Station News

The Connecticut Agricultural Experiment Station
Volume 14 Issue 12 | December 2024

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

JASON C. WHITE, PH.D. gave a presentation entitled "Nano-enabled agriculture: A path to global food security in a changing climate" at the Materials Innovation for Sustainable Agriculture Symposium, University of Central Florida, Orlando Florida (November 3-4); along with **Nubia Zuverza-Mena, Ph.D.** and **Sara Nason, Ph.D.** participated in a Zoom meeting with collaborators at Yale University and the University of Minnesota for a joint NIEHS grant (November 5); along **CHRISTIAN DIMKPA, PH.D., Choayi Deng, Ph.D.** and **Yi Wang, Ph.D.** with met by Zoom with collaborators at the Centre de Recherche sur la Biodiversité et l'Environnement in Toulouse France to discuss joint experiments (November 5); along with along with **Hina Ashraf, Ph.D.** met by Zoom with collaborators at Johns Hopkins University to discuss joint research work (November 5); participated in the weekly NSF Center for Sustainable Nanotechnology (CSN) all hands call by Zoom (November 6, 13); met with collaborators at the University of Minnesota and Convergent Bioscience to discuss joint experiments (November 6); along with **Hina Ashraf, Ph.D.** met by Zoom with collaborators at the University of Illinois Urbana-Champaign to discuss joint research (November 7); attended the 13th Sustainable Nanotechnology Conference (SNO) in Providence Rhode Island and gave a seminar entitled "Nanoparticle-enhanced PFAS Phytoremediation" (November 8-10); met by Zoom with collaborators from the University of Mauritius to discuss joint research (November 11); met by Zoom with a post-doctoral researcher at the University of Wisconsin Milwaukee for an NSF-I Corps interview (November 13); participated with **CHRISTIAN DIMKPA, PH.D.** in a Zoom call with faculty at Punjab Agricultural University to discuss collaborative research programs (November 14); met by Zoom with a collaborator at Purdue University to discuss joint research (November 15); met by Zoom with a collaborator at Merrimack College to discuss joint research (November 15); attended the 50th Anniversary meeting of Connecticut Association of The Conservation and Inland Wetlands Commissions (CACIWC) in Bristol and gave a presentation entitled "Long-term Environmental Changes and Emerging Threats in CT" (CT November 16); along with **Raja Muthuramalingam, Ph.D.** and **CHRISTIAN DIMKPA, PH.D.** met with colleagues at UConn and Carlton University to discuss collaborative research (November 18); met by Zoom with Yale University faculty and USFA NIFA Program staff to discuss CAES hosting the 2025 USDA Nanotechnology Program annual grantees meeting (November 18); met by Zoom with colleagues at Utah State University to discuss collaborative research (November 19); travelled to the University of Minnesota to meet with colleagues and participate in the annual meeting of Convergent Bioscience (November 20-21); along with **Sara Nason, Ph.D., Jasmine Jones,** and **CHRISTIAN DIMKPA, PH.D.** met with CT DEEP and CT DoAg staff to discuss the CT PFAS Farm Soil Testing Program (November 22); met with staff from the HNG Agri and Flower House to discuss collaborative programs with the country of Nepal (November 22); and along with **Nubia Zuverza-Mena, Ph.D.** met with colleagues at Tecnologico de Monterrey to discuss collaborative research (November 25).

PUBLICATIONS:

1. Cai, Z., Ma, C., Hao, Y., Jia, W., Cao, Y., Wu, H., Xu, X., Han, L., Li, C., Shang, H., Liang, A., White, J. C., Xing, B. (2024). Molecular evidence of nanoceria modulation of ABA and genes containing ABA-responsive cis-elements to promote drought tolerance in rice. *Environ. Sci. Technol.* 58, 49, 21804–21816. DOI: 10.1021/acs.est.4c08485

Abstract: Cerium dioxide nanoparticles (CeO2 NPs) have enzyme-like properties and scavenge excess ROS induced by stressors such as drought. However, the underlying molecular mechanisms by which CeO2 NPs enhance drought resistance are unknown. In this work, both foliar application and soil injection of CeO2 NPs were used to rice seedlings under a 30-day moderate drought (40% soil relative moisture). Foliar application of 4 mg of CeO2 NPs per pot reduced excess reactive oxygen species and abscisic acid (ABA) in rice leaves, thereby maintaining chloroplast structural integrity and photosynthetic output, ultimately increasing drought-stressed rice biomass by 31.3%. Genes associated with photosynthesis and ribosome activity provided the foundation by which CeO2 NPs enhanced rice drought resistance. Importantly, these genes were tightly regulated by ABA due to the large number of abscisic acid responsive elements in their promoter regions. CeO2 NPs also upregulated the expression of soluble sugar and fatty acid synthesis associated genes in drought-stressed rice, thereby contributing to osmotic balance and membrane lipid stability. These results highlight the potential of CeO2 NPs to enhance rice photosynthesis and drought-resistant biomolecule accumulation by regulating ABA-dependent responses. This work provides further evidence demonstrating nanomaterials have great potential to sustainably promote stress resistance and climate resilient crops.

2. Takeshita, V., Oliveira, F. F., Garcia, A., Zuverza-Mena, N., Tamez, C., Cardosa, B. C., Pinácio, W. C., Steve, B. T., LaReau, J., Astete, C. E., Sabliov, C. M., Fraceto, L. F., Tornisielo, V. L., Dimkpa, C. O., White, J. C. (2024). Delivering metribuzin from biodegradable nanocarriers: Assessing herbicidal effects for soybean plant protection and weed control. *Environ. Sci.: Nano* DOI: 10.1039/D4EN00784K

Abstract: The harmful effects of herbicides on crop plants are a significant concern, and nanoherbicides are no different in that regard. Several studies have reported improved weed control, targeted delivery, and active ingredient dose reduction with herbicide nanocarriers, especially with biodegradable nanoformulations. However, the effects on crops have yet to be widely explored. Here, we investigate the uptake and physiological effects of metribuzin on soybean plants treated with metribuzin in conventional and biodegradable nanoformulations (poly-ε-caprolactone - PCL and lignin-PCL) as measured by a range of indicators of plant health. Weed control by the nanoformulations was also evaluated as a measurement of target delivery. Soybean plants did not show any differences in the photosynthetic and oxidative stress parameters with nanoherbicide treatment, although a slight biomass reduction occurred at 60 days after application. The metribuzin formulations were accumulated by the root and translocated to the aerial part for both plant species. The presence of polymeric nanomaterials in the soil appeared to mitigate alterations in the bacterial community. With notable uptake, metribuzin caused severe photosynthetic damage and oxidative stress in the weed species, leading to eventual mortality. PCL-lignin was more effective in terms of sustainable herbicide nanoformulations, while PCL-MTZ presented greater efficacy for weed control. These results indicate that nanoformulations of MTZ did not increase soybean damage, presenting a potentially safe application for weed control in agriculture.

3. Ochao, L., Shrivastava, M., Srivastava, S., Cota-Ruiz, K., White, J. C., Hernandez-

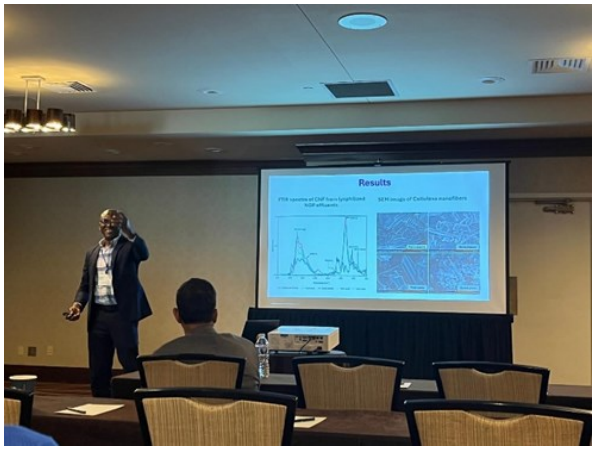
Viezcas, J. A., Gardea-Torresdey, J. L. (2024). Nanomaterials for managing abiotic and biotic stress in the soil-plant system for sustainable agriculture. *Environ. Sci.: Nano* DOI: 10.1039/D4EN00789A

Abstract: As the global population steadily increases, the need to increase agricultural productivity has become more pressing. It is estimated that agricultural production needs to double in less than 30 years to meet the projected food demand. However, crop species are being cultivated under a range of increasingly challenging environmental stressors, including the effects of climate change and factors. To address these issues, nanotechnology has emerged as an enabling strategy to bolster plant resistance to the adverse effects of stressors and improve their overall performance. In this review, we evaluate recent research in this field, examining the strategies by which nanomaterials (NMs) and nanoparticles (NPs) have been used to facilitate enhanced tolerance to pests, excessive salinity in soil, pathogenic fungi, and other stressors. The intent is to focus on the mechanisms by which plants cope with environmental stressors at the physiological and molecular levels. We also examine how plants interact with and acquire NMs, with a specific focus on the mechanisms behind their beneficial effects regarding stress response. Our review also evaluates key knowledge gaps and offers suggestions on how to address them. Additionally, we discuss the potential of NMs to enhance agricultural production systems and highlight essential considerations for mitigating crop stress and promoting sustainable agriculture at a global scale. While the use of nanotechnology in the agricultural sector is growing and shows tremendous promise, more mechanistic studies and field-scale demonstrations are needed to fully understand and optimize the use of nanomaterials on plants stress tolerance in a changing climate. In addition, few studies conducted life cycle field experiments to verify the effects of nano-agrichemicals on yield and nutritional quality, especially there is a lack of multiple-year and multiple-location experiments. Only by doing this, technology-readiness-level of nano-enabled agro-technologies can be improved and be closer to commercial application.

Kerala, India

ANALYTICAL CHEMISTRY

CHRISTIAN DIMKPA, PH.D. attended the "Modern Agricultural Sci-Tech Innovation Forum", from November 1 to 7, 2024, in Zhangjiang Science Hall, Shanghai, China. He gave a presentation on the *Role of Nanotechnology in Plant Nutrient Management* and was a panelist at the roundtable discussion on *Food Security and the Future of Agriculture*. The meeting had over 2000 attendees from multiple countries, including the United States. During the trip, Dr. Dimkpa visited the Zhejiang University (ZHU) China and met with Professor Bin Li of the Institute of Biotechnology at ZHU. Professor Li is interested in collaborating with CAES on the use of nanotechnology in plant production, especially in disease management. Dr. Dimkpa gave a talk on the same topic of nanotechnology to students at the Institute.



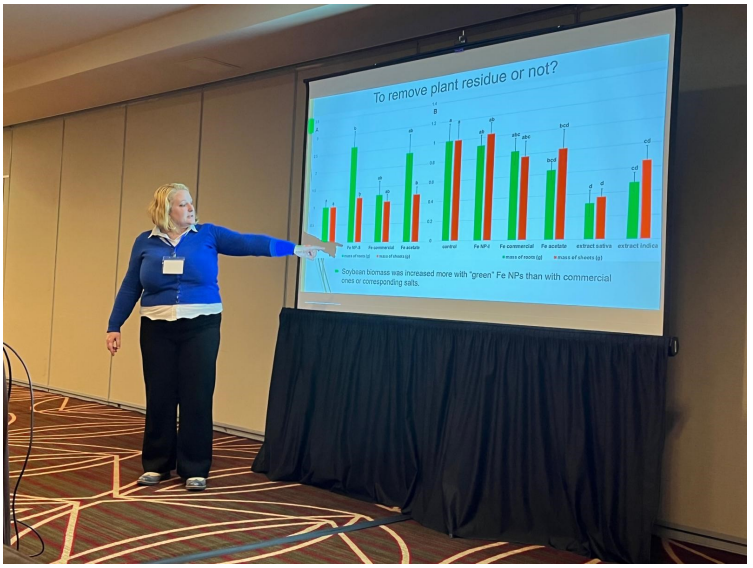
PAUL AIKPOKPODION, PH.D. attended the 13th edition of the Sustainable Nanotechnology Organization (SNO) Conference in Rhode Island, USA (November 08-10, 2024). During the conference, he presented a talk titled "Use of cellulose nanofiber-containing effluents for nutrients loss management in agricultural soils". About 136 participants attended the conference.

GUSTAVO GARCIA, PH.D. joined the Department of Analytical Chemistry on November 1st as a Postdoctoral Scientist at CAES. He earned his M.S. in Food Science in 2019 and his Ph.D. in Biological Engineering in 2024 from Louisiana State University. His doctoral research focused on engineering biodegradable materials from plant biowaste, such as lignin, by modifying natural polymers to create functional materials with controlled-release properties for active ingredient applications in food and agriculture. He also has experience in food bioprocessing systems, particularly in the preservation of produce and seafood. He has published over six scientific papers as both first and co-author in journals focused on food safety and sustainable agricultural production. His research interests include the application of innovative technologies to address food and agricultural challenges, with a particular focus on the sus-

tainable use of nanotechnology to enhance food safety, nutrient uptake, plant health, and food production. At CAES, Gustavo will work on evaluating contaminants in food and environmental matrices.

RAJA MUTHURAMALINGAM, PH.D. and **Nubia Zuverza-Mena, Ph.D.** presented their latest research findings on “Nanoformulated sunscreen for plants to mitigate UV stress” at the 13th edition of the Sustainable Nanotechnology Organization (SNO) Conference, held in Rhode Island, USA, from (November 8-10); delivered a CAES seminar titled "Tiny but Mighty: Advancing Nanoscale Innovations for Next-Generation Agricultural Solutions" on November 27, 2024.

MILICA PAVLICEVIC, PH.D. attended the 13th edition of the Sustainable Nanotechnology Organization (SNO) Conference in Rhode Island, USA (November 08-10, 2024). She presented a talk titled “When waste is not a waste - using hemp stem and leaves to synthesize “green” iron and manganese nanoparticles”. Conference was attended by approximately 130 participants.



YI WANG, PH.D. gave a seminar at the University at Albany on November 8th (30 adults), titled "Nano-enabled Agriculture: Efficient Utilization and Delivery of Nanoparticles to Enhance Plant Growth and Disease Suppression."

Dr. Yi Wang, Dr. Christian Dimkpa, and Dr. Jason White received a grant from USDA-AFRI. The funded project is titled” Controlling the Surface Retention and Penetration of Agro-nanomaterials: Designing a Broadly Applicable Strategy”. The funding is for two years with a total amount of $ 299,541.

PUBLICATIONS:

1. Takeshita, V., Oliveira, F. F., **Garcia, A.**, **Zuverza-Mena, N., Tamez, C.,** Cardoso, B. C., Pinácio, C. W., Steven, B., LaReau, J., Astete, C. E., Sabliov, C. M., Fraceto, L. F., Tornisielo, V. L., **Dimkpa, C. O., White, J. C.** (2024). Delivering metribuzin from biodegradable nanocarriers: Assessing herbicidal effects for soybean plant protection and weed control. Environmental Science: Nano. DOI: 10.1039/D4EN00784K

Abstract: Several studies have reported improved weed control and targeted delivery of herbicides by nanocarriers. However, the effects on crops and non-target organisms need to be considered. Here, we investigate the crop and soil health treated with metribuzin in conventional and biodegradable nanoformulations (poly-ε-caprolactone – PCL and lignin-PCL) (both at 480 g a.i. ha^{-1}). Weed control of *Amaranthus retroflexus* by the nanoformulations was also evaluated as a measurement of target delivery. Soybean plants did not show any differences in photosynthetic parameters and a slight oxidative stress with nanoherbicide treatment, with biomass reduction occurred at 60 days after application. The root accumulated metribuzin formulations and translocated to the aerial part for both plant species. The polymeric nanomaterials in the soil mitigated alterations in the bacterial community. Metribuzin formulations, mainly nanoformulations even at low dose (48 g a.i. ha^{-1}) caused severe photosynthetic damage in the weed species, with reduction of chlorophyll content (up to 2.35 time) and electron flow (up to 9.22 times), leading to eventual mortality. MTZ nanoformulations presented a greater efficacy (even in 10-fold less dose) for weed control compared to conventional formulation. These findings suggest that MTZ nanoformulations improve weed control and attenuate the negative effects on crop and soil health, offering an important nano-enabled strategy for sustainable weed management.

2. Boukhalfa, R., **Dimkpa, C. O., Deng, C., Wang, Y.,** Ruta, C., Calabrese, J. G., Messgo-Moumene, S., **Bharadwaj, A., Muthuramalingam, R.**, **White, J. C.,** De Mastro, G. (2024). Encapsulation in silica nanoparticles increases the phytotoxicity of essential oil from *Thymus vulgaris* in a weed species. *ACS Agricultural Science and Technology* DOI: 10.1021/acsagscitech.4c00580

Abstract: Weed control poses a significant challenge to agriculture, warranting the development of effective but environmentally safe herbicides. Encapsulation of plant essential oils (EOs) with herbicidal properties in nanoscale polymers can offer high loading capacity as well as controlled and tunable agrochemical delivery. This study investigated the use of encapsulated thyme EO against redroot pigweed (*Amaranthus retroflexus* L.), a difficult-to-control weed resistant to multiple herbicides. Three volumes of thyme EO (500, 750, and 1000 µL) were encapsulated in a silica nanoparticle (SiNP) suspension to achieve 250 µL/mL (hereinafter "500"), 375 µL/mL (hereinafter "750"), and 500 µL/mL (hereinafter "1000") EO concentrations. The efficacies of these preparations were compared to that of pristine EO. The loading efficiencies were 26, 42, and 64% for the "500", "750", and "1000" EO preparations, respectively. Transmission electron microscopy (TEM) revealed spherical and regular SiNPs with a size range of 220–300 nm. Fourier transform infrared (FT-IR) spectroscopy confirmed EO loading by the presence of characteristic peaks of isoprenoids and isomeric compounds. Herbicidal bioassays with pristine thyme EO in postemergence treatments on *A. retroflexus* seedlings exhibited a significant ($p \leq 0.05$) concentration-dependent herbicidal activity, reducing shoot biomass by 85% at the highest tested concentration ("1000"), compared to the control (Tween 20). Encapsulation with SiNPs further enhanced the herbicidal efficacy compared to the control, reaching 96% at the highest concentration. Compared to the pristine EO, EO-SiNPs induced significant ROS production at the highest concentration, leading to cell membrane damage and an imbalanced antioxidant system, as demonstrated by the increased shoot malondialdehyde content (40%) and activities of the antioxidant enzymes ascorbate peroxidase (APX) (65%), catalase (CAT) (52%), and superoxide dismutase (SOD) (36%). These results suggest significant potential for developing an effective nanobioherbicide using thyme EO encapsulated in SiNPs.

ENTOMOLOGY

PHILIP ARMSTRONG, SC.D. attended the Vector-borne and Zoonotic Disease Network meeting at Yale School of Public Health (November 1); participated in the Yale Institutional Biosafety Committee new member training (November 12); met with members of the Connecticut Mosquito Management Program and local health district directors to update the EEE response plan (November 12 and 26); met with colleagues at Yale School of Public Health to discuss resubmission of a NIH grant on Powassan virus (November 12); gave a presentation titled "Multiple bloodmeals enhance dissemination of arboviruses in three medically-relevant mosquito genera" at the Annual Meeting of the American Society of Tropical Medicine and Hygiene in New Orleans (November 15)

ANGELA BRANSFIELD participated by Teams in a CAES DEI meeting (November 13); participated by Zoom in Yale University's Biosafety Committee meeting (November 21); provided BSL3 laboratory training (2 attendees) (November 22); provided BSL3 laboratory training (1 attendee) (November 25).

KELSEY E. FISHER, PH.D. organized a tour of CAES for Quinnipiac students in Dr. Sarah Lawson's "Conservation in Action" class (16 students) (November 4); organized a symposium, "Old pest, new problem: Bt resistance in European corn borer in North America", at the Entomological Society of America conference in Phoenix, AZ (November 10-13) and presented three oral presentations: "Potential field evolved resistance of European corn borer to Bt traits in Connecticut", "Sentinel monitoring for resistance to Bt toxins in European corn borer in eastern North America", and "Impact of adjacent land use on bumblebee (*Bombus* sp.) abundance and diversity within small, manicured pollinator gardens", and one poster presentation: "European corn borer phenology in Connecticut"; planted a habitat augmentation and enhancement research plot in collaboration with Tracy Zarrillo (CAES) and Peter Piccone (CT DEEP) with 12 community volunteers in Goshen, CT (November 17); met and brainstormed with Erik Dopman (Tuffs University) and Brad Coates (USDA-ARS-CICGRU) about collaborative opportunities (November 25).

ANDREA GLORIA-SORIA, PHD. is a co-I in the proposal "Efficient, low-cost, identification of Culex mosquito vectors of West Nile Virus using computer vision based AI tools." PI: N. Saarman; Utah State U. awarded funding by the American Mosquito Control Association Research fund ($53,996.00).

NOELLE KHALIL presented an invited talk titled "Climate Change and the Rising Tide of Vector-borne Diseases" at the Flanders Environmental Research Symposium (30 attendees) (November 7).

MEGAN LINSKE, PH.D. gave a guest lecture titled "Tick Biology, Ecology, and Behavior" at Southern Connecticut State University (15 attendees) (November 4); gave an invited lighting talk and poster presentation titled "Systemic acaricidal treatment of white-footed mice (*Peromyscus leucopus*) against juvenile blacklegged ticks (*Ixodes scapularis*) in Connecticut" for the Medical, Urban, and Veterinary Entomology Section of the Entomological Society of America annual meeting in Phoenix, AZ (45 attendees) (November 13); participated in a meeting with collaborators from BanfieldBio, Inc. to discuss acquisition of new research project and funding (November 19).

GOUDARZ MOLAEI, PH.D. attended the CDC Cross-Center Intern Research Symposium (November 5); attended the Yale Biological Safety Committee training (November 12); presented a lecture on tick-borne diseases at Southern Connecticut State University (November 13); presented a lecture on tick and tick-borne disease surveillance at Southern Connecticut State University (November 18); and presented an invited talk: "Bracing for the Worst: Cli-

mate and Ecological Changes and the Rising Tide of Vector-Borne Diseases" to the Connecticut Environmental Council (November 19).

JACOB RICKER participated in the annual New England/New York Forest Health Cooperators Meeting, in the Jones Auditorium (November 6-7); participated in a live webinar on Integrated Pest Management for Arborists and Foresters hosted by the US EPA (November 19).

GALE E. RIDGE, PH.D. was interviewed by Chion Wolf from WNPR about Delusional Infestation (November1); interviewed on a live podcast called "Beauties and Beasties" out of England about bed bug behavior and Delusional Infestation (November 1); had a group of Quinnipiac student's visit the Insect Information Office on a tour sponsored by **Kelsey Fisher, Ph.D.** (12 attendees) (November 4); held Bed Bug Forum XII in the Jones auditorium (48 attendees) (November 5); presented a webcast talk on bed bugs to the New England local health departments and environmental health professionals (November 12); and presented a second webcast talk on bed bugs to the New England local health departments and environmental health professionals (November 20).

VICTORIA L. SMITH, PH.D. attended and participated in the annual New England/New York Forest Health Cooperators Meeting, held in the Jones Auditorium (November 6); participated in a webinar on Integrated Pest Management for Arborists and Foresters, sponsored by the US EPA Center for Integrated Pest Management (November 19).

PAULA WOLF participated in the Massachusetts Beekeepers Association Meeting (November 2); participated in the Apiary Inspectors of America tropilaelaps training at Auburn University in Auburn, AL (November 4-8); Participated in the Apiary Inspectors of America USDA update via Zoom (November 13); Participated in Connecticut Beekeepers Association's virtual Bee Talks meeting (37 attendees) (November 14); Participated in a tabling display with **Dr. Nubia Zuverza Mena and Dr. Nate Westrick** at the 2024 Connecticut Agricultural Expo at Aquaturf in Southington, CT (November 20).

TRACY ZARRILLO gave a tour of her lab and provided an overview of CAES wild bee research projects to Quinnipiac undergraduate students during a field trip to CAES.

PUBLICATIONS:

1. Price, L. E., Winter, J. M., **Cantoni, J. L., Cozens, D. W., Linske, M. A., Williams, S. C.,** Dill, G. M., Gardner, A. M., Elias, S. P., Rounsville, T. F., Smith, R. P., Palace, M. W., Herrick, C., Prusinski, M. A., Casey, P., Doncaster, E. M., Savage, J. D. T., Wallace, D. I., & Shi, X. (2024). Spatial and temporal distribution of *Ixodes scapularis* and tick-borne pathogens across the northeastern United States. *Parasites & Vectors* 17:481. DOI: 10.1186/s13071-024-06518-9

Abstract: Background The incidence of tick-borne diseases is increasing across the USA, with cases concentrated in the northeastern and midwestern regions of the country. *Ixodes scapularis* is one of the most important tick-borne disease vectors and has spread throughout the northeastern USA over the past four decades, with established populations in all states of the region. Methods To better understand the rapid expansion of *I. scapularis* and the pathogens they transmit, we aggregated and analyzed *I. scapularis* abundance and pathogen prevalence data from across the northeastern USA, including the states of Connecticut, Maine, New Hampshire, New York and Vermont, from 1989 to 2021. Maine was the only state to collect data during the entire time period, with the other states collecting data during a subset of this time period starting in 2008 or later. We harmonized *I. scapularis* abundance by county and tick season, where the nymph season is defined as May to September and the adult season is October to December, and calculated *I. scapularis* pathogen infection prevalence as the percentage of ticks that tested positive for *Anaplasma phagocytophilum*, *Babesia microti*, *Borre-*

lia burgdorferi, and *Borrelia miyamotoi*. We then explored temporal trends in *I. scapularis* abundance and pathogen prevalence data using linear models. Results The resulting dataset is one of the most spatially and temporally comprehensive records of tick abundance and pathogen prevalence in the USA. Using linear models, we found small or insignificant changes in the abundance of nymphs and adults over time; however, *A. phagocytophilum*, *B. microti* and *B. burgdorferi* prevalence in both nymphs and adults has increased over time. For the period 2017–2021, the statewide average prevalence of *B. burgdorferi* ranged from 19% to 25% in *I. scapularis* nymphs and from to 49% to 54% in *I. scapularis* adults. The statewide average prevalence of all other pathogens in *I. scapularis* for 2017–2021, including *A. phagocytophilum* (4–6% for nymphs, 4–9% for adults), *B. microti* (4–8% for nymphs, 2–13% for adults) and *B. miyamotoi* (1–2% for nymphs, 1–2% for adults), was considerably less. Conclusions Our efforts revealed the complications of creating a comprehensive dataset of tick abundance and pathogen prevalence across time and space due to variations in tick collection and pathogen testing methods. Although tick abundance has not changed along the more southern latitudes in our study over this time period, and only gradually changed in the more northern latitudes of our study, human risk for exposure to tick-borne pathogens has increased due to increased pathogen prevalence in *I. scapularis*. This dataset can be used in future studies of *I. scapularis* and pathogen prevalence across the northeastern USA and to evaluate models of *I. scapularis* ecology and population dynamics.

Pete Picone, Tracy Zarrillo, Kelsey Fisher, Ph.D., and volunteers from the Goshen Land Trust augmenting a meadow with native wildflower seed at the Goshen Wildlife Management Area.

Apiary Inspectors of America Tropilaelaps training at Auburn University

ENVIRONMENTAL SCIENCE & FORESTRY

SCOTT WILLIAMS, PH.D. participated in a Zoom call with Dr. Caroline Mullins (University of Glasgow) and David Poché (Genesis Laboratories, Inc.) about a collaborative research project involving the systemic treatment of mice against tick-borne pathogens in Scotland (November 5); met with Drs. Nathan Grubaugh and Chantal Vogels (Yale University) and **DRS. PHIL ARMSTRONG**, **ANDREA GLORIA-SORIA**, and **DOUG BRACKNEY** about collaborative research opportunities on Powassan virus (November 12); participated in the kick off meeting with staff from BanfieldBio and CDC's Division of Vector-Borne Diseases on a collaborative grant investigating the development of a botanical acaricide for blacklegged tick management (November 19); participated in a Zoom call with staff from the CDC Division of Vector-Borne Diseases on progress made on a funded integrated tick management project (November 19); as the Northeast Section Representative, participated in a Zoom call for members of the Professional Certification Review Board of The Wildlife Society (November 22); conducted botanical and ecological inventory on a piece of property for the Guilford Land Conservation Trust (November 27).

NATALIE BAILEY attended the Entomological Society of America annual meeting in Phoenix, AZ, and presented in a symposium titled "Building an Entomology Workforce Through Experiential Learning" (November 10-13); participated in a collaborative Zoom call with members of Banfield Biologic to discuss a tick repellent development plan (November 19).

JOSEPH P. BARSKY met virtually with Jamie Lewis Hedges of The White Oak Initiative to discuss potential future collaborations regarding The Connecticut Oak Mast Surveillance Program (November 5).

GREGORY J. BUGBEE gave an invited virtual talk entitled "Connecticut's Invasive Aquatic Plant Problem" to the Norwich Power Squadron" (15 attendees) (November 6); participated (virtually) in the USACE Hydrilla Demonstration Meeting (November 6); attended the United States Army Corps of Engineers/MADCR Hydrilla Demo Project MA Expansion Planning Meeting (November 14); gave an invited talk entitled "Connecticut Invasive Aquatic Plant Update" at the Connecticut Association of Conservation and Inland Wetland Commission's annual meeting at the Bristol Event Center (55 attendees) (November 16); gave an invited talk entitled "Hydrilla in the Connecticut River Update" at the annual meeting of the Northeast Aquatic Nuisance Species Panel at the New Hampshire Department of Environmental Conservation Headquarters in Portsmouth, New Hampshire (45 attendees) (November 21); attended the United States Army Corps of Engineers Marina Owners Meeting (November 25).

JEREMIAH FOLEY, IV, PH.D. accepted an invitation to join the Connecticut River Museum advisory council for the Environmental Symposium 2025 (November 7); served as an external advisor to Norwich Technical High School Biotechnology students for a science fair project using eDNA to identify hydrilla in Connecticut lakes as part of an early detection rapid response initiative (November 12); delivered an invited seminar to the University of Connecticut Department of Natural Resources and the Environment titled "Ripples of Invasion: Understanding the Spread and Impact of Aquatic Invasive Plants" (40 attendees) (November 15); and accepted an invitation to join Northeastern Naturalist as an Associate Editor (November 16), was interviewed by NPR Public Radio for a segment titled " Innovative solutions target

invasive Hydrilla in CT River," that aired on "All Things Considered" on Nov 26, again on "Morning Edition" on Nov 27, and was featured as an article on the WSHU – NPR News & Classical Music website.

SUSANNA KERIÖ, D.SC. participated in the Forest Health Cooperators Meeting organized at CAES (November 6-7); discussed a workshop on tree planting with Carter Peck (CT Tree Protective Association, Davey Tree Care) (November 13); met at Lockwood Farm chestnut orchards with Ph. D. candidate Alexa Duchesnau from the Department of Anthropology at Yale University to prepare a lecture on chestnuts as a food source for a class "Endangered Food" (November 18); participated a conference call to plan a tree planting workshop organized at the CT Urban Forest Council conference in collaboration with the CT Tree Protective Association (November 26).

SARA NASON, PH.D. met virtually with a local high school student to discuss a science fair project (November 1, 20); met virtually with Dr. Alex Aksenov (UConn) to discuss a collaboration on PFAS data analysis methods (November 1); as the vice chair, participated in virtual meetings for the Best Practices for Non-Targeted Analysis working group (November 4, 7, 19); met virtually with colleagues and students from the University of Minnesota (Dr. Christy Haynes, Riley Lewis, and Cheng-Hsin Huang) and CAES (**JASON WHITE, PH.D. and NUBIA ZUVERZA-MENA, PH.D.**) to discuss an ongoing funded collaboration on nanomaterial enhancement of PFAS phytoremediation (November 5); met virtually with Dr. Thivanka Ariyarathna, Dr. Lauren Kipp, Dr. Charles Schutte (Rowan University), Dr. Mark Sullivan, and Dr. Steve Evert (Stockton University) to discuss a new project on PFAS in marine food webs in New Jersey (November 5); met virtually with representatives from SciEx to discuss advances in instrumentation (November 12); attended a webinar on adding custom features to LC-MS data analysis software given by Thermo Scientific (November 14); was interviewed via email by Claire Thompson from Grist regarding work on PFAS phytoremediation (November 15); attended a webinar presentation by Antony Williams (US EPA) as part of the US FDA Food Emergency Response program (November 21); met virtually with representatives of a company in Belgium specializing in hemp phytoremediation to discuss our related work (November 22); met virtually with representatives of the CT Department of Agriculture, CT DEEP, and CAES (**JASON WHITE, PH.D., CHRISTIAN DIMKPA PH.D., JASMINE JONES**) to discuss the development of a program measuring PFAS in soils from CT farms (November 22); was interviewed via email by Melissa Lizotte from Bangor Daily News regarding work on PFAS contaminated sites in Maine (November 26).

ITAMAR SHABTAI, PH.D. met with **BLAIRE STEVEN, PH.D.** and with collaborators at UConn to discuss an ongoing project (November 4); gave a demonstration on soil science topics to students from Quinnipiac who were hosted by **FISHER KELSEY, PH.D.** (November 4); attended the 2024 ASA, CSSA, SSSA International Annual Meeting in San Antonio, TX (November 10-13) gave an oral presentation on "Evaluating the Use of Organic Amendments to Increase Soil Water Retention Capacity and Reduce Crop Drought Stress" (50 attendees) (November 11) and an oral presentation on "The Dependence of Root Exudate Carbon Distribution on Plant Water Availability and Water Use Strategies" (70 attendees) (November 12); with **BLAIRE STEVEN, PH.D.**, hosted an AP Environmental Science class from Bacon University and presented and gave lab demonstrations on topics of soil health and organic matter (15 attendees) (November 18); held a zoom meeting with collaborators from The Hebrew University of Jerusalem to discuss a collaboration on a soil health project (November 19); served

as an external committee member in an A-Exam of a PhD candidate from Cornell University (November 20).

ELISABETH WARD, PH.D. presented to Quinnipiac University students in Dr. Sarah Lawson's "Conservation in Action" seminar (15 participants) (November 4); hosted the Forest Health Cooperators meeting for New England, New York, and the USDA Forest Service Durham Field Office and presented Connecticut forest health updates (35 participants) (November 6-7); organized and co-led a tour of beech stands affected by beech leaf disease with participants from CT DEEP Forestry Division, Rhode Island Department of Environmental Management, the Peconic Land Trust, and the USDA Forest Service (13 participants) (November 8); presented an invited talk titled "Connecticut's Changing Forests" at the Woodbridge Garden Club (30 participants) (November 12); participated in the monthly State Coordinators meeting for the Forest Ecosystem Monitoring Cooperative (November 14); met with collaborators at Yale University and Woodwell Climate Research center to discuss project on plant mycorrhizal associations and soil carbon persistence (November 18); met with Drs. Mark Bradford, Sara Kuebbing, and Marlyse Duguid (The Forest School, Yale School of the Environment) and Jack Hatajik to discuss project on the effects of Emerald Ash Borer invasion on understory plant communities (November 21).

JEFFREY S. WARD, PH.D. (emeritus) along with **JOSEPH P. BARSKY**, spoke on effectiveness of slash to enhance regeneration diversity and growth at the Northeast Mid-Atlantic Partnership workshop in Seymour (61 attendees) (November 20).

SUMMER WEIDMAN led a meeting for the CAES Students in STEM Program (November 1); met virtually with students from Norwich Technical High School about a hydrilla eDNA science fair project (November 12); co-chaired the CAES DEI committee meeting (November 13); attended the quarterly CT River Hydrilla Meeting led by the Connecticut River Conservancy (November 14); chaired the virtual meeting of the Guilford Conservation Commission Lake Quonnipaug Subcommittee (November 19); attended the Northeast Aquatic Nuisance Species Panel (NEANS) meeting in Portsmouth, NH (November 20-21); led the pesticide recertification program for the Northeast Aquatic Plant Management Society (NEAPMS) grass carp webinar (November 22).

LEIGH WHITTINGHILL, PH.D. participated in the Common Ground Annual Farm and Garden Conference and interacted with a variety of local urban growers (November 2); participated in the laboratory visits by Quinnipiac University students in the "Conservation in Action" course (November 4); participated the New Haven Garden Club panel discussion "Public Green Spaces: An Urban Imperative" as a representative of CAES and spoke with garden club and panelists about green roofs, urban green spaces, and other projects (November 13); attended the CAES DEI committee meeting (November 13) and was voted the point person for the Disability and Accessibility subcommittee.

YINGUE (CHARLIE) YU, PH.D. attended the "EPA OSAPE Micropollutants Orientation Training Information" from EPA (November 5); attended the "A Simple, Effective Solution for Characterization and Quantification of Microplastics by Pyrolysis-GC/MS" webinar (November 6); attended the ASA-CSA-SSSA Annual Meeting in San Antonio, TX, hosted "Soil Physics and Hydrology Oral Session," and served as student competition judge for the Soil Physics and Hydrology Division (November 10–13); met with collaborators from EMSL

on Zoom to discuss the use of metabolomics for eco-corona characterization (November 22).

PUBLICATIONS:

1. Abdelraheem, W., Meng, L., Pignatello, J. J. Seenthia, N., Xu, W. (2024). Participation of strong H bonding to acidic groups contributes to the intense sorption of the anionic munition nitrotriazolone (NTO) to the carbon, Filtrasorb 400. *Environmental Science & Technology*, online. DOI: 10.1021/acs.est.4c07055

Abstract: 5-Nitro-1,2-dihydro-3H-1,2,4-triazin-3-one ("nitrotriazolone," NTO) is an insensitive munition compound used in modern weaponry. It poses a potential threat to soil and water quality at relevant sites due to its physical properties that cause high mobility in the environment. NTO is polar and predominantly monoanionic (NTO^-) at environmental pH (pK_{a1} = 3.64 and pK_{a2} = 11.06; determined by two independent methods in this study). Nevertheless, NTO^- sorbs strongly to the carbon, Filtrasorb 400 (Freundlich coefficient $K_F = 1.26 \times 10^4$ L^n μmol^{1-n} kg^{-1} at pH 9.5). We present evidence that sorption is contributed by the interaction of NTO^- with functional groups of similar acidity on the carbon to form exceptionally strong, negative charge-assisted hydrogen bonds, (−)CAHB, written (−N–···H^+···$^-$O–), where $-N^-$ is the deprotonated N of NTO, and $^-$O– represents a deprotonated surface group. Behaviors consistent with (−)CAHB include (1) a "hump" in the pH-sorption profile centered around pH 4, where maximal complexation is expected to occur; (2) an apparent □2.4-unit upward shift in pK_{a1} due to the enhanced H-bond strength; (3) the consumption of a proton from water to form the complex; and (4) sorption suppression by competing (−)CAHB-capable solutes. Anion exchange played a minor role. The findings help advance our understanding of weak acids sorption by carbonaceous materials.

2. Shabtai I. A., Hafner, B. D., Schweizer, S. A., Höschen, C., Possinger, A., Lehmann, J., Bauerle, T. (2024). Root exudates simultaneously form and disrupt soil organo-mineral associations. *Communications Earth & Environment 5*, 699. https://doi.org/10.1038/s43247-024-01879-6

Abstract: Organic compounds exuded by plant roots can form organo-mineral associations through physico-chemical interactions with soil minerals but can disrupt existing organo-mineral associations by increasing their microbial decomposition and dissolution. The controls on these opposing processes are poorly understood, as are the chemical and spatial characteristics of these associations which may explain gain or loss of organic matter at the root-soil interface termed the rhizosphere. By pulse-labeling with ^{13}C-carbon dioxide, we found that maize root exudates increased organic matter in the rhizosphere clay size fraction and decreased organic matter in the silt size fraction, and that organic matter loss was mitigated by dry conditions. Organic matter associated with rhizosphere clay particles was linked to microbial metabolism of exudates and was more spatially and chemically heterogeneous than non-rhizosphere clay particles. Our findings show that root exudates can simultaneously form and disrupt organo-mineral associations, mediated by mineral size and composition, and soil moisture.

3. Chen, Z., Wang, C., Allabakshi, S. M., Pignatello, J. J. (2024). Hydrogen peroxide-assisted alkaline defluorination of the fumigant and potent greenhouse gas, sulfuryl fluoride: Hydrogen peroxide as a nucleophilic reagent. *Environmental Science & Technology*,

58, 19523–19532. https://doi.org/10.1021/acs.est.4c06595

Abstract: Sulfuryl fluoride (SO_2F_2, SF) is an effective and increasingly popular fumigant for treating buildings and commodities in international trade but has come under scrutiny as a potent greenhouse gas. Passage of vent gases through an alkaline spray has been proposed for scrubbing SF, but base hydrolysis is insufficiently fast and generates equal yields of fluoride and fluorosulfate, the latter of unknown environmental hazard. We report here that alkaline hydrogen peroxide (H_2O_2) markedly accelerates SF removal and gives nearly quantitative yield of fluoride, with fluorosulfate produced in less than 3.5% yield. The other major products are sulfate, peroxymonosulfate, and oxygen. The oxidation state of S was unchanged. Hydroxyl and superoxide radical scavengers had no effect on the rate. The reaction proceeds by sequential nucleophilic displacement of fluoride by hydroperoxide ion (HO2–) to form a transient diperoxysulfate species that rapidly undergoes intramolecular redox rearrangement to give sulfate and singlet oxygen. Peroxymonosulfate, produced through side reactions, can fully defluorinate SF as well, although more slowly. Two new peaks were detected in the 19F-NMR spectrum corresponding to intermediates. Fluoride can be removed conventionally, and the other products are innocuous or short-lived. Thus, H2O2-assisted alkaline defluorination promises to be an effective method for scrubbing spent SF fumes and preventing SF from reaching the atmosphere. This study highlights the benefits of H_2O_2 and peroxymonosulfate as nucleophiles in remediation chemistry.

4. Allabakshi, S. M., Srikar, P. S. N. S. R., Gomosta, S., Gangwar, R. K., Maliyekkal, S. M. (2024). Treatment of textile dyes in a photo-surface dielectric barrier discharge hybrid reactor: Unraveling the degradation mechanisms. *Chemosphere*, *16*, 143775. https://doi.org/10.1016/j.chemosphere.2024.143775

Abstract: The study demonstrates the unprecedented ability of UV-C integrated surface dielectric barrier discharge (photo-SDBD) in the rapid removal of azo (brilliant red X3B), direct (direct yellow - 44), and reactive dyes (turquoise blue H5G) in textile wastewater. The degradation mechanisms of these dyes were studied using a high-resolution mass spectrometer (HRMS), and a step-by-step reaction pathway was proposed. The BR-X3B and DY-44 dyes undergo azo bond dissociation followed by functional group rearrangement, ring opening, and formation of open chain intermediates. On the other hand, TB-H5G underwent dissociation of porphyrin moieties, side chain cleavage, and aromatic ring cleavage, generating open-chain intermediates. The photo-SDBD showed a superior ability to degrade the dyes compared to SDBD over a pH range of 4–10 and a background salt concentration of 10,000 mg L−1. Salt presence did not significantly affect the photo-SDBD performance, irrespective of the dye and salt types used. The photo-SDBD showed a 2.4–6.5 times higher degradation rate and 1.4–2.9 times higher energy yield than SDBD. The hybrid system took only 42–84 min to mineralize dyes (>99%) depending upon the complexity of the molecule, whereas SDBD required double the time than photo-SDBD. The study proves that photo-SDBD is more energy-efficient and versatile than SDBD. Moreover, the hybrid system is less susceptible to wastewater characteristics such as pH and inorganic salts, making it a potential alternative to conventional plasma and other advanced oxidation processes for treating textile wastewater.

5. Sun, R., Alinezhad, A., Altarawneh, M., Ateia, M., Blotevogel, J., Mai, J., Naidu, R., **Pignatello, J.**, Rappe, A., Zhang, X., and Xiao, F. (2024). New insights into thermal degradation products of long-chain per- and polyfluoroalkyl substances (PFAS) and their min-

eralization enhancement using additives. *Environ. Sci. Technol.* Online ahead of print. DOI: 10.1021/acs.est.4c05782.

Abstract: The products of incomplete destruction (PIDs) of per- and polyfluoroalkyl substances (PFAS) represent a substantial ambiguity when employing thermal treatments to remediate PFAS-contaminated materials. In this study, we present new information on PIDs produced in both inert and oxidative environments from five long-chain PFAS, including three now regulated under the U.S. Safe Drinking Water Act, one cationic precursor compound, and one C10 PFAS. The data did not support the generation of tetrafluoromethane from any of the studied PFAS, and carbonyl fluoride was found only from potassium perfluorooctanesulfonate (K-PFOS) when heated in air in a narrow temperature range. Oxidative conditions (air) were observed to facilitate PFAS thermal degradation and accelerate the mineralization of K-PFOS. Spectroscopic data suggest that PFAS thermal degradation is initiated by the cleavage of bonds that form perfluoroalkyl radicals, leading to organofluorine PIDs (e.g., perfluoroalkenes). In air, perfluoroalkyl radicals react with oxygen to form oxygen-containing PIDs. The mineralization of PFAS was enhanced by adding solid additives, which were categorized as highly effective (e.g., granular activated carbon (GAC) and certain noble metals), moderately effective, and noneffective. Remarkably, simply by adding GAC, we achieved >90% mineralization of perfluorooctanoic acid at 300 °C and □1.9 atm within just 60 min without using water or solvents.

GRANTS RECEIVED:

ITAMAR SHABTAI, PH.D. and **ALICE ZHOU, PH.D,** along with a collaborator from Purdue University, were awarded an Exploratory Project by the Environmental Molecular Sciences Laboratory (EMSL), a Department of Energy User Facility. The project is titled "Quantifying calcium-induced surface attachment and deposition of microbial (necro)mass on mineral surfaces in the rhizosphere." EMSL will provide **$120,000** of in-kind value to access their unique electron microscopy, spectromicroscopy, proteomics and meta transcriptomic capabilities.

Rationale: Dead microbial cells and the organic compounds that they exude (collectively, necromass), make up roughly half of soil organic matter. Physicochemical associations of necromass with minerals limit its decomposition and increase necromass carbon (C) persistence in the soil. Though, it is unclear what controls the initial attachment and colonization of mineral surfaces, a prerequisite for mineral-necromass associations. Recent work shows that calcium (Ca) may promote microbial growth, surface attachment, and subsequent mineral-necromass associations. Here, we aim to understand the mechanisms underlying Ca-driven formation of mineral-associated organic matter derived from microbial necromass (Fig. 1). To do so, we will investigate two hypothesized roles of Ca: 1) inducing microbial surface attachment lifestyles and 2) promoting physicochemical interactions between surfaces and necromass. We will test the relative importance of these two mechanisms by conducting a microcosm experiment with a high-clay and low-clay soil, where a high clay content is expected to enhance the latter mechanism more than the former. Soils will be amended with two Ca-containing amendments, wollastonite and basalt rock dust, with low and high weathering rates, respectively. The application of these amendments on agricultural soils is intensively studied for their capacity to sequester soil inorganic C as they weather and release Ca. We will grow maize and compare rhizosphere to bulk soil since plant root exudation and respiration is expected to increase

SARA NASON, PH.D. along with colleagues from Rowan University and Stockton University, received funding from the New Jersey Sea Grant Consortium. The funded project is titled "Distribution and Sources of per- and polyfluoroalkyl substances in commercial costal species in South New Jersey. The funding is for two years with a total amount of $69,944, with **$35,500** coming to CAES.

Rationale: Per- and polyfluoroalkyl substances (PFAS) are an emerging class of persistent contaminants that are widespread in the environment and are toxic to humans and animals. There is a significant data gap in the distribution of PFAS in coastal biota, although it is crucial to evaluate human PFAS exposure via seafood consumption and maintain healthy coastal fish and shellfish populations. Exposure concentration is also a vital parameter for bioaccumulation, and field surveys show that PFAS accumulation in biota is both organism- and site-specific. Quantification of habitat concentrations (i.e. surface water, sediment) and identification of possible PFAS sources in the environment are essential for monitoring and regulatory efforts. Our primary objectives are: 1) evaluate PFAS distribution in commercial coastal species in South New Jersey; 2) identify empirical relationships between bioaccumulation and organismal, ecological, and environmental parameters; 3) evaluate surface water and groundwater as sources of PFAS contamination. We propose to analyze 19 PFAS compounds in pelagic and benthic species, surface water, and sediment in two coastal settings nearby Atlantic City (Absecon-Reeds Bay and Absecon Inlet) that represent contrasting environmental conditions including sediment type, water quality, and food availability. Bioaccumulation factors will be derived using habitat and species-specific PFAS concentrations for target organisms. Statistical analysis will be performed to identify factors affecting PFAS bioaccumulation including trophic position of the species and environmental parameters measured in the coastal habitat. We will also quantify PFAS in surface water from tributaries entering Absecon-Reeds Bay and groundwater samples from surrounding wetlands and/or beaches to assess PFAS influx from those sources. Project outcomes will help decision makers understand the level of PFAS contamination in coastal biota and habitats, develop regulatory and legislative actions such as fish harvesting and consumption advisories, and manage coastal habitats including development of best stormwater management practices to reduce the effects of PFAS contamination.

AWARDS:

DRS. ZHENGYANG (PHILIP) WANG and **JOSEPH PIGNATELLO** won the 2023 Best Paper Award from the American Chemical Society's journal *Environmental Science & Technology Engineering* for their previously published paper: **Wang, Z.**, Alinezhad, A., Sun, R., Xiao, F., **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.

CAES-SPONSORED EVENT:

The 2024 Connecticut-FFA Forestry Career Development Event

On November 14, the Department of Environmental Science and Forestry hosted the Con-

necticut-FFA Forestry Career Development Event at the Lockwood Farm Pavilion. The event evaluates students' general forestry knowledge, forest mensuration, tree identification, map and compass skills, knowledge of forestry related equipment, and chainsaw troubleshooting. Forty-four students from 11 State FFA Chapters participated in this year's event, with the four-student team from the E. O. Smith School Agricultural Education Program taking first place. These students will represent the State of Connecticut in national competition at the 2024 National FFA Convention in Indianapolis, IN.

The event was organized by Emily Picard of UCONN 4-H Extension (former CAES seasonal employee) with contributions and assistance from the following individuals: Eric Hansen of Ferrucci and Walicki, LLC, Frank Cervo of the Connecticut Department of Energy and Environmental Protection, George Lyman of the USDA-APHIS, and **JOSEPH P. BARSKY** of the Department of Environmental Science and Forestry. The Connecticut Agricultural Experiment Station has hosted this event annually since 2012.

J.P. Barsky explains to the high school students how the forestry equipment identification portion of the event works.

Students engaged in forestry equipment identification.

Group photo of all competing high school students at Lockwood Pavillion.

SUSANNA KERIÖ, PH.D. accepting The American Chestnut Foundation's (TACF) inaugural Partnership Award on behalf of CAES and Lockwood Farm at the TACF Symposium organized in Cromwell, Connecticut, on October 23 - October 26. Award was presented by Christine Oglesby (left, TACF Operations Specialist) and Hannah Leeper (right, TACF Southern Regional Outreach Coordinator). Photo credit: Catherine Martini (TACF Northern Regional Outreach Coordinator).

PLANT PATHOLOGY AND ECOLOGY

LINDSAY TRIPLETT, PH.D. participated in a meeting of the soil predators working group (9 adults) (November 8) and served on the dissertation committee for the Ph.D. defense of Gabrielle Corso (November 15).

YONGHAO LI, PH.D. participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (7 adults) (November 13) and
the Northeast Plant Diagnostic Network monthly meeting via Zoom (15 adults) (November 14);
gave a talk "Selection and Care of Houseplants" at the Bradley Point Garden Club meeting in West Haven (11 adults) (November 19).

FELICIA MILLETT and **WREN PADUA** hosted a behind the scenes tour of the Plant Disease Information Office and the seed testing lab for students visiting from Quinnipiac University (10 students) (November 4); participated in the NEPDN monthly meeting (13 adults) (November 14); participated in the NPDN Data Committee monthly meeting (10 adults) (November 14); and participated in the NPDN Proficiency Committee monthly meeting (5 adults) (November 19).

RAQUEL ROCHA, PH.D. gave a tour of her nematology lab to Conservation Biology students from Quinnipiac University (10 students) (November 4) as part of their "Conservation in Action" course.

QUAN ZENG, PH.D. presented an invited oral presentation at the Symposium - Materials Innovation for Sustainable Agriculture (MISA) held at University of Central Florida through zoom (30 adults) (November 5); gave two guest lectures on Bacterial plant diseases and pathogens, at the University of Connecticut for the General Plant Pathology class (20 adults) (November 6); organized an advisory board meeting with 6 organic apple growers from New Hampshire, New York, Rhode Island and Connecticut as part of the USDA-ORG grant (7 adults) (November 12).

PUBLICATIONS:

1. Richter, M., Segal, L.M., **Rocha, R.O.**, Rokaya, N., de Queiroz, A.R., Riekhof, W.R., Roston, R.L. and Wilson, R.A. (2024). Membrane fluidity control by the Magnaporthe oryzae acyl-CoA binding protein sets the thermal range for host rice cell colonization. *PLoS pathogens*, *20*(11). DOI: 10.1371/journal.ppat.1012738

Abstract: Following leaf cuticle penetration by specialized appressorial cells, the devastating blast fungus *Magnaporthe oryzae* grows as invasive hyphae (IH) in living rice cells. IH are separated from host cytoplasm by plant-derived membranes forming an apoplastic compartment and a punctate biotrophic interfacial complex (BIC) that mediate the molecular host-pathogen interaction. What molecular and cellular processes determine the temperature range for this biotrophic growth stage is an unanswered question pertinent to a broader understanding of how phytopathogens may cope with environmental stresses arising under climate change. Here, we shed light on thermal adaptation in *M. oryzae* by disrupting the *ACB1* gene encoding the single acyl-CoA-binding protein, an intracellular transporter of long-chain acyl-CoA esters. Loss of *ACB1* affected fatty acid desaturation levels and abolished pathogenicity at optimal (26°C) and low (22°C) but not elevated (29°C) infection temperatures (the latter following post-penetration shifts from 26°C). Relative to wild type, the Δ*acb1* mutant strain

exhibited poor vegetative growth and impaired membrane trafficking at 22°C and 26°C, but not at 29°C. *In planta*, Δ*acb1* biotrophic growth was inhibited at 26°C–which was accompanied by a multi-BIC phenotype—but not at 29°C, where BIC formation was normal. Underpinning the Δ*acb1* phenotype was impaired membrane fluidity at 22°C and 26°C but not at elevated temperatures, indicating Acb1 suppresses membrane rigidity at optimal- and suboptimal- but not supraoptimal temperatures. Deducing a temperature-dependent role for Acb1 in maintaining membrane fluidity homeostasis reveals how the thermal range for rice blast disease is both mechanistically determined and wider than hitherto appreciated.

NEW STUDENTS, STAFF, AND VOLUNTEERS:

Veedaa Soltaniband is a Ph.D. candidate in Plant Biology at Université Laval, Canada, where she also earned her Master's degree. As a Research Associate at the Plant Research and Innovation Center (CRIV), she has contributed to projects investigating plant defense mechanisms and biostimulants. Her work has led to multiple publications that highlight the role of biostimulants and forest tree extracts in strengthening plant disease resistance, elucidating plant-pathogen interactions, and enhancing crop productivity and fruit quality. Currently, Veedaa is collaborating with Dr. Quan Zeng's lab, where she is developing innovative methods to identify Systemic Acquired Resistance (SAR)-inducing yeast strains from the apple flower microbiome to combat fire blight, a disease caused by *Erwinia amylovora*.

VALLEY LABORATORY

DEWEI LI, PH.D., gave a presentation 'A *Scytalidium*-like indoor fungus revealing polyphyletic relationships in *Scytalidium*' at Nanjing Forestry University (85 participates) (November 5); made a field trip to rainforest in Xishuangbanna, Yunnan province to collect microfungal specimens with Drs. Li-Hua Zhu and Hui Sun, plant pathologists of Nanjing Forestry University and visited Prof. Yun-Hong Tan, Tropical Botanic Garden in Xishuangbanna to discuss potential collaboration (November 7- November 11).

JATINDER S AULAKH, PH.D. attended the first advisory committee meeting of Ms. Ritu Mohanpuria, PhD Student, UCONN (November 8) and submitted a manuscript entitled "First report of glyphosate-resistant common waterhemp (*Amaranthus tuberculatus*) in New York" to Weed Technology Journal (November 9); and reviewed a manuscript entitled "Evaluation of the efficiency of capsule herbicide injection for controlling invasive *Gleditsia triacanthos* L. in a riparian forest" for Invasive Plant Science and Management Journal (November 14); and submitted a manuscript entitled "Ornamental Plant Safety and Weed Control with Indaziflam" to Weed Technology Journal (December 6).

CAROLE CHEAH, PH.D., who was interviewed by film maker and producer, Darcy Dennett, Firefly Film Works on Jan 29, 2024, on biological control of hemlock woolly adelgid at Peoples State Forest for the 100th anniversary documentary, attended the premiere to the public on October 5, 2024 at Mathies Grove, Peoples State Forest in Barkhamsted (250); had an information booth on HWA biological control in CT and other CAES programs at the 100th Anniversary Celebration for Peoples State Forest on Oct 6 (800); assessed HWA at a private lake community at Doolittle Lake, in Norfolk, Oct 9 (2); gave a presentation on saving hemlocks and HWA biological control at the Simsbury Land Trust Annual General Meeting, at the Massaco Plantation, Simsbury Historical Society, Oct 10 (30); Gave a presentation on "30 years of biological control of hemlock woolly adelgid in CT" at a regional state and federal forest health meeting at the CAES New Haven on Nov. 6 (35); led a tour to assess HWA at a private lake association in Hartland, November 20 (4); had an article "Saving Connecticut's Hemlocks" published in Connecticut Woodlands Fall 2024 issue: https://ctwoodlands.org/our-work/publications/ct-woodlands-magazine/

RICHARD S. COWLES, PH.D. spoke to the Mansfield Garden Club about "Exotic Invasive Insects" (20 participants) (Oct. 17) and to the Cornell Club of Fairfield County on the same topic in Shelton, CT (15 participants) (Oct. 19); participated in a Zoom discussion on potential legislation to ban neonicotinoids, sponsored by the Norwalk River Watershed Association, American Bird Conservancy, Audubon, and others (10 participants) (November 18); participated with the Connecticut Christmas Tree Growers Association Zoom meeting, discussing the effects of the drought (15 participants) (November 19); presented "Beech leaf disease in Connecticut: biology and hope for the future," to the North Haven Neighborhood Watch Association, (20 participants) (November 19); was interviewed by Jesse Leavenworth for a story about beech leaf disease, (November 20).

PUBLICATIONS:

1. Hyde K, Noorabadi MT, Thiyagaraja V, He MQ, Johnston PR, Wijesinghe SN, Armand A, Biketova AY, Chethana KWT, Erdoğdu M, Ge ZW, Groenewald JZ,

Hongsanan S, Kušan I, Leontyev DV, **Li DW** et al. (2024). The 2024 Outline of fungi-and fungus-like taxa. Mycosphere 15(1), 5146–6239. MYCOSPHERE_15_1_25.pdf

Abstract: With the simultaneous growth in interest from the mycological community to discover fungal species and classify them, there is also an important need to assemble all taxonomic information onto common platforms. Fungal classification is facing a rapidly evolving landscape and organizing genera into an appropriate taxonomic hierarchy is central to better structure a unified classification scheme and avoid incorrect taxonomic inferences. With this in mind, the Outlines of Fungi and fungus-like taxa (2020, 2022) were published as an open-source taxonomic scheme to assist mycologists to better understand the taxonomic position of species within the Fungal Kingdom as well as to improve the accuracy and consistency of our taxonomic language. In this paper, the third contribution to the series of Outline of Fungi and fungus-like taxa prepared by the Global Consortium for the Classification of Fungi and fungus -like taxa is published. The former is updated considering our previous reviews and the taxonomic changes based on recent taxonomic work. In addition, it is more comprehensive and derives more input and consensus from a larger number of mycologists worldwide. Apart from listing the position of a particular genus in a taxonomic level, nearly 1000 notes are provided for newly established genera and higher taxa introduced since 2022. The notes section emphasizes on recent findings with corresponding references, discusses background information to support the current taxonomic status and some controversial taxonomic issues are also highlighted. To elicit maximum taxonomic information, notes/taxa are linked to recognized databases such as Index Fungorum, Faces of Fungi, MycoBank and GenBank, Species Fungorum and others. A new feature includes links to Fungalpedia, offering notes in the Compendium of Fungi and fungus-like Organisms. When specific notes are not provided, links are available to webpages and relevant publications for genera or higher taxa to ease data accessibility. Following the recent synonymization of Caulochytriomycota under Chytridiomycota, with Caulochytriomycetes now classified as a class within the latter, based on formally described and currently accepted data, the Fungi comprises 19 Phyla, 83 classes, 1,220 families, 10,685 genera and ca 140,000 species. Of the genera, 39.5% are monotypic and this begs the question whether mycologists split genera unnecessarily or are we going to find other species in these genera as more parts of the world are surveyed? They are 433 speciose genera with more than 50 species. The document also highlights discussion of some important topics including number of genera categorized as incertae sedis status in higher level fungal classification. The number of species at the higher taxonomic level has always been a contentious issue especially when mycologists consider either a lumping or a splitting approach and herein we provide figures. Herein a summary of updates in the outline of Basidiomycota is provided with discussion on whether there are too many genera of Boletales, Ceratobasidiaceae, and speciose genera such as Colletotrichum. Specific case studies deal with Cortinarius, early diverging fungi, Glomeromycota, a diverse early divergent lineage of symbiotic fungi, Eurotiomycetes, marine fungi, Myxomycetes, Phyllosticta, Hymenochaetaceae and Polyporaceae and the longstanding practice of misapplying intercontinental conspecificity. The outline will aid to better stabilize fungal taxonomy and serves as a necessary tool for mycologists and other scientists interested in the classification of the Fungi.

JOURNAL ARTICLES APPROVED NOVEMBER 2024

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