Station News

The Connecticut Agricultural Experiment Station
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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 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. CHRIS-**

TIAN 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).

PUBLICATIONS

1. Karmous, I., **Vaidya, S.**, **Dimkpa, C.**, **da Silva, W.**, Alves Barroso, K., Milagres, J., **Zuverza-Mena, N.**, **Bharadwaj, A.**, Abdelraheem, W., **White, J. C.**, and **Elmer, W. H.** (2023). Biologically synthesized zinc and copper oxide nanoparticles using *Cannabis sativa* L. enhance soybean (*Glycine max*) defense against *Fusarium virguliforme*. *Pest. Biochem. Physiol.* In press.

Abstract: In this study, zinc and copper oxide nanoparticles were synthesized using hemp (*Cannabis sativa* L.) leaves (ZnONP-HL and CuONP-HL), and their combined antifungal potential was assessed against *Fusarium virguliforme* in soybean (*Glycine max* L.). The ZnONP-HL and CuONP-HL showed UV-vis absorption peaks at 350 nm and 370 nm, with an average grain/crystallite size of 13.51 nm and 7.36 nm. The smaller particle size of biologically synthesized nanoparticles compared to chemically synthesized ones (ZnONP-chem, and CuONP-chem; 18.75 nm and 10.05 nm, respectively) confirms the stabilizing role of hemp-derived bio-molecules and phytocompounds, such as terpenes, flavonoids, and phenolic compounds. This was also demonstrated by the analysis of functional groups associated with ZnONP-HL and CuONP-HL, as well as phytochemicals present in the hemp leaf extract. The bioactivity of the biosynthesized NPs was interrogated by their application as foliar treatments on soybean infested with *F. virguliforme*. ZnONP-HL and CuONP-HL at 200 µg/ml significantly increased (~ 50%) soybean growth compared to diseased controls. The altered metabolic and nutritional profiles of diseased plants were significantly improved by the NPs as demonstrated by a 1-2-fold higher nutrient content (e.g., K, Ca, P) and enhanced photosynthetic indicators. Three-fold increases 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 present study provides novel insight into the application of green nanotechnology in the control of plant pathogens.

2. Chen, S., Pan, Z., Zhao, C., Zhou, Y., Rui, Y., Jiang, C., **Wang, Y.**, **White, J. C.**, and Zhao, L. (2023). Engineering climate-smart rice using a nanobiostimulant-based "stress training" strategy. *ACS Nano*. DOI: 10.1021/acsnano.3c02215

Abstract: Under a changing climate, cultivating climate-resilient crops will be critical to maintaining food security. Here, we propose the application of ROS-generating nanoparti-

cles as nanobiostimulants to trigger stress/immune responses, and subsequently increase the stress resilience of plants. We established three regimens of AgNPs-based "stress training": seed training (ST), leaf training (LT), and combined seed- and leaf- training (SLT). Trained rice seedlings were then exposed to either rice blast fungus (*M. oryzae*.) or chilling stress (10 ºC). The results show that all "stress training" regimes, particularly SLT significantly enhanced the resistance of rice against the fungal pathogen (lesion size reduced by 82% relative to un-trained control). SLT training also significantly enhanced rice tolerance to cold stress. The mechanisms for the enhanced resilience were investigated with metabolomics and transcriptomics, which show that "stress training" induced considerable metabolic and transcriptional reprogramming in rice leaves. AgNPs-boosted ROS activated stress signaling pathways by oxidative post-translational modifications of stress related kinases, hormones, and transcriptional factors (TFs). These signaling pathways subsequently modulated the expression of defense genes, including specialized metabolites (SMs) biosynthesis genes, cell membrane lipid metabolism genes, and pathogen-plant interaction genes. These molecular changes enable rice plants to mount a more rapid and intense response to future stresses. This nanobiostimulant-based strategy for increasing the stress resilience of crops will increase yield vigor against a changing climate and will contribute to sustainable agriculture by reducing agrochemical use.

3. Dimkpa, C. O., **Deng, C.**, **Wang, Y.**, Adisa, I., **Zhou, J.**, and **White, J. C.** (2023). Chitosan and zinc oxide nanoparticle-enhanced tripolyphosphate modulates phosphorus leaching in soil. *ACS Agric. Sci. Technol*. DOI: 10.1021/acsagscitech.3c00054

Abstract: Phosphorus (P) loss from agro-ecosystems impinges upon P use efficiency by plants, and thereby constitutes both agronomic and environmental nuisances. Herein, we report on the potential for controlling P leaching loss and use in fertilizing crops, through repurposing and nano-functionalizing tripolyphosphate (TPP) as a sole P source. The developed TPP-Chitosan and TPP-Chitosan-ZnO nanofertilizers exhibited positive surface charges, 5.8 mV 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, mono ammonium phosphate (MAP). Cumulative P leaching at 72 hours from these nanofertilizers were, respectively, 84 and 95% lower than from TPP alone. TPP-Chitosan-ZnO was, overall, 65% more effective in reducing P leaching, compared to TPP-Chitosan. Relative to MAP, wheat plant height was significantly increased by TPP-Chitosan-ZnO, 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, 35.5, 47, and 45%, compared to MAP, TPP and TPP-Chitosan, respectively. However, 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 a role for chitosan in nutrient mobilization. Taken together, our data highlights the potential for repurposing a non-fertilizer P material, TPP, for agricultural and environmental applications, and the effect of applying nanotechnology on such outcomes. 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.

4. Tao, R., Zhang, Y., Yang, J., Yang, T., **White, J. C.**, and Shen, Y. (2023). Biochar nanoparticles alleviate salt-stress in tomato (*Solanum lycopersicum*) seedlings. *Environ. Sci.: Nano.* DOI: 10.1039/D2EN00816E

Abstract: With the rapid increase in global population that is anticipated over the coming decades, more food will need to be produced to meet the increasing demand. The current agricultural production system is unable to meet this challenge, and as such, crop cultivation will need to occur under more marginal conditions. Soil salinization and the consequent salt stress on crops will become increasingly problematic. In this study, we prepared two kinds of biochar nanoparticles (NPs) (particle size 253 and 259 nm) from rice and corn straw at 350 ℃ and investigated their use as a soil amendment to alleviate salt stress (2000 mg kg-1 biochar NPs; 1000/2000 mg kg-1 NaCl) on tomato seedlings. After four weeks of growth, the biomass of tomato seedlings was reduced by 48.7% under 2000 mg kg-1 NaCl treatments. With rice straw biochar NPs application, the biomass increased by 13.1% over the stress controls. In addition, chlorophyll (SPAD value) was increased by 46.7% with rice straw biochar NPs. Rice straw biochar NPs inhibited the transfer of Na from roots to shoots; the Na translocation factor (TF) was 0.46, which is significantly lower than the corresponding value (0.72) for the saline stress controls. The corn straw biochar NPs also contributed to salt stress alleviation in tomato, although the effects were lower than that with rice straw biochar NPs, and there was no reduction in Na transport. However, under lower levels of salt stress with 1000 mg kg-1 NaCl treatments, there was little difference in the effects of the two biochar nanoparticles. These findings suggest that straw-derived biochar may be an effective soil amendment to increase the salt stress tolerance of crop species and can serve as an effective tool to facilitate food production under marginal soil conditions.

Dr. Jason C. White, **Dr. Shital Vaidya** and CAES visitors Naziya Nabi, Tanzeel Bashir, and Dr. Vinod Goyal visited the University of Massachusetts Stockbridge School of Agriculture.

Dr. Jason C. White at the International Network for Researching, Advancing, and Assessing Materials for Environmental Sustainability (INFRAMES) in Venice, Italy, from May 16-20, 2023.

Dr. Jason C. White at the 2023 International Phytotechnologies Conference.

ANALYTICAL CHEMISTRY

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* (May 22-23). The project is implemented by Dr. Ben Hsaio for SBU, and **DR. CHRIS DIMKPA** for The 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; a commercial partner in the *PFI-TT: Advancing Nanocellulose-Enabled BioNanofertillizers for Agricultural Applications* project.

MRS. KITTY PRAPAYOTIN-RIVEROS and **MRS. TERRI ARSENAULT** presented the "Introduction to ISO/IEC17025:2017" to CAES staff and visitors at Jones Auditorium, CAES (25 attendees) (May 18). **MRS. KITTY PRAPAYOTIN-RIVEROS** attended the CAES Data Custodian Kick-Off and File Server Data Review via MS Teams (May 24).

DR. NASSIFATOU KOKO TITTIKPINA was awarded the Experiment Station Associates' Early Career Scientist Award (April 24). **DR. NASSIFATOU KOKO TITTIKPINA** and other staff from The CAES volunteered as judges of the posters presented by Quinnipiac University at the Sigma Xi Quinnipiac Chapter Student Research Conference held on the at Quinnipiac University (April 26).

DR. YI WANG gave an invited seminar on the topic "Nano-enabled agriculture: Enhancement in plant nutrients, metabolic profiling, disease suppression, and agrochemical delivery" in University of Massachusetts, Amherst (April 3); served as a judge for the Sigma Xi Quinnipiac Student Research Conference at Quinnipiac University in Hamden CT (April 26); participated in an on-site training session organized by SCIEX at CAES, focused on mastering the operation of the newly purchased triple-quadrupole LC-MS/MS instrument (May 9-10).

NEW STUDENTS, STAFF, AND VOLUNTEERS

Ms. Naziya Nabi joined the Department of Analytical Chemistry on May 11, 2023 as a Seasonal Research Assistant under the OCP-CAES collaborative project on phosphorus. She recently completed her MS from Sher-e-Kashmir University of Agricultural Science and Technology, Kashmir, India. Her work at The CAES focuses on the synthesis, characterization and evaluation of starch- CNC composites. Naziya will be at The CAES for 4.5 months to assess biopolymer based nano P-fertilizers in plant-soil systems.

Ms. Tanzeel Bashir from India has joined the Department of Analytical chemistry on May 11, 2023 as Seasonal Research Assistant. She is pursuing her Ph.D at the Sher-e-Kashmir University of Agricultural Science and Technology, Kashmir (SKUAST-Kashmir), India. Her Research interests include the development of organic module for saffron production, stress tolerance, plant microbe interaction, metagenomics, and use of biofertilizers for plant production. The focus of Tanzeel's study at The CAES is on phosphorus management in plant-soil systems.

PUBLICATIONS

1. Dimkpa, C. O., **Deng, C.**, **Wang, Y.**, Adisa, I. O., **Zhou, J.**, and **White. J. C.** (2023). Chitosan and zinc oxide nanoparticle-enhanced tripolyphosphate modulate phosphorus leaching in soil. *ACS Agricultural Science & Technology*. DOI: 10.1021/acsagscitech.3c00054

Abstract: Phosphorus (P) loss from agro-ecosystems impinges upon P use efficiency by plants and thereby constitutes both agronomic and environmental nuisances. Herein, we report on the potential for controlling P leaching loss and application in crop fertilization through repurposing and nano-functionalizing tripolyphosphate (TPP) as a sole P source. 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. TPP-Chitosan-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 non-fertilizer P material, TPP, for agricultural and environmental applications and the effect of applying nanotechnology on such outcomes. Broadly speaking, 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.

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 Bio-Nanofertillizers for Agricultural Applications* from May 22-23, 2023. The project is implemented by Dr. Ben Hsaio for SBU (left in photo), and **Dr. Chris Dimkpa** for The CAES.

Dr. Paul Aikpokpodion (left) during his SBU Long Island visit.

Container vertical lettuce farm owned by Cubic Acres

ENTOMOLOGY

DR. GOUDARZ MOLAEI 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 vector-borne 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 LHD-IP-Infectious Diseases meeting (May 24).

DR. PHILIP ARMSTRONG was interviewed by a reporter from WTIC about the state mosquito monitoring program (May 31).

MS. TIA M. BLEVINS 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).

MS. ANGELA BRANSFIELD 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).

MS. KATHERINE DUGAS gave a talk about invasive insects and jumping worms to the New Roxbury Land Trust in Putnam (May 18).

DR. KELSEY FISHER met with colleagues at the USDA (May 1 and 18) and Quinnipiac University (May 3 and 18); participated in meetings with Pollinator Pathway and Community Place-making Engagement Network (CPEN) about establishing pollinator habitat along the Farmington Canal Trail (May 3, 12, and 19); met with colleagues at the Jones Family Farm (May 5); submitted an article to CT Gardener Magazine about planting milkweed to support monarch butterfly conservation (May 8); served as an Entomological Society of America Science Policy Fellow and met with staff from US House Representatives Rosa DeLauro, Kat Cammack, and Mike Collin staff from Senators Chris Murphy, Marco Rubio, and Rapheal Warnock in Washington DC to advocate for entomology and science priorities (May 15-17); served as an expert panelist after a showing of the documentary "My Garden of a Thousand Bees" at the Groton Public Library (May 23); provided a hands-on experience with arthropods for 5th grade students from Shepard Glen Elementary School (May 30); collaborated with **DR. RAQUEL ROCHA**, **DR. CLAIRE RUTLEDGE**, **MS. TRACY ZARRILLO**, and **DR. WASHINGTON DA SILVA** on planning and execution of various projects; and managed acceptance of two symposia for the Entomological Society of America meeting in November.

MS. NOELLE KHALIL attended an HR Roadshow at the Jackson Laboratory in honor of Lyme Disease Awareness Month, and informed the laboratory staff about the passive tick and tick-borne disease surveillance program at The CAES and the research conducted by **DR. GOUDARZ MOLAEI** and his group. She also participated by asking attendees trivia questions related to ticks and Lyme disease (May 10).

DR. MEGAN LINSKE 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, Pennsylvania (May 1); participated in a Center for Disease Control and Prevention (CDC) hosted meeting to discuss recent advances in white-tailed deer management and the impact on ticks and tick-borne diseases (May 3); presented a CAES lunch seminar talk titled "Optimization of Targeted Acaricide Application in Integrated Tick Management" (May 10); participated in an executive committee meeting for the NETWS as president elect (May 16); participated in a call with members of Genesis Labs, Inc. to discuss the 2023 field season and the application of their rodent-targeted products (May 26); 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 (May 30).

DR. GALE RIDGE 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).

DR. CLAIRE RUTLEDGE gave a lecture "Monitoring an invasive beetle with a native wasp" to the Master Gardeners class in Brooklyn, CT (May 5).

MR. JOHN SHEPARD 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).

DR. VICTORIA SMITH 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).

DR. KIRBY C. STAFFORD III (Emeritus) presented a talk on ticks and tick control for the Institute for Learning in Retirement in Hamden (May 25).

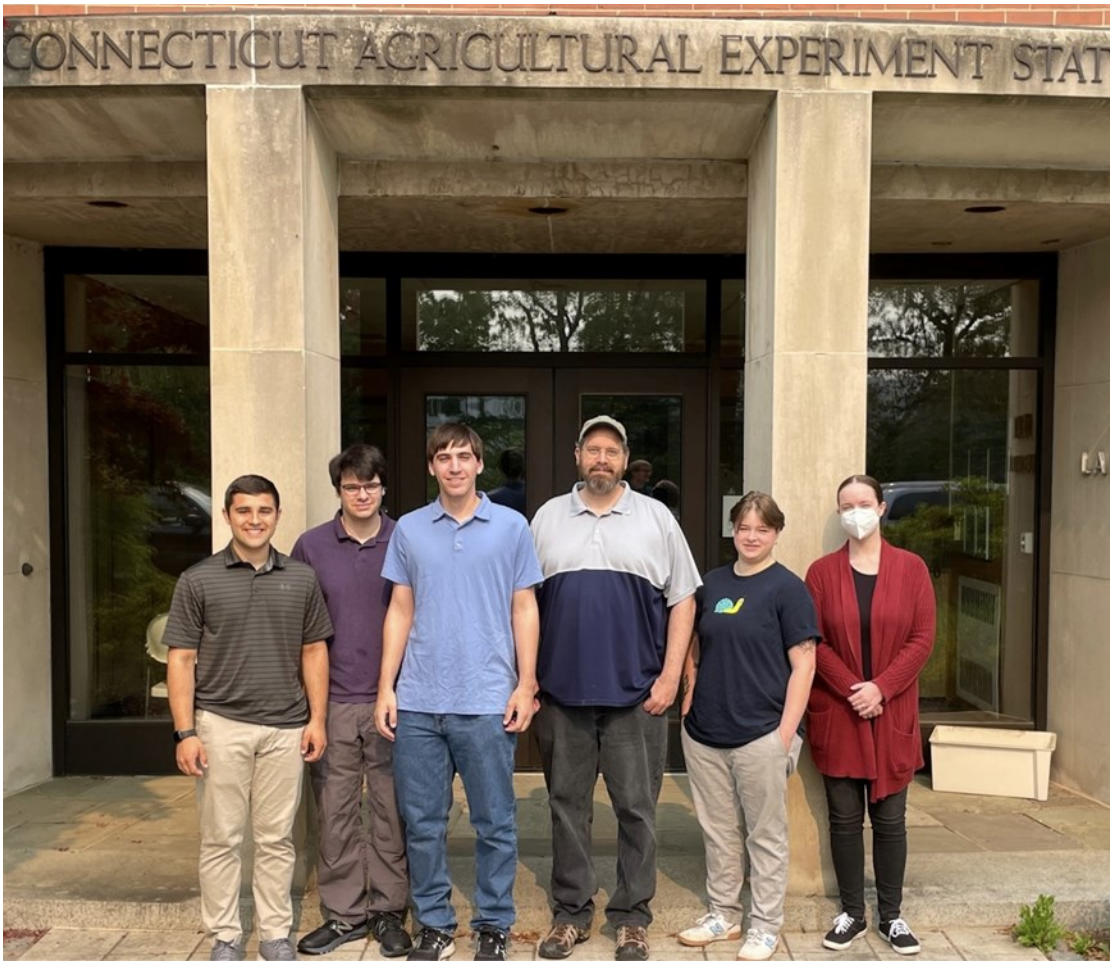
DR. KIMBERLY STONER (Emeritus) presented a talk with Laura Saucier of the CT Department of Energy and Environmental Protection on Connecticut laws pertaining to bees and pesticides and effects of climate change on pollinators to the Animal Law Section of the Connecticut Bar Association (May 16); and 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).

NEW STUDENTS, STAFF, AND VOLUNTEERS

Ms. Tatiana Alicea, a junior at New Haven Academy, interned from May 15 to June 1, 2023 in **DR. CLAIRE RUTLEDGE'S** laboratory, where Tatiana helped with a variety of projects. Tatianna shadowed **DR. GOUDARZ MOLAEI** as a technician in his tick testing laboratory, spent a day learning about fruit flies with **DR. HANY DWECK**, and spent a day aiding in curation of the CAES insect collection.

Ms. Kaitlyn Maurais is a Seasonal Research Assistant in the Department of Entomology at The CAES working as part of the EEE virus research team. She has completed her first year of her Master of Public Health at Yale University, specializing in Epidemiology of Microbial Diseases and Transmission Modeling. In addition to her MPH studies, Kaitlyn is a member of the YSPH SAYPH board as a liaison for the career services department and is an active member of Taps at Yale. She looks forward to continuing to explore careers and passions within public health, specifically focused on vector-borne diseases.



The CAES Mosquito and Arbovirus Surveillance Lab Crew (left-right): **Matt DeLucia**, **Mike Pazareskis**, **Ben Chiasson**, **Mike Olson**, **Cam Logalbo**, and **Emily Beltz**.

The CAES Mosquito and Arbovirus Surveillance Field Crew: *front row* (left-right): **Elizabeth Triana**, **Steph Davies**, **LuAnn Shaw**, **Scott Korman**; *back row* (left-right): **Shaun Kusmit**, **Hunter Badey**, **Mike Olson**, and **Sam Rudolph**.

PUBLICATIONS

1. Rutledge, C. E. (2023). Estimating the foraging range of *Cerceris fumipennis* (Hymenoptera: Crabronidae) using land cover data. *Annals of the Entomological Society of America*. DOI: 10.1093/aesa/saad014

Abstract: Biosurveillance monitors the prey of the solitary buprestid-hunting wasp, *Cerceris fumipennis* (Hymenoptera: Crabronidae), for the presence for emerald ash borer (*Agrilus planipennis*, Fairmaire: Coleoptera: Buprestidae). Still unresolved is the foraging range, and thus the surveillance range, of *C. fumipennis*. Foraging occurs in forest canopies and wasps are difficult to track. We assumed that the proportion of conifer-feeding beetles collected at a colony would be related to the proportion of conifers in the surrounding area. If this is the case, the radius of the area around a colony which best correlates the proportion of conifers with the proportion of conifer feeding prey should reflect the foraging range of the colony. In this study, we used 7 years of foraging data, and the National Land Cover Dataset 2016 map to estimate the foraging range of *C. fumipennis*. Overall, we found that the highest correlation between prey type collected, and forest type present, was between 1,000 and 1,500 m from the nest sites. We thus conclude that surveillance of a colony of *C. fumipennis* will yield information about the presence of non-native buprestids within a 1.0–1.5 km radius.

2. **Rutledge, C. E.** and Clark, R. E. (2023). Temporal and spatial dynamics of the emerald ash borer invasion in Connecticut as shown by the native digging wasp *Cerceris fumipennis*. *Frontiers in Insect Science*, *3*. DOI: 10.3389 finsc.2023.1179368

Abstract: Detecting and monitoring populations of the invasive emerald ash borer (EAB) is crucial to successful management of the pest and evaluation of its ecological impacts. However, the beetle's cryptic habit makes accurate monitoring costly and time-consuming. Biosurveillance takes advantage of the foraging effort of a predatory wasp *Cerceris fumipennis* (Hymenoptera: Crabronidae). This native, solitary, ground-nesting hunting wasp hunts adult buprestid beetles to provision its brood cells. By intercepting the hunting wasps, we can learn which species of buprestids are in the surrounding forest. The resulting data provides information on the presence and relative abundance of invasive buprestids like EAB which can supplement other monitoring efforts. In this paper we share results of ten years of biosurveillance surveys of the EAB in Connecticut. Among 112 sites, we observed EAB populations; from first detection, through the population peak and then through to the population crash, matching patterns observed in other regions of the United States. We also observed the spread of the EAB relative abundance as it moved through the state following an invasion front starting in New Haven, Co. The average time from first detection to population crash was nine years. On average, populations peaked three years after first detection, and remained at peak levels for three to four years. Population decline was gradual and took another three to four years. Notably, no evidence of a second introduction to Connecticut was seen with proportional abundance increasing over time after expanding outward from the introduction point. These results corroborate other traditional monitoring efforts in the eastern U.S. and provide independent validation of predicted population dynamics in ash stands.

3. Rose, N. H., **Shepard, J. J.**, and Ayala, D. (2023). Establishing colonies from field-collected mosquitoes: Special accommodations for wild strains. *Cold Spring Harbor Protocols*. DOI: 10.1101/pdb.top107654

Abstract: A researcher may have many reasons for wanting to establish new laboratory colonies from field-collected mosquitoes. In particular, the ability to study the diversity found within and among natural populations in a controlled laboratory environment opens up a wide range of possibilities for understanding how and why burdens of vector-borne disease vary over space and time. However, field-collected mosquitoes are often more difficult to work with than established laboratory strains, and considerable logistical challenges are involved in safely transporting field-collected mosquitoes into the laboratory. Here, we provide advice for researchers working with *Aedes aegypti*, *Anopheles gambiae*, and *Culex pipiens,* as well as notes on other closely related species. We provide guidance on each stage of the life cycle and highlight the life stages for which it is easiest to initiate new laboratory colonies for each species. In accompanying protocols, we provide methods detailing *Ae. aegypti* egg collection and hatching as well as how to transport larvae and pupae from the field.

4. Ayala, D., **Shepard, J. J.**, and Rose, N. H. (2023). Mosquito larvae and pupae transport from the field. *Cold Spring Harbor Protocols*. DOI: 10.1101/pdb.prot108184

Abstract: Laboratory study of field-collected mosquitoes can allow researchers to better understand the ways variation within and among mosquito populations shapes burdens of mosquito-borne disease. The *Anopheles gambiae* complex comprises the most important vectors of malaria, but it can be challenging to keep in the laboratory. For some species of mosquitoes, especially *An. gambiae*, it is very difficult to bring viable eggs into the laboratory. Instead, it is preferable to collect larvae or pupae and then transport them as carefully as possible back to the laboratory. This simple protocol allows a researcher to start new laboratory colonies from larvae or pupae collected from natural breeding sites or proceed directly to their planned experiments. The use of natural breeding sites provides additional reassurance that the resulting colonies are representative of natural populations.

5. Rose, N. H., **Shepard, J. J.**, and Ayala, D. (2023). Collecting, storing, and hatching *Aedes aegypti* eggs. *Cold Spring Harbor Protocols*. DOI: 10.1101/pdb.prot108183

Abstract: Laboratory study of natural populations of mosquitoes can play a key role in determining the underlying causes of variation in burdens of mosquito-borne disease. *Aedes aegypti* is the main vector of the viruses that cause dengue, chikungunya, Zika, and yellow fever, making it a high priority for laboratory study. *Ae. aegypti* eggs provide an ideal starting point for new laboratory colonies. Eggs can be collected using ovicups, which are small plastic cups lined with seed-germination paper and partially filled with leaf-infused H_2O. Once collected, dry eggs will remain viable for months and can be safely transported long distances back to the laboratory as long as they are properly stored. This protocol provides step-by-step instructions for preparing for collecting, storing, and hatching *Ae. aegypti* eggs and has successfully yielded laboratory colonies from locations across both the native and invasive range of this species.

ENVIRONMENTAL SCIENCE AND FORESTRY

DR. SCOTT WILLIAMS 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).

MR. JOSEPH P. BARSKY co-organized the 2023 Connecticut Agriscience Fair and hosted tours of The CAES's New Haven campus for the high school students (15 students) (May 4); along with **DR. JEFFREY WARD** and **DR. ELISABETH WARD**, met with Alana Russell (RI-FHM) and Nathan Piche (CT-DEEP) to discuss concerns regarding beech leaf disease in Portland (May 17); gave a presentation titled "Forest Ecology in Connecticut" to the South Windsor Active Adventures (6 adults) (May 25).

MR. GREGORY BUGBEE 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).

DR. JEREMIAH FOLEY, IV participated in weekly collaborative meetings with the U.S. Army Engineer Research and Development Center (ERDC) to develop standard operating procedures and gather preliminary data for 2024 herbicide trails for Connecticut River *Hydrilla* infestations (May 10, 17, 24, and 31); assisted DEEP Fisheries in the removal of grass carp from Candlewood Lake (May 24); assisted the Town of Guilford in removing a benthic barrier from Lake Quonnipaug (May 25); met with Dr. Mark Heilman Director of Aquatic Technology at SEAPRO to discuss research collaborations on effects of herbicide selectivity to threatened and endangered species (May 31).

DR. SUSANNA KERIÖ 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).

DR. SARA NASON 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 Non-Targeted Analysis working group (May 11 and 16).

MS. SUMMER STEBBINS 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).

DR. ELISABETH WARD met with Connor Hogan (Director, McLean Game Refuge) to discuss forest management practices that promote bird habitat while limiting the influence of deer browse (May 8); met with Eric Dunnack (Forester, NRCS) and Connecticut landowners to discuss implementation of slash walls to limit deer browse in regenerating forests on private land (May 10); participated in a monthly Forest Ecosystem Monitoring Cooperative (FEMC) State Coordinators meeting (May 11); met with Alana Russell (University of Rhode Island) and Nate Piche (State lands forester, CT DEEP) at Meshomasic State Forest to discuss a regional assessment of the impacts of Beech Leaf Disease on tree health (May 17); was interviewed by Hallie Metzger (Editor) for the Professional Timber Producers Association of Connecticut (TIMPROCT) newsletter (May 23); met with Dr. Mark Bradford and Michael Culbertson (Yale University, School of the Environment) to develop sampling protocols that capture heterogeneity in soil carbon stocks in managed and unmanaged forest stands (May 25).

DR. JEFFREY WARD (Emeritus) 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).

DR. LEIGH WHITTINGHILL 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).

NEW STUDENTS, STAFF, AND VOLUNTEERS

DR. ELISABETH B. WARD ("Eli") joined The CAES's 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.

DR. JEREMIAH R. FOLEY, IV 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.

PUBLICATIONS

1. Williams, S. C., Linske, M. A., and **Stafford, K. C. III.** (2023). Orally delivered fipronil-laced bait reduces juvenile blacklegged tick (*Ixodes scapularis*) burdens on wild white-footed mice (*Peromyscus leucopus*). *Ticks and Tick-borne Diseases*, *14*. DOI: 10.1016/j.ttbdis.2023.102189.

Abstract: While the topical acaricidal treatment of rodent pathogen reservoirs has been readily explored over the past several decades, oral systemic acaricidal treatment is only recently gaining traction as an alternative approach to the management of ticks and tick-

borne pathogens. Recent laboratory tests have shown promise in the effectiveness of this systemic strategy against the blacklegged tick (*Ixodes scapularis*) and a Canadian field evaluation was recently published, but no recent field data from the United States yet exist. With this research, we sought to field deploy a commercially available fipronil-laced bait (Kaput® Flea Control Bait, Scimetrics Ltd Corp., Wellington, CO, USA; 0.005% fipronil; Environmental Protection Agency Reg. No. 72500-28), in an alternate use targeting white-footed mice (*Peromyscus leucopus*) to determine bait acceptance and potential impacts to juvenile *I. scapularis* burdens. Bait was readily accepted by wild *P. leucopus* and other rodent reservoirs. An *ad libitum* distribution strategy as well as placing smaller volumes of fipronil-laced bait within individual Sherman traps both resulted in significant reductions (57-94%) in juvenile *I. scapularis* burdens as compared to control over two years. The oral delivery of systemic acaricides shows promise in reduction of *I. scapularis* burdens on *P. leucopus* and should be further explored to determine effectiveness on host-seeking tick abundances, associated pathogen infection, and potentially incorporated into integrated tick management programs.

2. Williams, S. C., Linske, M. A., DeNicola, A. J., DeNicola, V. L., and Boulanger, J. R. (2023). Experimental oral delivery of the systemic acaricide moxidectin to free-ranging white-tailed deer (Artiodactyla: Cervidae) parasitized by *Amblyomma americanum* (Ixodida: Ixodidae). *Journal of Medical Entomology*, *60*. DOI: 10.1093/jme/tjad056

Abstract: Orally delivered, host-targeted, systemic acaricide treatment has potential to be an effective areawide tick abatement strategy. Past efforts using ivermectin for livestock were reported effective at controlling both *Amblyomma americanum* (L.) and *Ixodes scapularis* Say on *Odocoileus virginianus* (Zimmermann). However, the labeled 48-day withdrawal period for human consumption largely prevented utilization of this strategy targeting *I. scapularis* in autumn, when peak adult host-seeking activity coincides with regulated white-tailed deer hunting seasons. The modern-day compound moxidectin is the active ingredient in the pour-on formulation Cydectin (5 mg moxidectin/ml; Bayer Healthcare LLC), with a labeled 0-day withdrawal period for human consumption of treated cattle. We sought to re-examine the systemic acaricide approach for tick management by determining if we could successfully deliver Cydectin to free-ranging white-tailed deer. Over 2 years in late spring/early summer, coinciding with adult and nymphal *A. americanum* activity, we fed Cydectin-coated corn to free-ranging white-tailed deer in coastal Connecticut. Through serum analysis, we documented moxidectin levels at or above those previously reported effective for control of ectoparasites (5–8 ppb for moxidectin and ivermectin) in 24 of 29 white-tailed deer (83%) captured while exposed to treated corn. While we did not document differences in burdens of parasitizing *A. americanum* based on moxidectin sera levels, we did document fewer engorged specimens on deer with increased sera levels. The systemic use of moxidectin for tick management in critical reproductive hosts has the potential to be effective in an areawide capacity while also permitting human consumption of treated venison.

PLANT PATHOLOGY AND ECOLOGY

DR. WASHINGTON DA SILVA 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 (May 3); presented a seminar titled "Small Things Considered: Using RNAI and Nanotechnology to Control Plant Pathogens" as an invited speaker at University of Leeds, Leeds, UK (50 adults) (May 4); attended the Connecticut Farm Wine Development Council meeting with the CT Commissioner of the Department of Agriculture, Bryan P. Hurlburt (8 adults) (May 11).

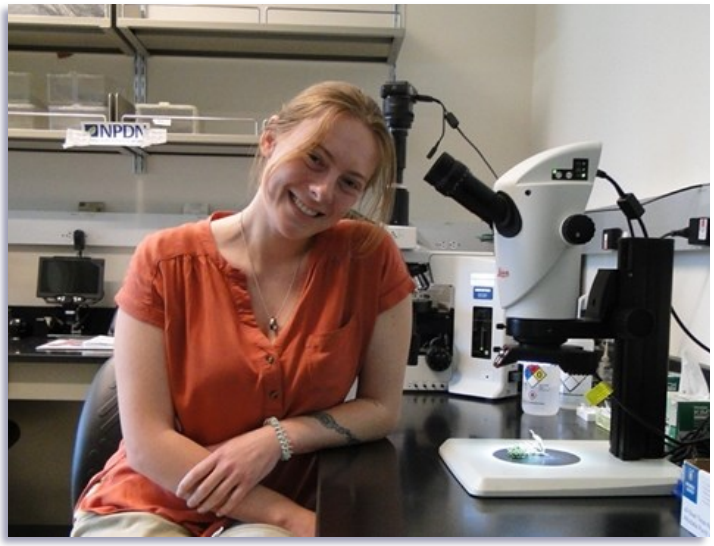
DR. YONGHAO LI presented "Backyard Composting" to Conning Wellness program via WebEx (24 adults) (May 4); presented "Backyard Composting" to Colchester Library education program (23 adults) (May 4); presented "Organic Gardening" to Chester Garden Club in Chester (26 adults) (May 9); presented "Vegetable Gardening" to Morris Cove Garden Club in New Haven (14 adults) (May 10); Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (6 adults) (May 10); presented "Common Diseases of Tomato and Pepper" in Foster Hill Farm in Stafford Springs (12 adults) (May 18); attended the Northeast Plant Diagnostic Network monthly meeting via Zoom (May 25).

MS. FELICIA MILLETT attended UConn Graduate School Commencement 2023 upon completion of her MS degree, accompanied by her Graduate Advisor **DR. QUAN ZENG** (May 8); participated in the NPDN Proficiency Meeting (11 adults) (May 16); and participated in the NEPDN Monthly Meeting (20 adults) (May 25).

DR. ROBERT MARRA attended the Yale Climate Day Summit (May 4); co-led, with **DR. JEFFREY WARD** and Jerry Milne (DEEP), a field class on forest pests and pathogens for the CFPA Master Woodland Managers certification program (20 adults) (May 6); joined **DR. REBECCA JOHNSON** and **MS. MEGHAN CAHILL** as "special award" judges at the New Haven Public Schools Science Fair held at Hillhouse High School, for the CAES Special Award, which was awarded to Siulmarie Santana, in 10th grade at Hillhouse, for her research on growing vegetables in regolith (May 15-16); gave a presentation "Climate Extremes: Impact of Drought and Heat on Tree Health" to the PierceCare Senior Living Center, Brooklyn, CT (20 adults) (May 17).

DR. QUAN ZENG attended UConn Graduate Commencement for his former graduate student **MS. FELICIA MILLETT** (May 8); 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); attended a graduate committee meeting of a PhD student Tammy Wilkinson at Michigan State University through Zoom (May 18).

NEW STUDENTS, STAFF, AND VOLUNTEERS



Ms. Isabella Butzgy is a 4th year transfer student at the University of Maine. She joined the Department of Plant Pathology and Ecology as a Seasonal Research Assistant working with **DR. YONGHAO LI** and **MS. FELICIA MILLETT** on plant disease diagnosis and seed testing programs. She is studying plant science, hoping to continue her education into the plant pathology world and then shifting paths to the medical cannabis industry. She is hoping to be working with pathogens that affect the cannabis plants. She enjoys hiking and snowboarding, as well as hanging out with her cat Goose!

Mr. James Standish, from Southern CT State University, joined the Department of Plant Pathology and Ecology as a Seasonal Research Assistant working with **DR. QUAN ZENG** on characterization of yeasts that grow on apple flowers.

CAES Plant Health Fellow Interns 2023: *Standing* (left-right): **Eva Rodriguez**, **Charles McLean**, **Oliver Kelsey**, **Anand Turner**, **Karena Kulakowski, Aoife Collier-Clarke**, **Leo Babicz**, **Alexandra Carabetta**, **Ana DiMauro**, **Talia Tracton**, and **Justice Glasgow**. *Kneeling*: **Tessa Lancaster**.

Twelve college undergraduates started 9-week internships at The CAES through the Plant Health Fellows, a competitive USDA-funded program coordinated by **DR. LINDSAY TRIPLETT** and colleagues at Southern Connecticut State University.

Plant Health Fellow Interns were assigned to the following CAES scientists' laboratories:

Department of Analytical Chemistry:

- Justice Glasgow will be working with **DR. NUBIA ZUVERZA-MENA** in Analytical Chemistry and **DR. SARA NASON** in Environmental Science and Forestry.

Department of Entomology:

- Oliver Kelsey (**DR. CLAIRE RUTLEDGE)**
- Anand Turner (**DR. HANY DWECK**)
- Karena Kulakowski (**DR. KELSEY FISHER**)

Department of Environmental Science and Forestry:

- Aoife Collier-Clarke (**DR. BLAIRE STEVEN**)
- Leo Babicz (**DR. LEIGH WHITTINGHILL**)
- Ana DiMauro (**DR. SUSANNA KERIÖ**)
- Tessa Lancaster (**DR. ITAMAR SHABTAI**)

Department of Plant Pathology and Ecology:

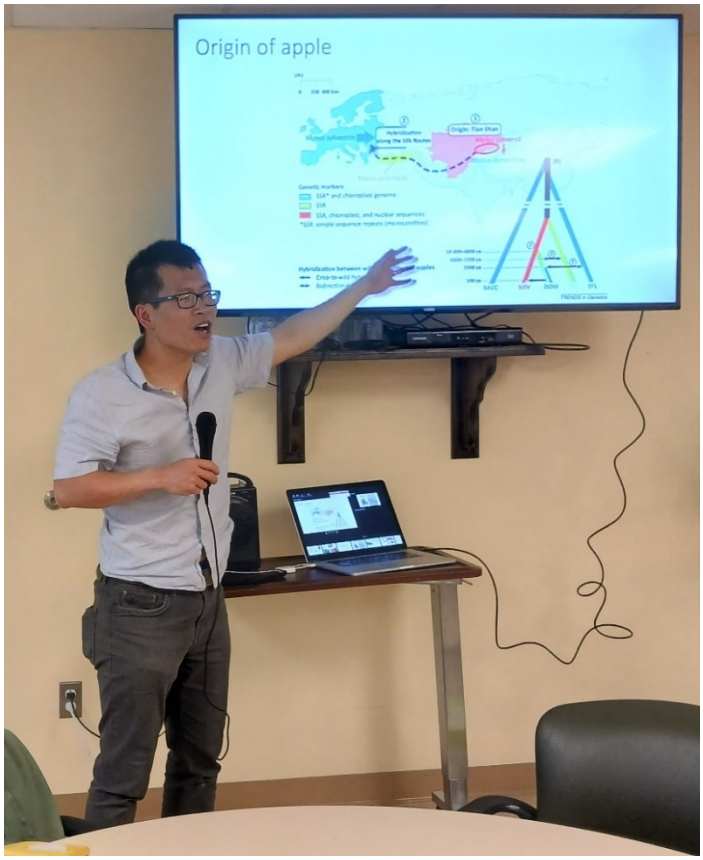
- Eva Rodriguez (**DR. RAQUEL ROCHA**)
- Charles McLean (**DR. QUAN ZENG**)
- Alexandra Carabetta (**DR. LINDSAY TRIPLETT**)
- Talia Tracton (**DR. WASHINGTON DA SILVA**)

PUBLICATIONS

1. Ogonkov, A., Brosius, P. E., **Zeng, Q.**, Sasso, S. and Nagel, R. (2023). Not all *Acidovorax* are created equal: Gibberellin biosynthesis in the turfgrass pathogen *A. avenae* subsp. *avenae*. *Mol. Plant-Microbe Interact.* DOI: https://doi.org/10.1094/MPMI-02-23-0017-R

Abstract: In recent years *Acidovorax avenae* subsp. *avenae* was identified as a major cause of bacterial etiolation and decline (BED) in turfgrasses and has become a growing economical concern for the turfgrass industry. The symptoms of BED resemble those of bakanae, or foolish seedling disease, of rice (*Oryzae sativa*) in which the gibberellins produced by the infecting fungus *Fusarium fujikuroi* contributes to the symptom development. Additionally, an operon coding for the enzymes necessary for bacterial gibberellin production was recently characterized in plant pathogenic bacteria belonging of the y-proteobacteria. We therefore investigated the possibility for the presence of this gibberellin operon in *A. avenae* subsp. *avenae.* A homolog of the operon has been identified in two turfgrass-infecting *A. avenae* subsp. *avenae* phylogenetic groups, but not in closely related phylogenetic groups or strains infecting other plants. Moreover, even within these two phylogenetic groups the operon presence is not uniform. For that reason, the functionality of the operon was examined in one strain of each turfgrass-infecting phylogenetic group (*A. avenae* subsp. *avenae* strains KL3 and MD5). All nine operon genes were functionally characterized through heterologous expression in E. coli and enzymatic activities were analyzed by LC-MS/MS and GC-MS. All enzymes were functional in both investigated strains, thus demonstrating the ability of phytopathogenic β-proteobacteria to produce biologically active GA4. This additional gibberellin produced by *A. avenae* subsp. *avenae* could disrupt phytohormonal balance and be a leading factor contributing to the pathogenicity on turf grasses.

Ms. Felicia Millett attended UConn Graduate School Commencement 2023 upon completion of her MS degree, accompanied by her Graduate Advisor **Dr. Quan Zeng** on May 8. Congratulations, Felicia!



Dr. Quan Zeng presenting, "Apples - History, Origin, Cultivation, Breeding and Modern Technologies," at the Senior Center in Waterbury on May 25, 2023

VALLEY LABORATORY

DR. CAROLE CHEAH 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).

MS. ROSE HISKES conducted a free Invasive Plant Walk and Talk at the Little River Preserve with Jim Sanders in Oxford, CT (8 attendees) (May 20).

Ms. Rose Hiskes conducted a free Invasive Plant Walk and Talk at the Little River Preserve with Jim Sanders in Oxford, CT on May 20, 2023.

JOURNAL ARTICLES APPROVED MAY 2023

Alarcon, H. V., Mohl, J., Chong, G., Betancourt, A., **Wang, Y.**, Leng, W., **White, J. C.**, Brune, D., and Xu, J. Autotrophic growth of purple sulfur bacteria enabled by solid-phase metal sulfide as a sulfur and electron donor source. *Frontiers in Microbiology*.

Chen, S., Liu, H., Yangzong, Z., Gardea-Torresdey, J., **White, J. C.**, and Zhao, L. Nano-enabled seed training strategy to enhance maize abiotic stress tolerance. *Environmental Science and Technology*.

Davenport, R., Bowen, B. P., Lynch, L., Kosina, S. M., **Shabtai, I.**, Northernm, T. R., and Lehmann, J. Molecular diversity in soil organic matter. *Proceedings of the National Academy of Sciences*.

Gomez-Maldonado, D., Phillips, S. G., **Vaidya, S.**, Bartley, P. C., **White, J. C.**, Fairbrother, D. H., and Peresin, M. S. Slowing soluble NPK release with hydrophobized nanocellulose-based hydrogels for enhanced efficiency fertilizers. *Environmental Science Nano.*

He, J., **Li, D.-W.**, Cui, W.-L., Zhu, L.-H., and Huang, L. Phylogeny and genetic diversity of *Fusarium* species causing leaf blight on Chinese fir (*Cunninghamia lanceolata*). *Mycosphere*.

Hillen, A. P., **Foley, J. R. IV**, Salcedo, M. K., Socha, J. J., and Salom, S. M. 3D X-ray analysis of the subterranean burrowing depth and pupal chamber size of *Laricobius* (Coleoptera: Derodontidae), a specialist predator of *Adelges tsugae* (Hemiptera: Adelgidae). *Integrated Pest Management*.

Johnson, R. M., **Cozens, D. W.**, Ferdous, Z., **Armstrong, P. M.**, and **Brackney, D. E.** Increased blood meal size and feeding frequency compromise mosquito midgut integrity and enhance arbovirus dissemination. *PLoS Neglected Tropical Diseases.*

Kandohl, N., Singh, V. P., Sharma, S., Herrera-Estrella, L., **White, J. C.**, Tran, L.-S.P., and Tripathi, D. K. Nanomaterials-based gene editing in plants: An upcoming genetic revolution? *Nature Nanotechnology*.

Kong, M., Jing, J., Wang, F., Huang, H., Xu, H., He, W., Ma, C., Shen, Y., **Elmer, W.**, and **White, J. C.** CuO nanoparticle size controls inhibition of *Fusarium graminearum*. *Nano Today*.

Lewis, R. E., Huang, C.-H., **White, J. C.**, and Haynes, C. L. Using 19F NMR to investigate cationic carbon dot association with per- and polyfluoroalkyl substances (PFAS). *ACS Nanoscience Au*.

Sigmon, L. R., **Vaidya, S.**, Thrasher, C., Mahad, S., **Dimkpa, C. O.**, **Elmer, W.**, **White, J. C.**, and Fairbrother, D. H. Identifying the role of phosphorous type and biodegradable polymer on phosphorus fate in a plant-soil system to optimize treatment efficacy and sustainability. *ACS Sustainable Chemistry and Engineering*.

Sun, M., Cai, Z., Li, X., Xu, X., Qian, K., Li, H., Guo, Y., Liang, A., Han, L., Shang, H., Jia, W., Ma, C., **White, J. C.**, and Xing, B. Nanoscale ZnO improves the nutritional quality of tomato and the subsequent nutrient assimilation in a simulated human gastrointestinal tract mode. *ACS Nano*.

Wan, Y., Zhu, L.-H., and **Li, D.-W.** First report of *Diaporthe acuta* causing leaf blight of *Acer palmatum* in China. *Plant Disease*.

Ward, E. B., Polussa, A., and Bradford, M. A. Depth-dependent effects of tree and shrub mycorrhizal associations on soil carbon and nitrogen pools in a temperate forest. *Global Change Biology*.

CAES

The Connecticut Agricultural Experiment Station

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The Connecticut Agricultural Experiment Station

Main Laboratories
123 Huntington Street
New Haven, CT 06511-2016
Phone: 203-974-8500

Lockwood Farm
890 Evergreen Avenue
Hamden, CT 06518-2361
Phone: 203-974-8618

Griswold Research Center
190 Sheldon Road
Griswold, CT 06351-3627
Phone: 860-376-0365

Valley Laboratory
153 Cook Hill Road
Windsor, CT 06095-0248
Phone: 860-683-4977

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Lockwood Farm, Hamden

Griswold Research Center, Griswold

Valley Laboratory, Windsor

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Station News was prepared and edited by Dr. Jason White, Ms. Vickie Bomba-Lewandoski, and Ms. Kelly Fairbrother.

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