

Station News

The Connecticut Agricultural Experiment Station
Volume 12 Issue 7 | July 2022



This Issue

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.



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The Connecticut Agricultural Experiment Station

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ADMINISTRATION

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DR. JASON C. WHITE along with **DR. SARA NASON** and **DR. NUBIA ZUVERZA-MENA** participated in a Zoom call with collaborators at Yale University and the University of Minnesota to discuss progress on a joint NIEHS grant (June 1); hosted a Zoom call with collaborators at the African Materials Research Society to discuss collaborative grant proposals (June 1); participated in the weekly all-hands Zoom call for the NSF Center for Sustainable Nanotechnology (June 1, 29); along with Department of Analytical Chemistry staff met with Green Empire Therapeutics to discuss the CT Adult Use Cannabis program (June 2); gave a remote presentation titled “Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition, and Yield” to the University of Vienna Centre for Microbiology and Environmental Systems Science (June 2); along with **DR. SARA NASON** participated in the monthly call of the PFAS Testing Laboratory work group (June 3); hosted the CAES Retiree luncheon at Lockwood Farm (June 3); participated in a PhD committee meeting by Zoom with a graduate student at the University of Wisconsin (June 3); participated in the monthly Laboratory Preparedness meeting at the CT Department of Public Health Laboratory in Rocky Hill CT (June 6); participated in a Zoom call with collaborators at the University of New Haven regarding a joint grant proposal (June 6); attended the 26th Annual Green Chemistry & Engineering Conference in Reston, VA and presented a lecture titled “Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition, and Yield” (June 6-8); along with **DR. CHRISTIAN DIMKPA** participated in a US TAG to ISO/TC 229 Zoom meeting and discussed the new project - Toxicity assessment of manufactured nanomaterials in soils using plant *Arabidopsis thaliana* (June 9); hosted a Zoom call with Andrea Brunelli of University Ca ‘Foscari of Venice Italy to discuss collaborative research (June 10); hosted a Zoom call with Dr. Nathan Bossa of Duke University to discuss available CAES post-doctoral positions (June 10); along with **DR. QUAN ZENG** and **DR. SUSANNA KERIÖ** participated in a Zoom call with Dr. Tariq Sofi and colleagues of Skuast-Kashmir to discuss an upcoming research stay at CAES (June 13); participated in the monthly FDA LFFM Zoom calls for the Human and Animal Food and the Food Defense programs (June 13); attended the TechConnect World Innovation Conference and Expo in Washington DC and presented a lecture titled “Tuning Agrochemical Chemistry at the Nanoscale to Enhance Stress Tolerance, Crop Nutrition, and Yield” (June 13-15); participated in an organizational call for the 2023 Annual International Phytotechnologies Society meeting (June 16); participated in a Teams call with Connecticut Department of Consumer Protection staff to discuss sample collection for the FDA LFFM Human Food Program (June 17); attended the 2022 Nanoscale Science and Engineering for Agriculture and Good Systems Gordon Research Conference at Southern New Hampshire University Manchester NH and gave a presentation titled “Convergence of Nanotechnology with Food and Agriculture”; also served as a Discussion Leader and co-presented two posters titled “AFRI 2021-67021-34001: Biodegradable polymer nanocomposites for controlled release and targeted delivery of phosphorus during plant growth” and “AFRI 2020 67022 32416 Nanoscale sulfur for plant nutrition, disease suppression, and food safety” as part of the USDA NIFA Nanotechnology Program annual review (June 19-24); along with **DR. NUBIA ZUVERZA-MENA** hosted a Zoom call with collaborators at the University of Texas El Paso and the University of Rhode Island to discuss a joint grant proposal (June 23); hosted a tour of CAES programs and facilities as part of the 2022 International Festival of Arts and Ideas (June 23); participated in a Zoom call with collaborators from the University of Delaware to discuss a collaborative research proposal (June 27);

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hosted the monthly CAES J-visa recipient meeting (June 27); participated in a Zoom call with collaborators at Nanyang Technological University in Singapore to discuss collaborative research (June 28); spoke to reporter Brian Scott Smith as part of a new CAES podcast on nanotechnology and agriculture (June 28); along with **DR. SHITAL VAIDYA**, **DR. CHRISTIAN DIMKPA** and **DR. WADE ELMER** hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA research project (June 28); gave a presentation for the CT Department of Public Health Toxi-Rounds meeting titled “Hemp and Adult Use Cannabis Testing at The CAES” (June 30); and along with **DR. NUBIA ZUVERZA-MENA** and **DR. WASHINGTON DA SILVA** hosted a Zoom call with collaborators at Louisiana State University to discuss collaborative research (June 30).

Experiment Station Update



Dr. Christian Dimkpa (left), head of the Department of Analytical Chemistry and Dr. Jason White (right), director of CAES, with a new instrument purchased for \$598,000 to conduct PFAS analysis in food, feed and biosolids/fertilizer, as well as to support the FDA's pesticide analysis program and the state's Adult Use Cannabis regulatory testing program.

The Connecticut Long-Term Wild Bee Monitoring Program

Wild native bees are a very diverse group of insects, with 378 species in Connecticut. Despite their role as important pollinators, most go unnoticed and live in the background of our lives. There is evidence of decline in certain species of bees in Connecticut, some species are stable, and other bee species are increasing in abundance. However, more records are needed for many to accurately assess their status. The Connecticut Long-Term Wild Bee Monitoring Program was created to learn more about where wild bee species live in Connecticut, and to identify threats to their survival in our landscape.

Addressing Phosphorus Fertilizers To Reduce Environmental Problems

Phosphorus (P) is the second most important crop nutrient after nitrogen. However, P global stocks are finite, and plants are severely challenged as to how they use P in fertilizers. More than 70% of applied P is lost due to surface run-

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off, leaching, or through binding to other soil components. Scientists at the CAES are working to address low P use efficiency by plants through developing improved P-fertilizer products that permit the use of lower P rates and limit P losses, thereby improving crop productivity per unit of fertilizer applied.

Soil Predators for Plant Health

Healthy soils are filled with microscopic organisms called protists. Some protists feed on detrimental bacteria or stimulate the activity of beneficial ones, which can help plants grow and resist pathogens and heat stress. Researchers at CAES are working to identify which protists are most important in the plant environment, and how they encourage the growth of certain bacteria, to determine if protists could be good bio-fertilizers in the future.

Cannabis sativa: An Emerging Crop in Connecticut

In December of 2018, the farm bill legalized the growing of hemp on a

national level. This created an opportunity for local growers to market *Cannabis sativa* with low level THC across state lines. Within the state of CT, the Department of Agriculture has regulatory authority over hemp growing, while the Department of Consumer Protection (Drug Control) maintains authority over *Cannabis sativa* with high levels of THC. The CAES is working with both agencies to provide the analytical testing services required to differentiate *Cannabis sativa* that is legal nationally (i.e., hemp) from that which is legal on a state level (i.e., adult use cannabis). The only reliable method for determining the legal status of cannabis is through laboratory testing. In addition, CAES is evaluating hemp varieties for compliance to the THC testing limit.

Beech Leaf Disease: A New Disease Threatening Two Iconic Species of CT Forests and Landscapes

Beech Leaf Disease (BLD), caused by the foliar nematode, *Litylenchus crenatae mccannii*, was first discovered

Connecticut Gardener

Publications

1. White, J. C., Zuverza-Mena, N. and Elmer, W. (2022). From nanotoxicology to nano-enabled agriculture: Following the science at The Connecticut Agricultural Experiment Station (CAES) *Plant Nano Biology*, 1. DOI: [10.1016/j.plana.2022.100007](https://doi.org/10.1016/j.plana.2022.100007)

Abstract: The Connecticut Agricultural Experiment Station was founded in 1875 and has a 147-year history of “Putting Science to Work for Society.” No program exemplifies that core mission more than the Station’s 12-year effort on nanotechnology. Although this runs the risk of appearing self-serving by being a perspective piece that cites too much of our work, we feel it is an interesting story and is worth telling. CAES work with “nano” first started in the realm of nanotoxicology, evaluating the negative effects of these potential emerging contaminants on crop species and in agricultural systems. However, as evidence began increasing that select nanomaterials at appropriate doses and under certain conditions could actually convey some benefit to plant species, work in nano-enabled agriculture began. With an increasing population and a changing climate driving food insecurity, CAES has developed a robust program on the safe and sustainable application of nanotechnology for food production and preservation. Initiatives include novel strategies for crop protection against a range of pathogens; enhancing crop tolerance abiotic stresses such as drought, salinity and toxic metal contamination; elevating rates of photosynthesis; developing biopolymer-based delivery systems for agrochemicals with much greater efficiency and efficacy; and novel food nanoscale strategies for food preservation. By collaborating with over 30 domestic and international institutions, CAES has and will continue to lead and participate in efforts to combat global food insecurity.

2. Zhao, Z., Xu, T., Pan, X., White, J. C., Hu, X., Miao, Y., Demokritou, P., Ng, K. W. (2022). Sustainable nutrient substrates for enhanced seedling development in hydroponics. *ACS Sus. Chem. Eng.* 10(26), 8506–8516.

Abstract: Sustainable agriculture can be achieved by recycling and repurposing organic wastes for high value applications. Keratin and cellulose are two natural biopolymers which are plentiful in biowastes: the former in keratinous wastes such as hair and poultry feathers while the latter in plant wastes such as wood shavings and vegetable trimmings. In this study, these waste-derived biopolymers are converted into bioactive nutrient substrates that can support crop development in hydroponics culture systems. Keratins extracted from human hair, and cellulose nanofibers obtained from wood pulp were fabricated into composite substrates by freeze drying a “one-pot” mixture. The substrates exhibited microporous structure (~90% porosity, ~100-200 μm pore size) and superior hydrophilicity, which contribute to excellent water uptake capacity (~40 times its own weight). The substrates were mechanically resilient in aqueous conditions due to secondary crosslinking between keratins and cellulose. The keratin-cellulose substrates not only serve as a physical carrier to support seed germination and seedling development, but they also function as a macronutrient supply through the degradation of keratin. In addition, the substrate can be further enhanced into advanced nutrient delivery platforms by the incorporation and controlled release of carbon dots and micronutrient-doped carbon dots. Functional experiments using model plant *Arabidopsis* and crops including Pak Choy and Arugula indicated that the keratin-cellulose composite substrates have the potential to enhance seed germination and seedling development in comparison to conventional, inert substrates which are less environmentally sustainable. This study demonstrates the feasibility of recycling and repurposing keratinous and cellulosic wastes to provide a novel solution for nutrient delivery to crops that minimizes nutrient waste, maximizes efficiency of nutrient delivery and is environmentally sustainable.

3. Yan, X., Pan, Z., Chen, S., Shi, N., Bai, T., Dong, L., Zhou, D., White, J. C., and Zhao, L. (2022). Rice exposure to silver nanoparticles in a life cycle study: Effect of dose responses on grain metabolomic profile, yield, and soil bacteria. *Environ. Sci.: Nano*, 9, DOI: [10.1039/D2EN00211F](https://doi.org/10.1039/D2EN00211F)

Abstract: Here, we conducted a life-cycle study with rice grown in soil amended with different concentrations (1 and 10 mg/kg) of AgNPs for 120 days. The lower dose of AgNPs promoted rice tillering, resulting a significant increase in grain yield (42.3%) and aerial biomass (30.1%), while higher dose of AgNPs significantly decreased grain yield and biomass. Inductively coupled plasma-mass spectrometry (ICP-MS) data reveal that Ag was accumulated by roots and translocated into shoots. Importantly, Ag was detected in the rice seeds, but was primarily mainly located in rice hull and bran, not reaching edible tissue (polished rice), suggesting a low dietary risk to human health. Gas chromatography-mass spectrometry (GC-MS) based metabolomics show that the lower dose of AgNPs altered the grain metabolome, increasing the abundance of functional metabolites and decreasing several primary metabolites (TCA cycle intermediates). In rice grain, the content of Fe and Mo was significantly decreased by 24.7% and 31.8%, respectively, upon exposure to 1 mg/kg AgNPs, indicating a trade-off between grain yield and mineral nutrient content. In addition, AgNPs at 1 mg/kg caused a significant increase in several putative plant-beneficial taxa, including Frankiales, Rhizobiales, Chitinophagales, and Saccharimonadia. Taken together, the data show that AgNPs at 1 mg/kg is generally beneficial to plant and associated soil microbes, although additional work on material properties and amendment regimen is needed to optimize the crop benefits and minimize potential negative consequences on grain nutrient content

4. Azeem, A., Adeel, M., Ahmad, M. A., Shakoor, N., Zain, M., Yousef, N., Zhao, Y., Azee, K., Zhou, P., White, J. C., Rui, Y. (2022). Micro and nanoplastics interactions with plant species: Trends, meta-analysis, and perspectives. *Environ. Sci. Technol. Letters*, 9(6), 482–492.

Abstract: The ubiquitous presence of nano plastics (NPx) and micro plastics (MPx) in the environment has been demonstrated, and as such, the exposure scenarios, mechanisms of plant response, and ultimate risk must be determined. However, the current literature reports ambiguous outcomes and provides limited mechanistic insight into critical governing processes. Here, we performed a meta-analysis of the most recent literature investigating the effect of MPx/NPx on plant species under laboratory and field conditions so as to evaluate the current state of knowledge. Toxic effects of MPx/NPx exposure in plants varies as a function of plant species and interestingly, generally non-significant responses are reported in staple crops. We found that NPx (<100 nm) more negatively affected plant development parameters (n=341) (n is total number of observations), photosynthetic pigments (n=80), and biochemical indicators (n=91) than did MPx (>100 nm). Surprisingly, NPx exposure exhibited negligible effects on germination rate (n=17), although root morphology (n=45) was negatively affected. Alternatively, MPx negatively affected (14%) germination (n= 27) and generally exhibited non-significant effects on root morphology (n=64). The effect of MPx/NPx on plant health decreases with increasing exposure time. No specific trends were evident for the production of biochemical enzymes as related to MPx/NPx concentration or size. Future work should include crop full life cycle studies to highlight the accumulation of MPx/NPx in edible tissues and also to investigate the potential trophic transfer of MPx/NPx. Furthermore, we provide a framework for additional investigative work to address these and other knowledge gaps and to enable accurate assessment of the fate and risk of these materials to environmental and human health.

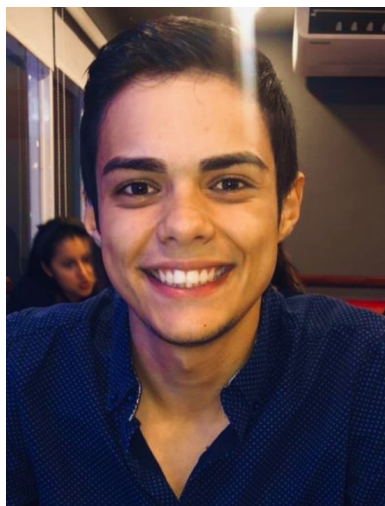
5. Ahmed, T., Noman, M., Jiang, H., Shahib, M., Ma, C., Wu, Z., Nazir, M. M., Alia, A., White, J. C., Cheng, J., Li, B. (2022). Bioengineered chitosan-iron nanocomposite controls bacterial leaf blight disease by modulating plant defense response and nutritional status of rice (*Oryza sativa* L.). *Nano Today*. DOI: [10.1016/j.nantod.2022.101547](https://doi.org/10.1016/j.nantod.2022.101547)

Abstract: Rice production is severely affected by the bacterial pathogen, *Xanthomonas oryzae* pv. *oryzae* (Xoo), which causes bacterial leaf blight (BLB) disease. Nano-enabled strategies have recently attracted attention as a sustainable platform to improve crop nutrition and protection. Here, we report the bioengineering of chitosan-iron nanocomposites (BNCs) along with their *in vitro* and *in vivo* bactericidal activity against Xoo. In addition, the impact of BNCs on the endophytic microbiome of healthy and BLB diseased rice was evaluated using a high-throughput sequencing technique. The BNCs were spherically shaped with an average size of 86 nm. *In vitro* antibacterial assays showed that BNCs significantly inhibited biological functions of the pathogen (*viz.*, growth, motility, and biofilm formation) at 250 $\mu\text{g mL}^{-1}$ concentration as compared with respective control. A greenhouse experiment demonstrated that foliar exposure to 250 $\text{mg}\cdot\text{L}^{-1}$ BNCs significantly reduced the BLB disease incidence (67.1%) through modulation of antioxidant enzymes *viz.*, superoxide dismutase (49.2%), peroxidase (38.8%) and ascorbate peroxidase (53.4%); BNCs amendment also improved photosynthesis efficiency by promoting production of total chlorophyll (43.2%) and carotenoids contents (60.0%), and the nutritional profile of rice plants as compared with untreated diseased control. Moreover, BNCs-induced disease resistance response corresponded to an increase in transcript level of defense-related genes, such as OsPRs, OsSOD and OsAPX, in rice plants. High-throughput sequencing results revealed that BNCs amendment decreased the relative abundance of *Xanthomonas* (87.5%) by reshaping the phyllospheric and root-endophytic bacterial community of rice. In addition, BNCs increased the bacterial community diversity in healthy and diseased plants; significant increases in relative abundance of *Ochrobactrum*, *Allorhizobium*, *Methylobacterium*, *Devosia*, *Pseudolabrys*, *Sphingomonas* and *Bradyrhizobium* in BNCs-treated diseased and healthy plants was noted. These findings demonstrate that BNCs have potential to serve as non-toxic, sustainable and highly efficient alternative for plant disease management.

DR. CHRISTINA ROBB participated in the FDA FoodShield Rapid Response Team monthly call (June 2); attended executive committee meetings for the Eastern Analytical Symposium (EAS) (June 6, 13, 20, 27); participated as a subject matter expert for the APHL Laboratory Chemistry Framework (LCF) Chemistry track in defining the knowledge, skills and abilities and constructing competencies for an analytical chemist performing advanced liquid chromatography (LC) (June 6, 7); attended the APHL Food Chemistry workgroup monthly meeting (June 7); attended the Flanders LEARN committee meeting (June 9); attended the virtual GC Symposium (June 10, 17, 24).

DR. SHITAL VAIDYA attended the Gordon Research Conference on Nanoscale Science and Engineering for Agriculture and Food Systems Southern New Hampshire University during June 18 - 24, 2022, where she presented a poster on “Biodegradable polymer nanocomposites for controlled release and targeted delivery of phosphorus during plant growth”. Estimated Session Attendance was 115. Dr. Vaidya subsequently led a Discussion Session on “Nanotechnology Applications as carrier”, with 42 participants.

DR. YI WANG attended the Gordon Research Conference on Nanoscale Science and Engineering for Agriculture and Food Systems Southern New Hampshire University during June 18 - 24, 2022. She presented a poster on Nanoscale Sulfur for Plant Nutrition, Disease Suppression, and Food Safety. Estimated Session Attendance was 140. Dr. Yi subsequently led a Discussion Session on Nanotechnology Implications in Agroecosystems, with 45 participants.



MR. KEVIN IVÁN RODRÍGUEZ OTERO joined the Department of Analytical Chemistry (DAC) from the University of Puerto Rico in Cayey as an intern under the auspices of the Center for Sustainable Nanotechnology. He is currently in the fifth year of a bachelors program in biology and plans to graduate next year, in May 2023. He arrived in Connecticut on Sunday the 5th of June for his first travel and internship experience. Kevin will be at DAC for 70 days, during which period he hopes to develop new laboratory techniques, improve techniques he learned in college, obtain hands on experience on an innovative scientific project and try to absorb as much information as possible to prepare himself for a competitive future. At DAC Kevin will be involved in ongoing work on elucidating the effects of

various types of fertilizer nanomaterials on plant growth, health, nutrient accumulation and overall performance. Kevin hopes to learn basic laboratory techniques such as laboratory safety, pipetting, preparing petri dishes and the handling of dangerous materials. In addition, he would like to learn how to digest and analyze samples, how to use equipment like the ICP and nitrogen analyzer, the processes of growing and planting treated plants, and a broader view of nanoparticles as a tool to improve the productivity and longevity of agricultural plants



MS. AALIYAH WALKER is a student at Central Connecticut State University. She joined the Analytical Chemistry Department in June as an intern under the Plant Health Fellows Program. She is working on the subject of emerging contaminants, specifically PFAS. There is an expanding interest in PFAS, a group of chemicals that are present almost everywhere and known to cause harm to animals and people. PFAS have a unique chemical makeup allowing them to stay intact in the environment for years amplifying their potential harm. At the station Aaliyah will be testing the levels of PFAs in soil samples provided from Maine, to understand current contamination with the end goal for remediation. She hopes to get a better understanding of the processes of testing for possible contaminants as well as familiarity with several instruments in the lab that help analyze samples and to use the knowledge gained from CAES to better her skills as a future scientist.



MS. EMILIA KENDRICK Joined the Station in June as an intern under the Plant Health Fellows Program in partnership with Southern Connecticut State University (SCSU). She is going into her senior year of college at SCSU for her Bachelor of Science. At CAES she is working primarily with **Dr. Nubia Zuverza-Mena** on a hydroponics experiment involving the contamination of macrocosms with arsenic and boscalid, microplastics of different sizes, and combinations of arsenic, boscalid and microplastics. The goal of the study is to determine how these contaminants interact with each other to affect their respective uptake by plants. During her time at CAES, Emilia is hoping to learn how to use the instruments and interpret the data from them. She is looking to see how state labs operate and the methods that are used to analyze samples from the public and from research.



MS. SUMAYA MAHAD is from the University of Minnesota and joined the Station in June as an intern under the auspices of the Center for Sustainable Nanotechnology. She is working on biodegradable polymer nanocomposite for the efficient and sustainable supply of phosphorus during plant growth. She hopes to gain an opportunity to apply the skills learned from CAES, such as the usage of several instruments and the processes involved in research, to help her become a better scientist. By working at the station, she looks forward to furthering her research capabilities and expanding her knowledge.



MR. OLIVER MACKINNON became a part of the Analytical Chemistry Department on 6/07/2022 as an intern under the Plant Health Fellows Program. Oliver is a student at UConn going into his sophomore year. He will be working on aiding with the remediation of a retired air force base in Maine by analyzing a set of PFAS samples sent to CAES from a native tribe. While here, Oliver will be learning how to manage and analyze PFAS samples, gaining experience using different equipment in the process. He hopes to learn how the Department of Analytical Chemistry functions and learn from the processes that they use to help him in his future career.

PUBLICATIONS

1. Wang, Y., Deng, C., Elmer, W., Dimkpa, C. O., Sharma, S., Navarro, G., Wang, Z., LaReau, J., Steven, B. T., Wang, Z., Zhao, L., Li, C., Dhankher, O. P., Gardea-Torresdey, J., Xing, B., White, J. C. (2022). Therapeutic delivery of nanoscale sulfur to suppress disease in tomatoes: in vitro imaging and orthogonal mechanistic investigation. *ACS Nano*. DOI: 10.1021/acsnano.2c04073

Abstract: Nanoscale sulfur can be a multifunctional agricultural amendment to enhance crop nutrition and suppress disease. Pristine (nS) and stearic acid coated (cS) sulfur nanoparticles were added to soil planted with tomatoes (*Solanum lycopersicum*) at 200 mg/L soil and infested with *Fusarium oxysporum*. Bulk sulfur, ionic sulfate, and healthy controls were included. Orthogonal end points were measured in two greenhouse experiments, including agronomic and photosynthetic parameters, disease severity/suppression, mechanistic biochemical and molecular end points including the time-dependent expression of 13 genes related to two S bioassimilation and pathogenesis-response, and metabolomic profiles. Disease reduced the plant biomass by up to 87%, but nS and cS amendment significantly reduced disease as determined by area-under-the-disease-progress curve by 54 and 56%, respectively. An increase *in planta* S accumulation was evident, with size-specific translocation ratios suggesting different uptake mechanisms. In vivo two-photon microscopy and time-dependent gene expression revealed a nanoscale-specific elemental S bioassimilation pathway within the plant that is separate from traditional sulfate accumulation. These findings correlate well with time-dependent metabolomic profiling, which exhibited increased disease resistance and plant immunity related metabolites only with nanoscale treatment. The linked gene expression and metabolomics data demonstrate a time-sensitive physiological window where nanoscale stimulation of plant immunity will be effective. These findings provide mechanistic understandings of nonmetal nanomaterial-based suppression of plant disease and significantly advance sustainable nanoenabled agricultural strategies to increase food production.

ENTOMOLOGY

DR. GOUDARZ MOLAEI was interviewed by reporters for the Connecticut Post (June 3), WTNH (June 08), Fox 61 (June 8), WSHU/NPR (June 10), Journal Inquirer (June 14), and WTIC-AM Radio (June 16) on Powassan virus, ticks and tick-borne disease activities, infections and coinfections in ticks; spoke to visitors about the tick and tick-borne pathogen surveillance and tick testing program and provided a tour of the CAES Tick Testing Laboratory (CAES-TTL) as part of the Arts and Ideas Festival (June 16, 24); and directed the CAES-TTL where 840 submissions were processed and blood-engorged adult blacklegged ticks were tested for Lyme disease, babesiosis and anaplasmosis, and results were reported.

DR. VICTORIA SMITH participated in a webinar on beech leaf disease, presented by the Maine Department of Agriculture, Conservation, and Forestry (June 17); was interviewed by Brendan Crowley of the CT Examiner, about spotted lanternfly (June 24); and was interviewed by Robert Miller of the Danbury News-Times, about the spongy moth outbreak in Litchfield County (June 27).

DR. PHILIP ARMSTRONG spoke to a reporter from CT public radio about recent changes in mosquito species composition and abundance that were identified after analyzing more than 20 years of statewide surveillance data (June 1); and spoke to visitors about the mosquito trapping and testing program as a part of the Arts and Ideas Festival (June 16, 24).

MS. ANGELA BRANSFIELD participated in a Yale's Biosafety Committee meeting (virtual) (June 16).

MR. MARK CREIGHTON spoke on Straw Bale Gardening in support of pollinators at Stonington Vineyard hosted by The Stonington Land Trust (June 14).

MS. KATHERINE DUGAS spoke to visitors about her work at the CAES Insect Information Office as part of the Arts and Ideas Festival (June 16, 24).

DR. MEGAN LINSKE participated in a networking call with the Wildlife Society (TWS) Diversity, Equity, and Inclusivity (DEI) committee as an active member (June 20); held a meeting with Dr. Richard Poche of Genesis Labs Inc. to provide an update on the collaborative novel rodent targeted tick treatment project (June 14); and participated in TWS Leadership Institute Mentoring Meet and Greet for the Class of 2022 (June 28).

DR. GALE E. RIDGE was interviewed by reports from NPR's Science Friday (June 6), Hartford Courant (June 7), NBC TV News (June 13), Channel 8 (June 14), News 12 CT (June 14), Chaz and AJ morning radio (June 15), Fox 61 (June 17) on Asian jumping worms; was interviewed by a reporter from Republican American Newspaper on spongy moth; was interviewed by Chaz and AJ morning radio on the Asian longhorned ticks (June 23); presented a talk about the worms to the Big Pond Association in Otis, MA (June 18); along with Dr. Li spent the lunch hour talking with CAES interns about careers in biological sciences (June 20); spoke to visitors about her work at the CAES Insect Information Office as part of the Arts and Ideas Festival (June 16, 24).

DR. CLAIRE RUTLEDGE helped to administer the oral examination portion of the Tree Protection Exam, Lockwood Farm, Hamden, CT (June 8); trained three volunteers for the citizen-scientist program, The Wasp Watchers, Killingworth, Portland, CT (June 29, 30); and contributed to a chapter, “*Toward Successful Biological Control of the Invasive Emerald Ash Borer in the United States*” (Jian J. Duan, J. J., Gould, J. R., Slager, B. H., Quinn...**Rutledge**, C. E., et al.) in the book, “*Contributions of Classical Biological Control to the U.S. Food Security, Forestry, and Biodiversity*” (Eds. Van Driesche, R. G., Winston, R. L., Perring, T. M., and Lopez, V. M., 2022).

MR. JOHN SHEPARD was interviewed by Gautier Dubois about the effect of West Nile virus on birds in 1999 and 2000 and mosquito trapping and testing for West Nile virus for a documentary on epizootic viruses for the French production company Kwanza (June 29); presented a virtual talk, “Surveillance for Mosquito-Borne Viruses in Connecticut” for the weekly Epidemiology Program Meeting Group at CTDPH (June 30); provided updates from the CT Mosquito Trapping and Arbovirus Surveillance Program as part of Arbovirus Situational Awareness conference calls organized by the Northeast Regional Center for Excellence in Vector-Borne Diseases (June 6, 27).

MS. TRACY ZARRILLO led a tour of the “Garden in the Park” in New Haven focusing on bee species encountered and plant/pollinator relationships for The Hunneebee Project (June 4); and presented a virtual talk titled “Bumble Bees of Connecticut: Rare, Common, and Declining Species” sponsored by the Glastonbury Pollinator Pathway (June 9).

DR. KIRBY C. STAFFORD III retired as Chief Scientist and State Entomologist effective June 1, and as an Emeritus Scientist presented a talk on ticks and prevention of tick-borne diseases for a virtual vector-borne disease panel at the annual meeting of the County, State, Territorial Epidemiologists (June 19); and led and participated in meetings of the writing group for the Tick-Borne Disease Working Group (June 2, 9, 23).

MANUSCRIPTS PUBLISHED

Editor’s Choice Article:

1. **Goudarz Molaei***, Lars M. Eisen, Keith J. Price, Rebecca J. Eisen. (2022). Range Expansion of Native and Invasive Ticks, a Looming Public Health Threat. *The Journal of Infectious Diseases*. <https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiac249/6613411?login=true>

Abstract: Native and invasive tick species pose a serious public health concern in the United States. Range expansion of several medically important tick species has resulted in an increasing number of communities at risk for exposure to ticks and tickborne pathogens.

2. **Goudarz Molaei*** and Theodore Andreadis. (2022). The Connecticut Center for Vector Biology & Zoonotic Diseases: A Long History of Research Partnership and Outreach in Public Health Entomology. *Wing Beats*, 33, 30-34. https://cdn.ymaws.com/www.mosquito.org/resource/resmgr/docs/publications/wingbeats/summer_2022_44_pages.pdf

MANUSCRIPTS SUBMITTED

1. Noelle Khalil and **Goudarz Molaei***. Exacerbating Public Health Challenges of Ticks and Tick-borne Diseases. *The Habitat*. Submitted June 13, 2022.

NEW STUDENTS, STAFF, AND VOLUNTEERS



MS. DANA CRANDALL became the new State Survey Coordinator (SSC) in June 2022. She is from Richmond, Rhode Island and graduated from the University of Rhode Island with a bachelor's degree in Biological Sciences. During her education at URI, she worked in the Biological Control Laboratory where she assisted in surveying and conducting research for the biological control of various invasive plants and insects across Rhode Island.



MS. RAFFAELA (ELLA) NASTRI is a student at the University of Connecticut majoring in Ecology and Evolutionary biology and minoring in Italian. She joins the Department of Entomology as a seasonal employee to work with **Dr. Victoria Smith, Ms. Gerda Magana, and Ms. Dana Crandall** on insect pest surveys in vineyards. She has previously assisted with research at UConn measuring insects' critical thermal maximum to help predict how they will respond to climate change.



Mr. Niklas Lowe is a seasonal assistant to the CAPS Coordinator in the Department of Entomology. He is a graduate student at Central Connecticut State University, pursuing an MA in Biological Sciences: Global Sustainability. He has worked in the USDA Forest Service Quarantine Facility in Ansonia, Connecticut for the past two years, where he assisted with research on several forest pest species, including spongy moth, Asian longhorn beetle, and spotted lanternfly.

DR. SCOTT WILLIAMS participated in a conference call with Genesis Laboratories, Inc. on upcoming research funding collaboration (June 28).

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

MR. GREGORY BUGBEE with **MS. SUMMER STEBBINS**, gave a talk titled “Rogers Lake Aquatic Plant Survey 2021” at a public meeting of the Rogers Lake Authority at the Rogers Lake Association Clubhouse in Lyme (approx. 40 attendees) (June 8).

DR. SUSANNA KERIÖ administered the arborist exam at Lockwood Farm (June 8); attended a Zoom meeting to plan collaborative chestnut research (June 27).

DR. SARA NASON attended virtual meetings for the Benchmarking and Publications for Non-Targeted Analysis working group (June 1, 9, 21); met virtually with colleagues from the CT Department of Public Health, University of Connecticut, and the Yale School of Public Health to discuss PFAS laboratory capacity in CT (June 3); and met virtually with colleagues from the University of Virginia, Princeton University, and Upland Grassroots to discuss collaborative PFAS phytoremediation research (June 9).

DR. ITAMAR SHABTAI attended the annual meeting of the Multi-State Hatch Project (NC1178) at College Station, TX (June 7-9); visited the Canadian Light Source synchrotron in Saskatoon, Canada to analyze the interactions between roots exudates and soil clay minerals on the SM (spectro-microscopy) and mid-IR (FTIR microscopy) beamlines (June 15-19).

MS. SUMMER STEBBINS gave a virtual talk titled “West Lake Aquatic Plant Survey Results” to the West Lake Health Committee (10 attendees) (June 27).

DR. BLAIRE STEVEN attended the American Society of Microbiology Meeting in Washington DC and presented a poster titled "The Axenic and Gnotobiotic Mosquito: Models for Host Microbiome Interactions and Community Assembly" (June 9-13).

DR. JEFFREY WARD participated in a Connecticut Forest and Park Association Governance Committee meeting (June 14); participated in CT DEEP Forestry 490 training (June 15); spoke on impact of diseases and insects on forest dynamics for Connecticut Forest and Park Association's (CFPA) Master Woodlands Managers Partner's in Naugatuck (14 attendees) (June 19); met with Jeremy Clark (DEEP Forestry) and Peter Picone (DEEP Wildlife) to offer advice on implementing a crop tree management demonstration area (June 29).

DR. LEIGH WHITTINGHILL met virtually with Jacqueline Kowalski, UConn Extension

Educator in Urban Agriculture and Chris Sullivan from the Southwest Conservation District to discuss upcoming climate smart agriculture trainings that are being planned (June 2); met virtually with a group from the University of New Haven to discuss their ideas for an NSF Engine and possible collaboration on the project (June 16); spoke as part of the Urban Food Production: Practical Realities- Exposed Urban Agriculture Environments panel discussion at the Green Roofs for Healthy Cities, Grey to Green Virtual Conference (June 22); met with Doreen Abubakar about how we can help her with materials for her urban agriculture work in New Haven (June 30).

NEW STUDENTS, STAFF, AND VOLUNTEERS

Seasonal Employees:

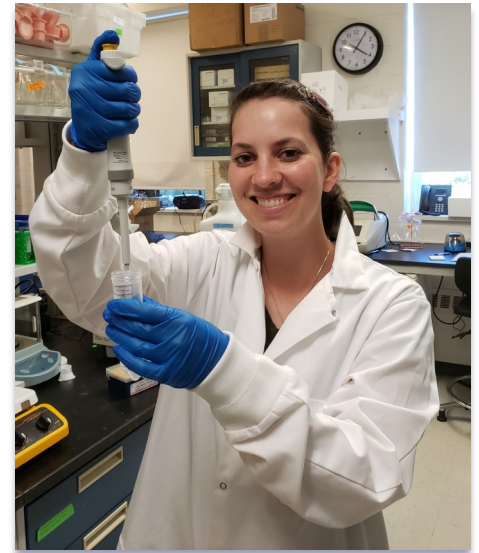


Front Row – Left to Right:

Juniper Allen-Cantu, Rachael Harris, Sofia Shubin, Aishwarya Nyasargi, Alexa Garbiel, Claire Keanna

Back Row – Left to Right:

Hanna Litwak, Jessica Shanley, Meara Burns, Eva Ramey



Ms. Jacqueline Lemmon



MR. ALEXANDER WALLER is a seasonal assistant in the Department of Environmental Science and Forestry working with **Dr. Joseph Pignatello** and **Dr. Philip Zhengyang Wang** on a project testing the use of biochar as a new environmentally-friendly phosphate fertilizer. He graduated from Yale University in the spring of 2022 with BS degree in Geology and Geophysics. He plans to start a Master of Philosophy (Science) degree at the University of Sydney, Australia in January 2023, where he will be conducting research on the impacts that mangrove ecosystems have on adjacent coral reefs.

PLANT PATHOLOGY AND ECOLOGY

DR. WASHINGTON DA SILVA participated in the CT Farm Wine Development Council meeting as the Scientific Border Advisor Member (10 participants) (June 23). Dr. da Silva was interviewed by the journalist, Brian Scott-Smith, for the WSHU (a member of NPR located in Westport CT) regarding the USDA-NIFA grant that Dr. da Silva and his group were awarded to study nanocarriers of dsRNA molecules (June 27).

DR. QUAN ZENG met Dr. Vijay Choppakatla from Biosafe Inc and discussed collaborative research (June 14), participated a virtual graduate committee progress meeting for Ms. Shreyashi Mitra, University of Wisconsin-Milwaukee (5 adults) (June 23).

DR. YONGHAO LI participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (5 adults) (June 8); talked about the Plant Disease Information Office and Disease Diagnosis to the Station Tour from the International Festival of Arts and Ideas in New Haven (13 adult) (June 16) and (17 adults and 5 children) (June 24); discussed “Career Paths in Public Service as a Plant Diagnostician” to summer interns in Plant Health and Protection Program in New Haven (9 adults) (May 20); presented “Backyard Composting” to Windsor Garden Club and Windsor Conservative Commission members via Zoom (17 adults) (June 21); participated in the National Plant Diagnostic Network Northeast Regional Meeting via Zoom (13 adults) (June 28).

DR. ROBERT MARRA was interviewed about Beech Leaf Disease by Brian Scott Smith for WSHU radio (June 10); co-led, with Jeff Ward, a forest pest and pathogen walk at Naugatuck State Forest for the Connecticut Forest and Park Association (CFPA) Master Woodland Manager certification program (17 adults) (June 18); was interviewed by Brendan Crowley for the CT Examiner (June 22); attended the International Union of Forest Research Organizations (IUFRO) conference on Foliage, Shoot, and Stem Diseases, where he co-led field trips, presenting on beech bark disease, non-destructive assessment of internal decay using sonic and electrical impedance tomography, and beech leaf disease, and co-authored an oral presentation titled “Early in situ detection of beech leaf disease using near infrared spectroscopy and machine learning” (June 26-July 2); fielded 14 phone calls and 57 emails regarding beech leaf disease (June, 1, 3, 6, 7-9, 13-17, 20, 25-27, 29, 30).

DR. LINDSAY TRIPLETT gave a presentation titled “Exploring the identity and function of protist-associated bacteria in the rhizosphere” via Zoom as part of the Terrestrial Ecology colloquium at the University of Cologne, followed by a meeting with lab members about potential collaboration opportunities (15 adults) (June 1); met with Dr. Derek Lundberg of the Swedish University of Agricultural Sciences via Zoom about collaboration opportunities (June 14), and twice gave a presentation titled “CAES Then and Now” to members of the public as part of Arts and Ideas Festival events. The presentation was followed by campus tours guided by **Drs. Lindsay Triplett, Christian Dimkpa, and Jason White**; tour stops were presented by **Drs. Goudarz Molaei, Carlos Tamez, Phil Anderson, Claire Rutledge, Washington da Silva, Gale Ridge, and Yonghao Li** (12 adults) (June 16) and (22 adults, 3 children) (June 24).

PLANT PATHOLOGY AND ECOLOGY

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



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

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





DR. JATINDER S. AULAKH attended the Connecticut Invasive Plant Council Meeting (June 2); and talked about weed management at the Connecticut Christmas Tree Growers twilight meeting at the Bees, Flees and Trees Farm in Litchfield, CT (~40 attendees) (June 21); and reviewed a manuscript titled “Response of *Vincetoxicum nigrum* (Black Swallowwort) to Herbicides plus Mowing” for Invasive Plant Science and Management journal (June 29), and submitted an article titled “Summer Weed Management in Christmas Trees” to the Real Tree Line Magazine of the Connecticut Christmas Tree Growers Association (June 30).

DR. CAROLE CHEAH trained property owners at two private lake communities in Norfolk, and guided releases of *Sasajiscymnus tsugae* for hemlock woolly adelgid (HWA) control at Tobey Pond and surrounds (13 attendees) (June 1-3), at Doolittle Lake (11 attendees) (June 7); gave a talk on collaborations in HWA biological control for the forest health lecture program at Great Mountain Forest, Norfolk (25 attendees) (June 11); gave a talk to the Appalachian Trail Conservancy Ridge Runners and volunteers at the North West Camp, Connecticut Chapter of the Appalachian Mountain Club on Mt. Riga, Salisbury (7 attendees) (June 15).

DR. RICHARD COWLES presented “Insect and disease management” at the CCTGA twilight meeting, Litchfield (40 attendees) (June 21).

Bugbee, G. J. and Stebbins, S. E. Pachaug Pond, Griswold CT Aquatic Vegetation Survey, Water Chemistry, Aquatic Plant Management Options 2020. CAES Bulletin (web only).

Bugbee, G. J. and Stebbins, S. E. Connecticut River, Middle and Upper Sections, East Had-dam, CT to Agawam, MA, Invasive Aquatic Vegetation Survey, Hydrilla Overwintering and Spread, Management Options 2020/21. CAES Bulletin (web only).

Bugbee, G. J. and Stebbins, S. E. Rogers Lake, Old Lyme, CT Aquatic Vegetation Survey, Water Chemistry, Aquatic Plant Management Options 2021. CAES Bulletin (web only).

Kahlil, N. and Molaie, G. Exacerbating public health challenges of ticks and tick-borne dis-eases. *The Habitat*.

Sun, M., Zhao, C., Shang, H., Hao, Y., Han, L., Qian, K., **White, J. C.**, Ma, C., and Xing, B. ZnO quantum dots outperform nanoscale and bulk particles for enhancing tomato growth. *En-vironmental Science: Nano*.

Crow, W. T., Mitkowski, N. A., and **LaMondia, J. A.** Nematode Problems in Ornamentals and Turf and Their Sustainable Management. *Nematode Diseases of Crops and their Sustaina-ble Management*. Elsevier.

Cheah, C. and Ellis, D. Biological Control of Mile-a-Minute Weed in Connecticut. CAES Bulletin.



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