium (January 20).

MS. NOELLE KHALIL presented an invited talk titled "Gleaning Insights into Passive Tick and Tick-borne Pathogen Surveillance to Inform Public Health Response" to the 1st Annual Yale Vector-borne and Zoonotic Diseases (January 20); and attended the CCSU Department of Biology Internship and Career Fair, set up an information booth and poster display, and informed attendees about the research and internship opportunities at The CAES (January 30).

DR. MEGAN LINSKE 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 and evaluation (January 3, 5, and 10); participated in regional active tick surveillance meeting hosted by Dr. Lucas Price and Dr. Jonathan Winter (Dartmouth College) to discuss recent updates in their collaborative study on tick distribution and infection in the Northeast and their use in predictive analytics (January 12); accompanied the Wilbur Cross High School Girl's STEM program participants through CAES for the new shadowing program (January 23); participated in the Center for Disease Control and Prevention's (CDC) Vector Week 2023 Conference (January 25); participated in a Wildlife Society Diversity, Equity and Inclusivity Committee networking call for updates for the 2023 year (January 24); hosted Dr. Allison Snow (University of Massachusetts) and discussed host-targeted acaricidal-treatment strategies used on primary host species, as well as host capture techniques (January 26).

DR. CLAIRE RUTLEDGE presented 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).

DR. VICTORIA L. SMITH 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).

MS. TRACY ZARRILLO participated in a virtual meeting with **DR. KELSEY FISHER**, **DR. KIMBERLY STONER,** and leaders of the Connecticut Pollinator Pathway to discuss future collaborations (January 19); participated in a virtual meeting for the Tundra to Tropics Project to discuss project updates and taxonomy issues (January 20); attended a meeting of the Connecticut Pollinator Advisory Committee with **DR. GOUDARZ MOLAEI**, **DR. KIMBERLY STONER, DR. KELSEY FISHER, DR. VICTORIA SMITH**, **DR. KIRBY STAFFORD, MR. MARK CREIGHTON, DR. RICHARD COWLES,** Ms. Diane Jorsey, Ms. Laura Saucier, and Ms. Elizabeth Gemski discussed upcoming pesticide legislation (January 24 and 31); and attended the Scientific Writing and Communicating Workshop sponsored by the CAES Postdoctoral Association (January 27).

DR. KIMBERLY STONER (Emeritus) 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).

GRANTS AWARDED

1. DR. HANY DWECK 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.

PUBLICATIONS

1. Stoner, K. A., Hendriksma, H. P., and Tosi, S. (2023). Editorial: Pollen as food for bees: Diversity, nutrition, and contamination. *Frontiers in Sustainable Food Systems*, *6*. DOI: 10.3389/fsufs.2022.1129358

Abstract: Pollen has long been understood to be the essential primary source of protein, lipids, vitamins, and minerals to support bee development and reproduction, but this broad generalization hides a multitude of complex questions as we examine how bees nourish themselves by foraging for pollen across landscapes, how the pollen they collect provides the nutrients they need, and how nutrition drives bee health in their wide network of environmental interactions. These articles fit into a framework with three approaches: (1) identification of the bees visiting focal plant species, (2) evaluation of foraging preferences of adults in focal bee species, and (3) experimental laboratory study of nutritional requirements of larval or adult focal bee species.

NEW STUDENTS, STAFF, AND VOLUNTEERS

DR. KELSEY E. FISHER 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.

DR. HANY DWECK joined the Department of Entomology on January 3, 2023, as an Assistant Agricultural Scientist II. 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.

Bria Fielding, a senior biotechnology major at Southern Connecticut State University, joined **DR. KELSEY FISHER'S** laboratory on January 30, 2023, to conduct her internship on monarch butterfly migration patterns and their wing morphology.

Allison Flagg, a senior at UNH, majoring in Forensic Science, is doing a research internship this spring with **DR. CLAIRE RUTLEDGE**. Allison will be looking at species composition of carrion flies attracted to beef liver as impacted by time of year and length of time the liver has been exposed. Such information can be helpful in accurately assessing time of death in homicide cases and has not been studied explicitly in Connecticut.

Justin Bellemare, a senior at the University of New Haven majoring in Biology, started a research internship in with **DR. CLAIRE RUTLEDGE** on January 20, 2023. Justin is working on a study comparing the species diversity of two habitats, natural sandplains, and artificial sandplains (baseball fields). He will be focusing on two taxa characteristic of sandy habitats, tiger beetles and velvet ants.

ENVIRONMENTAL SCIENCE AND FORESTRY

DR. SCOTT WILLIAMS 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).

MR. JOSEPH P. BARSKY 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).

MR. GREGORY BUGBEE 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).

DR. SUSANNA KERIÖ 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).

DR. SARA NASON 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 pro-

jects 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).

MS. SUMMER STEBBINS was elected to the Northeast Aquatic Plant Management Society Board of Directors (January 17).

DR. JEFFREY WARD 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).

DR. LEIGH WHITTINGHILL served on a CT Department of Agriculture grant review panel.

PUBLICATIONS

1. Wang, Z., Alinezhad, A., Sun, R., Xiao, F., and **Pignatello, J. J.** (2023). Pre- and postapplication thermal treatment strategies for sorption enhancement and reactivation of biochars for removal of perfluoroalkyl substances from water. *ACS ES&T Engineering*. DOI: 10.1021/acsestengg.2c00271.

Abstract: Exposure to per- and polyfluoroalkyl substances (PFAS) in drinking water poses a major public health threat. Commercial granular activated carbon (GAC) has been used for the sorptive removal of PFAS in practical applications. Biochar is a possible cheaper alternative to GAC for small-scale water treatment systems. Here, we report a strategy for employing biochar for PFAS removal that combines post-pyrolysis modification, which greatly improves performance, with a reactivation step that enables its reuse. Modification entails brief postpyrolysis air oxidation at 400 °C, which considerably enlarges pore size and specific surface area and thereby increases the solid-to-water distribution ratio, KD, of individual PFAS by as much as 3 orders of magnitude. In some cases (e.g., perfluorooctanoic acid) the KD was comparable to that of commercial GAC. The sorbed PFAS could be decomposed by brief thermal reactivation of the spent biochar at 500 °C in N2 or air. After thermal reactivation in air, the biochars exhibited even greater PFAS KD values in a second cycle. While thermal reactivation of a GAC in air could be achieved, as well, sorption affinity for the shorter-chain PFAS was noticeably reduced. Overall, this study points to a new strategy of using biochars for PFAS removal.

2. Chand, M., Choi, J. Y., Pal, A. C., Singh, P., Kumari, V., Thekkiniath, J., Gagnon, J., Timalsina, S., Gaur, G., **Williams, S.**, Ledizet, M., and Ben Mamoun, C. (2022). Epitope profiling of monoclonal antibodies to the immunodominant antigen BmGPI12 of the human pathogen *Babesia microti*. *Frontiers in Cellular and Infection Microbiology*, *12*, 1754. DOI: 10.3389/fcimb.2022.1039197

Abstract: The significant rise in the number of tick-borne diseases represents a major threat to public health worldwide. One such emerging disease is human babesiosis, which is caused by several protozoan parasites of the *Babesia* genus of which *B. microti* is responsible for most clinical cases reported to date. Recent studies have shown that during its intraerythrocytic life cycle, *B. microti* exports several antigens into the mammalian host using a novel vesicular-mediated secretion mechanism. One of these secreted proteins is the immunodominant antigen BmGPI12, which has been demonstrated to be a reliable biomarker of active *B. microti* infection. The major immunogenic determinants of this antigen remain unknown. Here we provide a comprehensive molecular and serological characterization of a set of eighteen monoclonal antibodies developed against BmGPI12 and a detailed profile of their binding specificity and suitability in the detection of active *B. microti* infection. Serological profiling and competition assays using synthetic peptides identified five unique epitopes on the surface of BmGPI12 which are recognized by a set of eight monoclonal antibodies. ELISA-based antigen detection assays identified five antibody combinations that specifically detect the secreted form of BmGPI12 in plasma samples from *B. microti*-infected mice and humans but not from other *Babesia* species or *P. falciparum*.

NEW STUDENTS, STAFF, AND VOLUNTEERS

MS. RILEY DOHERTY joined the Department of Environmental Science and Forestry on January 3, 2023, as a Research Technician I in the Office of Aquatic Invasive Species. Riley received her B.S. in Natural Resources with a focus in climate and water resources from the University of Connecticut and is currently working towards a Master of Geographic Information Systems (GIS) from Pennsylvania State University. She grew up in Haddam, CT along the Connecticut River and previously worked for the Wild and Scenic Eightmile River Watershed. She has interests in water resources, aquatic invasive species management, GIS, cartography, and science communication. Welcome Riley!

PLANT PATHOLOGY AND ECOLOGY

DR. LINDSAY TRIPLETT served on a confidential Federal Grant Panel.

DR. DONALD AYLOR (Emeritus Scientist) gave an invited lecture titled "Aerial Dispersal of Plant Pathogens " to the NSF funded Aero-biometeorology Working Group at Colorado State University via Zoom (15 adult participants) (February 2).

DR. WASHINGTON DA SILVA met with two high school students from New Haven, Daleska and Juliana, to discuss their interest in coming to the lab to learn more about sciences and the daily life of a scientist in the Laboratory (January 10) – this is part of a program that we are trying to establish at The CAES called "Mentoring Girls in STEM." **Dr. da Silva** 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 (20 participants) (January 20). **Dr. da Silva** had a Zoom call with Professors Marcia Ambrosio and Iona Araújo from Universidade Federal Rural do Semi-Árido (UFERSA) to discuss future collaborations and plans to bring students from their university to spend a year in the da Silva Laboratory at The CAES to be trained on molecular biology research related to plant pathogens (January 23).

DR. WADE ELMER (Emeritus Scientist) presented "Vegetable benefits and disease control of nanotechnology" to the UConn Extension's 2023 Vegetable & Small Fruit Growers' Conference in Rocky Hill (100 people attended) (January 4).

DR. YONGHAO LI participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (7 adults) (January 11); presented "Recap 2022, Bedding Crop Diseases to Prepare for 2023" at UConn 2023 Spring Bedding Plant Meeting in Torrington (27 adults) (January 18); attended the Plant Diagnostic Network Northeast Reginal monthly meeting and Core Accreditation Training via Zoom (January 20); attended the National Plant Diagnostic Network IT Meeting via Zoom (January 24); presented "Selection and Care of Houseplants" to the Avon Public Library Adult Education Program via Zoom (37 adults) (January 25).

DR. ROBERT MARRA presented "Biology of Beech Leaf Disease" at the Annual Meeting of the Connecticut Tree Protective Association (850 adults) (January 19); was interviewed about beech leaf disease by journalist Gabriel Popkin of Science News (January 23).

MS. FELICIA MILLETT 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); attended the Winter Symposium of the Connecticut Nursery and Landscape Association (January 24); and 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).

DR. NEIL SCHULTES was awarded one of the CAES Board of Control Research Awards for his proposal "Can the apple pathogen *Erwinia amylovora* be used in biocontrol of fire blight?" (January 18).

DR. QUAN ZENG 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).

GRANTS AWARDED

1. DR. WASHINGTON DA SILVA 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.

2. DR. ROBERT MARRA 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).

PUBLICATIONS

1. Li, Y. (2023). Botrytis Blight of Blueberry. CAES Fact Sheet.

2. Li, Y. (2023). Phytophthora Root Rot of Woody Ornamentals. CAES Fact Sheet.

3. Gomes, I. R. F., Silva, J. L. S., Costa, T. E., Pinto, P. S. L., **da Silva**, **W. L.**, Ambrósio, M. M. Q., and Holand, I. S. A. [Manuscript submitted for publication]. First Report of *Cladosporium tenuissimum* causing spot diseases on leaves and fruits of cucurbits in Brazil. *Plant Disease*.

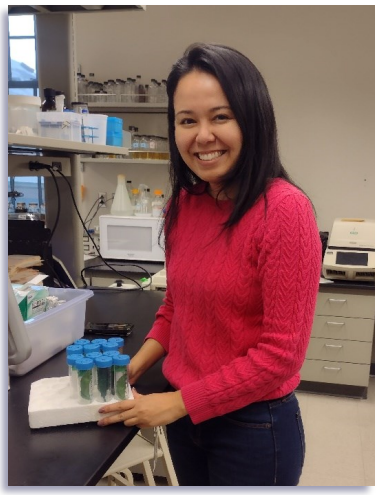
Abstract: Cucurbitaceae crops are widely cultivated in the Northeast region of Brazil, which is the biggest producer of melon and watermelon in the country (Oliveira, 2020). Between November and December 2020 leaves of pumpkins (*Cucurbita maxima* L.) and watermelon (*Citrullus lanatus* L.), and leaves and fruits of melon plants (*Cucumis melo* L.) were collected with moderate to severe necrotic, irregular, and brown lesions from farms in the state of Rio Grande do Norte, Brazil. Fragments of diseased tissues were cut into small pieces and surface disinfested in 70% ethanol for 30 seconds, then in 2% sodium hypochlorite for 1 minute, and washed in sterile distilled water. Disinfested pieces of tissue were plated on potato dextrose agar (PDA) and incubated for seven days in the dark at 28 ± 2 °C. A total of 12 fungal isolates (four from pumpkins, one from watermelon, and seven from melons) were isolated from leaves and symptomatic fruits. All isolates in this study shared similar morphological characteristics...Many growers in the region are reporting similar symptoms in their melon plantations and it appears that the disease incidence is getting more severe year after year, based on growers's reports. Therefore, more research needs to be conducted to determine the epidemiology and the extension of the economic impact caused by this pathogen to Cucurbits to develop strategies for disease control. To the best of our knowledge, this is the first report of *C. tenuissimum* causing disease in Cucurbits in Brazil.

4. Burcham, D. C., Brazee, N. J., **Marra, R. E.**, and Kane, B. (2023). Geometry matters for sonic tomography of trees. *Trees*. DOI: 10.1007/s00468-023-02387-4

Abstract: Key Message: Due to the simplifying assumptions used to analyze acoustic wave propagation in trees, the accuracy of sonic tomograms varies significantly according to the geometry of the measured tree part.

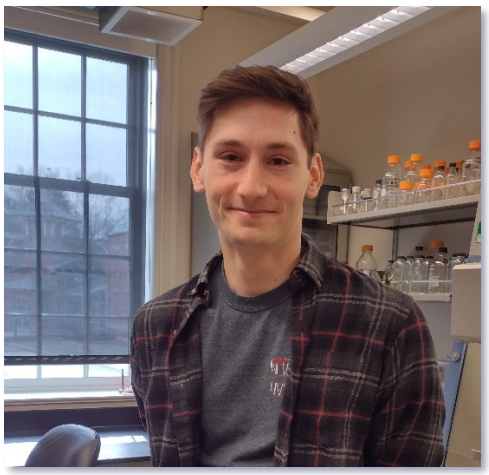
For trees growing in communities, arborists routinely check for evidence of damaged wood during tree risk assessment, and sonic tomography is occasionally used to measure the amount of internal damage in trees. Existing studies investigating the accuracy of commercially available sonic tomography devices have mostly considered a limited range of measurement conditions, limiting their application in practice. Using measurements incorporating greater variability in test conditions, this study examined the accuracy of sonic tomography by comparing the percent damaged cross-sectional area in tomograms with the destructively measured internal condition of trees. Although the accuracy of tomograms differed between the examined temperate and tropical tree species, the variation was largely explained by underlying differences in the cross-sectional geometry of the measured tree parts. The amount of decay was repeatedly underestimated in measurements of small, circular cross sections, and, conversely, it was consistently overestimated in measurements of large, irregularly shaped cross sections. Using different approaches to generating and interpreting tomograms, a wide range of decay estimates was obtained for a given set of measurements. By adjusting software settings, it was possible to obtain tomograms with the least error for a given cross-sectional geometry, and the tomograms could be visually interpreted to similarly compensate for the anticipated measurement error. Although practitioners can use the identified strategies to compensate for the expected measurement error in different situations, there is also a fundamental need to develop improved measurement and analysis routines for sonic tomography relying on physically realistic assumptions about acoustic wave propagation in wood.

NEW STUDENTS, STAFF, AND VOLUNTEERS

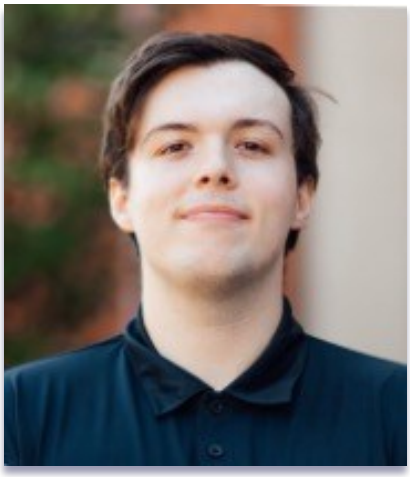


Dr. Cintia Duarte Sagawa is visiting the **TRIPLETT LABORATORY** part-time to perform experiments for her postdoctoral research on editing citrus genomes for disease resistance. She works under the mentorship of Drs. Yannick Jacob and Vivian Irish at Yale University.

Matthew Pinsley is performing student research in the **TRIPLETT LABORATORY** for the spring semester, where he is studying tailocin tolerance mechanisms under the supervision of **RAVIKUMAR PATEL**. He is a junior studying microbiology and immunology at Quinnipiac University.



Erica Sellers is a first year Master's student at Southern Connecticut State University. She will be performing her thesis research part time in the **TRIPLETT LABORATORY** throughout 2023. She will work under the supervision of **DR. STEPHEN TAERUM**, with the goal of identifying functional patterns of protist predation of rhizosphere bacteria.



James Standish a senior from Southern Connecticut State University, joined **DR. QUAN ZENG'S** laboratory as for the spring semester. During his internship, James will study the mechanism of yeast-plant interactions.

VALLEY LABORATORY

DR. DEWEI LI 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).

DR. JATINDER S. AULAKH 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).

DR. RICHARD COWLES 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).

MS. ROSE HISKES met with CIPWG co-chairs (January 10); participated in the Cooperative Agricultural Pest Survey meeting via Zoom (16 attendees) (January 17).

PUBLICATIONS

1. Aulakh, J. S. (2023). Asiatic dayflower (*Commelina communis*) control in Douglas fir. *Invasive Plant Science and Management*. *15*(4), 168-173. DOI: 10.1017/inp.2023.1

Abstract: Asiatic dayflower (*Commelina communis* L.) is becoming increasingly invasive in Christmas tree plantations in the U.S. Northeast. Response of *C. communis* to preemergence or postemergence herbicides was evaluated in separate field and greenhouse experiments. The preemergence herbicides consisted of two application rates of flumioxazin (215 and 429 g ai ha−1), hexazinone plus sulfometuron-methyl (316 and 527 g ai ha−1), indaziflam (41 and 82 g ai ha−1), and S-metolachlor (2,136 and 4,272 g ai ha−1). The postemergence herbicides were: bentazon at 1,121 g ai ha−1, clopyralid at 280 g ae ha−1, mesotrione at 526 g ai ha−1, topramezone at 294 g ai ha−1, and triclopyr at 842 g ae ha−1. At 16 wk after treatment, higher rates of flumioxazin (429 g ha−1), hexazinone plus sulfometuron-methyl (527 g ha−1), indaziflam (82 g ha−1), and S-metolachlor (4,272 ha−1) provided 80% to 92% control and reduced *C. communis* plant density by 84% to 93% compared with the nontreated control. The lower rates of flumioxazin (215 g ha−1), hexazinone plus sulfometuron-methyl (316 g ha−1), and S-metolachlor (2,136 ha−1) gave 65% to 72% control and reduced *C. communis* plant density by 27% to 75% compared with the nontreated control. The postemergence applica-

tion of mesotrione at 526 g ha−1, topramezone at 294 g ha−1, and triclopyr at 842 g ha−1 resulted in 76% to 90% control and reduction in dry biomass of 10- to 12-leaf *C. communis* at 28 d after treatment. Bentazon at 1,121 g ha−1 and clopyralid at 280 g ha−1 applied postemergence were ineffective with <10% control and reduction in *C. communis* dry biomass. This study showed that *C. communis* can be managed effectively with currently registered preemergence and postemergence herbicides in Christmas trees.

JOURNAL ARTICLES APPROVED JANUARY 2023

Bonser, C., **Tamez, C.**, **White, J. C.**, Astete, C. E., Sabliov, C., and Davis, J. A. Field applications of zein as a precise nanoscale delivery system for methoxyfenazide. *Journal of Insect Science.*

Dorey, J. B., Chesshire, P. R., Bolaños, A. N., O'Reilly, R. L., Bossert, S...**Zarrillo, T. A.**...Cobb, N. S. A globally synthesised and flagged bee occurrence dataset and cleaning workflow. *Scientific Data*.

Li, H., Liao, Y.-C.-Z., **Li, D.-W.**, and Zhu, L.-H. Beneficial impacts of foliar applied ZnO quantum dots on endophytic and rhizosphere microbial communities of pumpkin (*Cucurbita moschata* Duch.). *Environmental Science and Technology*.

Muthuramalingam, R., Barroso, K., Milagres, J., Tedardi, V., de Oliveira, F. F., Takeshita, V., Karmous, I., Eltanbouly, R., and **da Silva, W.** Tiny but mighty: The role of nanoscale materials in plant disease management. *Plant Disease*.

Rutledge, C. E. Estimating the foraging range of *Cerceris fumipennis* (Hymenoptera: Crabronidae) using land cover data. *Annals of the Entomological Society of America*.

Sharma, S., Singh, G., **Wang, Y.**, **Elmer, W. H.**, **White, J. C.**, Xing, B., and Dhankher, O. P. Nanoscale sulfur alleviates silver nanoparticle toxicity and improves seed and oil yield in soybean (*Glycine max*). *Science of the Total Environment*.

Wang, Z., Liu, Y., Luo, X., Wang, C., Yue, L., **Elmer, W.**, Dhankher, O. P., **White, J. C.**, Cao, X., and Xing, B. Mechanistic investigation of enhanced bacterial soft rot resistance in lettuce (*Lactuca sativa* L.) with elemental sulfur nanomaterials. *Science of the Total Environment.*

Williams, S. C., **Linske, M. A.**, and **Stafford, K. C. III.** Reduction in parasitizing juvenile blacklegged tick (*Ixodes scapularis*) abundances on wild white-footed mice (*Peromyscus leucopus*) using orally delivered fipronil-laced bait. *Ticks and Tick-borne Diseases*.

Ye, Y., Reyes, A., Li, C., **White, J. C.**, and Gardea-Torresdey, J. L. Orthogonal microscopic analysis of MnNPs *Capsicum annuum* L. leaves: Mechanisms of internalization, distribution and autophagy. *Environmental Science and Technology*.

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