Station News

The Connecticut Agricultural Experiment Station
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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.

CAES

The Connecticut Agricultural Experiment Station

Putting Science to Work for Society since 1875

GRANTS RECEIVED MAY 2022

1. MS. TRACY ZARRILLO received $3,000 from the Connecticut Department of Energy and Environmental Protection for the "Connecticut Wild Bee Checklist."

ADMINISTRATION

DR. JASON C. WHITE participated in the monthly Laboratory Preparedness meeting at the CT Department of Public Health Laboratory in Rocky Hill (May 2); participated in the APHL sponsored kick-off planning meeting for the annual FDA LFFM face to face meeting scheduled to occur in November 2022 (May 3); with collaborators at the University of Massachusetts Amherst, spoke with NIEHS program staff about a recent USDA workshop that we ran that focused on toxic metals in food (May 4); 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 (May 4); participated in the PhD Dissertation defense of Dr. Becky Curtis of the University of Wisconsin Milwaukee (May 4); spoke by Zoom with Dr. Miriam Krause of the NSF Center for Sustainable Nanotechnology (CSN) to plan a blog post on nano-enabled agriculture (May 5); with **DR. SARA NASON** and **DR. NUBIA ZUVERZA-MENA**, participated in the monthly call of the PFAS Testing Laboratory Working Group (May 6); with **DR. CARLOS TAMEZ** and **DR. CHAOYI DENG**, participated in a Zoom call with collaborators at the University of Wisconsin Milwaukee to discuss collaborative experiments (May 6); participated by Zoom in a PI review for the NSF CSN (May 9); hosted CT DPH Commissioner Dr. Manisha Juthani and gave the opening remarks for the CAES Vector-borne Diseases Workshop (May 10); 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 (May 10); with **MR. MICHAEL LAST**, participated in the Valley Laboratory design meeting in Windsor (May 10); gave a presentation by Zoom titled "Nanotechnology-enabled Agriculture: A Path to Global Food Security?" to the International Environmental Institute based in Ontario, Canada (May 11); with the CT Department of Consumer Protection Food Division, participated in the annual FDA audit of the MFRPS (May 11); with **DR. SHITAL VAIDYA** and **DR. NUBIA ZUVERZA-MENA**, hosted a Zoom call with a prospective visiting PhD student from the University of Lahore in Pakistan (May 11); participated in the weekly all-hands Zoom call for the NSF CSN (May 11, 17); participated in a Zoom call with Prof. Soledad Peresin of Auburn University to discuss a joint grant submission to USDA (May 12); with **DR. LEIGH WHITTINGHILL**, participated in a Zoom call with an EPA staff intern to discuss their project on evaluating plant uptake pathways of chemical contaminants in state models for risk assessments of contaminated sites (May 13); participated in the NIEHS Superfund Research Program Progress in Research Zoom call (May 13); gave a presentation by Zoom titled "Nanotechnology-enabled agriculture: A path to global food security?" for the Novo Nordisk Foundation Challenge program "Biocompatible Nanofertilizers for Targeted Delivery and Programmed Release of Essential Mineral Ions in Crops" at the University of Copenhagen (May 16); hosted a Zoom call with collaborators from Johns Hopkins University (May 16); hosted a Zoom call with collaborators at the University of Rhode Island to discuss a joint grant proposal (May 17); hosted the monthly NSF CSN Nanochemistry-Plant call (May 17); spoke by Zoom with collaborators at the University of Massachusetts Amherst to discuss joint experiments (May 17); participated in a Zoom call as part of the 2022

Farmland Restoration Program review panel (May 17); participated in a Zoom call with UConn CAHNR faculty and CT DEEP staff to discuss an invasive aquatic species coordinator position (May 18); participated in the Farmland Preservation Advisory Board Meeting (May 19); participated in the monthly NSF CSN Faculty meeting (May 19); met by Zoom with USDA APHIS staff to discuss the response to the spotted lanternfly (May 19); with **DR. SARA NASON** and **DR. NUBIA ZUVERZA-MENA**, participated in a Zoom call with Dr. Sara Thomas who will be joining the CAES NIEHS grant on PFAS phytoremediation (May 20); with **DR. YI WANG** and **DR. WADE ELMER**, met by Zoom with collaborators from the University of Massachusetts to discuss collaborative research on a joint USDA nanoscale sulfur project (May 23); gave a presentation at Duke University titled "Nanotechnology-enabled Agriculture: Crop Nutrition and Food Security?" for the International Network for Researching, Advancing, and Assessing Materials for Environmental Sustainability (INFRAMES) (May 26); with **DR. CHAOYI DENG**, participated in a meeting with collaborators at the University of Illinois to discuss collaborative experiments (May 27); met by Zoom with colleagues at UMass Amherst and Salem State University to discuss a joint USDA grant proposal (May 27); met by Zoom with collaborators at Johns Hopkins University to discuss a joint experiment (May 27); hosted the monthly CAES J-1 Visa Recipients meeting (May 31); and attended a Connecticut Farm Bureau Association Farm-to-Table Dinner at Jones Family Farm to honor American Farm Bureau Federation president Zippy Duvall (May 31).

ANALYTICAL CHEMISTRY

DR. CHRISTINA ROBB attended the Chemistry FDA LFFM calls on Food Defense (C-FD) and Human and Animal Food (C-HAF) (May 9); participated in the Eastern Analytical Symposium (EAS) Executive Committee meeting (May 2, 9, 16, 23); attended the EAS May board meeting (May 13); provided expertise for the EAS Virtual Student Symposium (May 20); participated in the Association of Public Health Laboratory (APHL) Chemistry working group meeting (May 23); 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 advanced analytical chemist performing liquid chromatography (May 23-24).

DR. NUBIA ZUVERZA-MENA, with **DR. JASON WHITE** and **DR. SARA NASON**, held a video call with collaborators from Yale and the University of Minnesota on the Station's nanomaterials-enhanced phytoremediation project (May 4); presented "Nanotechnology Strategies Towards a Sustainable Agriculture" at the Materials Research Society in Hawaii (approx. 20 in-person attendees) (May 10); with **DR. JASON WHITE** and **DR. SHITAL VAIDYA**, interviewed Sanyia Sattar for a possible six-month stay to research biosynthesized nanoparticles against *Erwinia carotovora* (May 11); attended the NIEHS "Progress in Research" virtual webinar in which the department's work on nano-enhanced phytoremediation was presented (May 13); and attended the monthly CAES J-1 Visa Recipients meeting (May 31).

ENTOMOLOGY

DR. GOUDARZ MOLAEI was interviewed by reporters from WFSB Channel 3 on Powassan virus (May 4), WTNH on Powassan virus (May 5), Fox 61 News on Powassan virus (May 4, 5), WNPR on climate change and increasing tick activity (May 5), *Hartford Courant* on Powassan virus (May 5), WSHU/NPR on climate change and tick-borne diseases (May 11), *New York Times* on Alpha gal syndrome or red meat allergy (May 13), *News-Times* on public health risks of tick bites and tick-borne diseases (May 14), and Cheddar TV News, New York, on Alpha gal syndrome (May 16); organized a Vector-borne Disease symposium in Jones Auditorium assisted by **DR. MEGAN LINSKE**, **DR. REBECCA JOHNSON**, and **DR. ZANNATUL FERDOUS** (May 10); presented a talk titled "Tick and Tick-borne Disease Surveillance in Connecticut" to the Vector-borne Disease symposium in Jones Auditorium (May 10); and directed the CAES Tick Testing Laboratory where 614 submissions were processed and blood-engorged adult blacklegged ticks were tested for Lyme disease, babesiosis, and anaplasmosis, and results were reported.

DR. KIRBY C. STAFFORD III was interviewed about the emergence of new ticks and tick-borne diseases by Jesse McKinley from the *New York Times* (May 4); was interviewed about tick bite prevention by Theresa Sullivan-Barger for *Connecticut Magazine* (May 9); presented a talk on a historical perspective and current challenges for tick control as part of the Vector-Borne Disease symposium in Jones Auditorium (May 10); led and participated in a meeting of a writing group for the Tick-Borne Disease Working Group (May 12); spoke on ticks and tick-borne diseases to the Thames River Garden Club at the Waterford Public Library in Waterford (30 attendees) (May 19); spoke on ticks and tick-borne diseases to the Colchester Garden Club at the Cragin Memorial Library in Colchester (33 attendees) (May 23); participated in a technical meeting of the Tick-Borne Disease Working Group (May 24); and led and participated in a meeting of a writing group for the Tick-Borne Disease Working Group (May 26).

MS. JAMIE CANTONI presented a talk about ticks and the Active Tick Surveillance Program, and the efforts and importance of the Surveillance Program in the state for the Prospect Land Trust's annual banquet dinner (May 1).

MS. KATHERINE DUGAS presented an evening insect program about pollinators, beneficials, pests, and invasive species for the Hillstown Grange in East Hartford (May 5).

DR. GALE E. RIDGE was quoted by The Patch in an article titled "Jumping Worms that Destroy Soil Spotted in Connecticut." She suggested some corrective measures to manage the worms (May 15); was interviewed about pantry moths (May 24), and about mosquitoes, public health, and how to manage them in and around home settings (May 27) by Harlan Levy for the *Journal Inquirer*.

DR. CLAIRE E. RUTLEDGE volunteered as a judge at the Connecticut Tree Protective Association tree climbing competition (May 14); hosted Priya S., an intern from New Haven Academy high school, as part of their annual internship program for juniors. Priya S. learned some basic insect biology and dissecting scope operation. She assisted Dr. Rutledge in sample sorting to ascertain attraction of southern pine beetle predators to different pheromones. She also shadowed technicians in the laboratory of **DR. GOUDARZ MOLAEI**, **DR. QUAN ZENG**, **MS. TRACY ZARRILLO**, and **MS. JACQUELYN LAREAU**.

DR. VICTORIA L. SMITH was interviewed about spotted lanternfly by Amanda Steffen of NBC Connecticut News (May 9); and was interviewed about a potential outbreak of spongy moth by Brian Scott-Smith of WSHU (May 17).

MS. TRACY ZARRILLO attended a meeting titled "Virtual Workshop on Native Bee Inventories and Monitoring" sponsored by the Commission for Environmental Cooperation to discuss the upcoming project called "Advancing Pollinator Conservation throughout North America" (May 3); attended a virtual meeting with Bruce Young of NatureServe and Laura Saucier of CT DEEP to discuss methods for assessing and ranking Connecticut's bee fauna (May 17); presented a virtual talk titled "A Checklist of the Bees of Connecticut, Then and Now" to the Granby Senior Center (May 18); was invited to participate in a project called "Tropics to Tundra" by Dr. Neil Cobb of Northern Arizona University (May 23); presented a virtual talk titled "Bumble Bees of Connecticut: Rare, Common, and Declining Species" sponsored by the Hamden Land Conservation Trust and The Norfolk Hub (May 26).

ENVIRONMENTAL SCIENCES

DR. JOSEPH PIGNATELLO participated in the virtual SERDP Interim Progress Report Workshop on his grant project on remediation of munitions chemicals (approx. 25 attendees) (May 2); and attended the virtual Connecticut Academy of Science and Engineering Annual Dinner and Meeting (May 26).

DR. PHILIP ARMSTRONG gave a lecture titled "Mosquito-based Surveillance to Detect and Monitor Arbovirus Risk in Connecticut" at the Vector Day Symposium at CAES (May 10); and spoke about the start of the mosquito trapping and testing program to reporters from WFSB Channel 3 (May 31).

MS. ANGELA BRANSFIELD attended the CAES Vector-borne Disease Symposium (May 10); participated virtually in Yale's Biosafety Committee meeting (May 19); and participated in the Federal Select Agent Program's Responsible Official webinar series "Interim Final Rule: SARS-CoV/SARS-CoV-2 Chimeric Viruses; Procedures for Adding New Registered Spaces" (May 25).

MR. GREGORY BUGBEE served as a panelist on the Northeast Aquatic Nuisance Species Panel at the Spring meeting (May 10, 12); with **MS. SUMMER STEBBINS**, gave a talk titled "Hydrilla in the Connecticut River" at a seminar sponsored by the Connecticut River Conservancy (approx. 30 attendees) (May 18); and, with **MS. SUMMER STEBBINS**, held an Invasive Aquatic Plant Workshop for staff of the Aquarion Water Company in Trumbull (approx. 25 attendees) (May 31).

DR. ANDREA GLORIA-SORIA gave a talk titled "Invasion Biology of *Aedes* Mosquitoes" at the CAES Vector Biology Day symposium (104 attendees) (May 10); gave a talk titled "Population Genetics of an Invasive Mosquito Vector; *Aedes albopictus* in the Northeastern USA," at the 5th International Workshop on *Aedes albopictus*, Montpellier, France (approx. 120 attendees) (May 11-13).

DR. REBECCA JOHNSON served as a judge for the virtual New Haven Science Fair viewing presentations by third graders (May 18).

DR. SARA NASON attended virtual meetings with the Benchmarking and Publications for Non-Targeted Analysis working group (May 5, 10, 12); met virtually with colleagues from the CT Department of Public Health, University of Connecticut,

and the office of Connecticut State Senator Christine Cohen to discuss PFAS laboratory capacity in Connecticut (May 6); spoke on "Understanding and Enhancing PFAS Phytoremediation Mechanisms Using Hemp Plants" as part of an NIEHS Superfund Research Program (SRP) Progress in Research webinar (259 attendees) (May 13,); and gave a talk titled "Building Stakeholder Relationships to Facilitate Expanded Application of Non-Targeted Analysis Methods" at the SETAC Non-Targeted Analysis focused topic meeting in Durham, NC, and virtually (approx. 100 in-person attendees) (May 26).

MR. JOHN SHEPARD spoke about mosquitoes and the CT Mosquito Trapping and Arbovirus Surveillance Program with Fox 61 News (May 5); spoke on "Biology, Ecology, and Feeding Behavior of Mosquitoes in Connecticut" at the Vector-borne Disease Symposium held in Jones (104 attendees) (May 10); and spoke about the CT Mosquito Trapping and Arbovirus Surveillance Program at a press conference held by the Milford Health Department (May 13).

DR. BLAIRE STEVEN served virtually on an NSF review panel for the Integrated Organismal Systems in the Organism Response to Climate Change Program (May 18-20); and was nominated to the Editorial Board of the American Society of Microbiology journal *Microbiology Spectrum* (May 25).

FORESTRY AND HORTICULTURE

DR. JEFFREY S. WARD spoke on "The Biodiversity Crisis" for the Milford Garden Club (23 attendees) (May 10); spoke on "White Oak Precommercial Crop Tree Release" at the Yankee Society of American Foresters summer meeting in Oakham, MA (48 attendees) (May 13); spoke on "Using Slash Walls to Enhance Oak Regeneration" at the Yankee Society of American Foresters summer meeting in Oakham, MA (29 attendees) (May 13); spoke on "The Biodiversity Crisis" for the Great Mountain Forest lecture series in Norfolk (21 attendees) (May 14); was interviewed about the impact of beech leaf disease on forest health by the *News-Times* (May 17); and participated in a Connecticut Forest and Park Association Board of Directors meeting (May 25).

DR. LEIGH WHITTINGHILL met virtually with members of the New Haven Food System Policy Division to discuss respective projects and collaboration (May 3); with **DR. JASON WHITE**, met virtually with Ashley DeJuliannie, a VSFS EPA intern, to discuss her report on heavy metals uptake by food crops in urban agriculture (May 13); presented a two-hour workshop titled "Green Roofs: Benefits and Possibilities" to Master Gardeners through the UConn Extension (May 14); and participated in a meeting of the Soil Health Committee of the CT Council on Soil and Water Conservation regarding finalization of the Soil Health Plan (May 31).

DR. SUSANNA KERIÖ served on the CT Urban Forestry Council's conference planning committee (May 16); and attended the CT Urban Forestry Council's Annual Meeting in Hartford where she was elected as Secretary (May 19).

MR. JOSEPH P. BARSKY gave a talk titled "Ecological and Economic Importance of Precommercial Crop Tree Release on White Oak" at the spring field tour and meeting of the Society of American Foresters and Forest Stewards Guild Yankee Division in Rutland, MA (50 attendees) (April 13).

PLANT PATHOLOGY AND ECOLOGY

DR. QUAN ZENG and **DR. LINDSAY TRIPLETT** hosted Cheshire Pack 92 fourth grade Webelos Scouts on a tour of Lockwood Farm to help them earn their "Adventures in Science" pin. **DR. ZENG** explained the apple life cycle and talked about his apple blossom experiments (6 children and 6 adults) (May 5).

Quan Zeng with Pack 92 Webelos Den and their Den Leader, Kevin Koch.

DR. LINDSAY TRIPLETT participated in a virtual grant panel for a federal agency (April 27) and was interviewed by Josh Flynn of the Logansport, IN *Pharos-Tribune* about her career as a CAES scientist and plant pathologist in an article titled "Logansport native breaks boundaries in fields of plant pathology and ecology" https://www.pharostribune.com/news/article_22629d38-cd76-11ec-a0c5-c314f26bad1b.html (May 6).

DR. YONGHAO LI participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (5 adults) (May 11); presented "Summer Gardening Tips" to Kensington Garden Club members in Berlin (32 adults) (May 19); and participated in the National Plant Diagnostic Network Northeast Regional meeting and presented "Plant Disease Updates – CAES" via Zoom (12 adults) (May 24).

DR. NEIL SCHULTES had a Zoom meeting with four students from South Windsor High School for their upcoming science fair project. Part of their project was to interview scientists on the feasibility of using CRIPSR technology in the control of invasive weeds (May 19); and met with Dr. Rosemary Whelan, a biology professor at Albertus Magnus College in New Haven, to discuss student internships at CAES and tours for biology students during the academic year (May 26).

DR. WASHINGTON DA SILVA presented two seminars: one at the Department of Plant Pathology at Cornell University titled "Nano-enabled Technologies: Prospective Weapons to Tackle Destructive Plant Viruses" (75 attendees) (April 26), and one at Flagship Pioneering, an RNA biology company based in Cambridge, MA, titled "Small Things Considered: Using RNAi and Nanotechnology to Control Plant Pathogens" (25 attendees) (May 6).

DR. QUAN ZENG and **DR. MOHAMED-AMINE HASSANI** visited the University of Massachusetts and met Dr. Dan Cooley and his graduate student Paull O'Connor to perform collaborative research (May 12); and gave a lecture titled "Fire Blight, Disease Biology, Epidemiology, and Control" to plant pathology majored undergraduate and graduate students at the China Agricultural University (75 students) (May 20).

Thirteen members of the Plant Pathology and Analytical Chemistry departments came together to do a thorough cleaning and organization of the plant pathology greenhouse (May 18).

Ines Karmous and **Ravi Patel** took charge of the dirty work!

VALLEY LABORATORY

DR. CAROLE CHEAH trained volunteers for the Wyndham Land Trust on techniques for hemlock health field assessments (April 8); was interviewed about biological control agents of hemlock woolly adelgid (HWA) by Bob Miller of the *News-Times* (April 26); released *Sasajiscymnus tsugae* for biological control of HWA at the Town of Glastonbury Cotton Hollow preserve and Wickham Park, Manchester, with town and park staff (May 5); released *S. tsugae* along the Farmington River watershed forest at the American Legion State Forest with DEEP forestry staff (May 11); gave a talk on biological control of HWA and led a tour for releases of *S. tsugae* for an event by the Friends of American Legion and Peoples State Forests (May 14); and trained foresters and interns from Great Mountain Forest, Norfolk, and implemented releases of *S. tsugae* for HWA control (6 attendees) (May 19, 20, 23).

DR. JAMES LAMONDIA spoke about 2022 research projects and plant breeding goals at the Nutrien Tobacco Growers meeting in Somers (80 attendees) (May 4).

DR. DEWEI LI presented a seminar titled "Fungi Found in CT: Good and Bad" at Real Art Ways in Hartford (53 attendees) (May 11).

DEPARTMENTAL RESEARCH UPDATES MAY 2022

ADMINISTRATION

1. Huang, G., **Zuverza-Mena, N.**, **White, J. C.**, Hu, H., Xing, B., Parkash Dhankher, O. (2022). Simultaneous exposure of wheat (*Triticum aestivum* L.) to CuO and S nanoparticles alleviates toxicity by reducing Cu accumulation and modulating antioxidant response. *Sci. Tot. Environ*. DOI: 10.1016/j.scitotenv.2022.156285

Abstract: Widespread use of metal-based nanoparticles (MNPs) may result in the increased accumulation of metals in agricultural soil, which could affect crop productivity and contaminate the food-chain. The effect of sulfur nanoparticles (SNPs, 200 mg/L) co-exposure on the toxicity of CuO nanoparticles (CuO NPs, 25 and 50 mg/L) to wheat seedlings was investigated in a hydroponic system. CuO NPs exposure significantly inhibited the growth of wheat seedlings, causing 43.6% and 54.1% decreases in the fresh biomass of plants and 82.8% and 83.1% decreases in the total chlorophyll contents at CuONP25 and CuONP50, respectively, as compared to controls. CuO NPs exposure at both concentrations increased the MDA content in shoot and root tissues by 66.4-67.9% and 47.7-48.8%, respectively. Further, CuO NPs exposure elevated the activities POD, SOD, and CAT by 2.19-2.27, 5.82-6.09, and 1.44-1.95 times in roots, and by 45.2-67.8%, 86.7-154.5%, and 22.5-56.1% in shoots, respectively, in comparison to controls. The addition of SNPs alone increased wheat biomass by 11.0% and total chlorophyll contents by 4.4%, compared to controls. Further, simultaneous exposure to 200 mg/L SNPs and CuO NP25 or CuO NP50 alleviated the CuO NPs toxicity, wheat biomass was 47.8% and 37.7% higher in CuONP25+SNP and CuONP50+SNP treatments, respectively, as compared to CuO NPs alone treated plants. Co-exposed plants showed reduced levels of total reactive oxygen species (ROS), $O_2^{\cdot -}$ and H_2O_2. Additionally, SNPs exposure reduced Cu uptake and accumulation in both root and shoot tissues by 32.2-54.4% and 38.3-57.5%, respectively. In summary, SNPs alleviated CuO NPs toxicity to wheat seedlings, most likely by

reducing Cu bioavailability and accumulation in plant tissues, and also altered S nutrition and the modulation of antioxidant response in plants. These results showed that SNPs application has the potential to alleviate CuO NP toxicity and increase wheat productivity affected by metal toxicity.

ANALYTICAL CHEMISTRY

1. Deng, C., **Wang, Y.**, Cantu, J. M., Valdes, C., Navarro, G., Cota-Ruiz, K., Hernandez-Viezcas, J. A., Li, C., **Elmer, W. H.**, **Dimkpa, C. O.**, **White, J. C.**, Gardea-Torresdey, J. L. (2022). Soil and foliar exposure of soybean (*Glycine max*) to Cu: Nanoparticle coating-dependent plant responses. *NanoImpact*, *26*. DOI: 10.1016/j.impact.2022.100406

Abstract: In this study, we investigated the effects of citric acid (CA) coated copper oxide nanoparticles (CuO NPs) and their application method (foliar or soil exposure) on the growth and physiology of soybean (Glycine max). After nanomaterials exposure via foliar or soil application, Cu concentration was elevated in the roots, leaves, stem, pod, and seeds; distribution varied by plant organ and surface coating. Foliar application of CuO NPs at 300 mg/L and CuO-CA NPs at 75 mg/L increased soybean yield by 169.5% and 170.1%, respectively. In contrast, foliar and soil exposure to ionic Cu with all treatments (75 and 300 mg/L) had no impact on yield. Additionally, CuO-CA NPs at 300 mg/L significantly decreased Cu concentration in seeds by 46.7%, compared to control, and by 44.7%, compared to equivalent concentration of CuO NPs. Based on the total Cu concentration, CuO NPs appeared to be more accessible for plant uptake, compared to CuO-CA NPs, inducing a decrease in protein content by 56.3% and inhibiting plant height by 27.9% at 300 mg/kg under soil exposure. The translocation of Cu from leaf to root and from the root to leaf through the xylem was imaged by two-photon microscopy. The findings indicate that citric acid coating reduced CuO NPs toxicity in soybean, demonstrating that surface modification may change the toxic properties of NPs. This research provides direct evidence for the positive effects of CuO-CA NPs on soybean, including accumulation and in planta transfer of the particles, and provides important information when assessing the risk and the benefits of NP use in food safety and security.

2. Huang, G., **Zuverza-Mena, N.**, **White, J. C.**, Hu, H., Xing, B. and Dhankhe, O. P. Simultaneous exposure of wheat (*Triticum aestivum* L.) to CuO and S nanoparticles alleviates toxicity by reducing Cu accumulation and modulating antioxidant response. *Science of the Total Environment*. Accepted for publication.

ENVIRONMENTAL SCIENCES

1. Pless, E., Powell, J. R., Seger, K. R., Ellis, B., **Gloria-Soria, A.** (2022). Evidence for serial founder events during the colonization of North America by the yellow fever mosquito, *Aedes aegypti*. *Ecology and Evolution*, *12*(5).

Abstract: The *Aedes aegypti* mosquito first invaded the Americas about 500 years ago and today is a widely distributed invasive species and the primary vector for viruses causing dengue, chikungunya, Zika, and yellow fever. Here, we test the hypothesis that the North American colonization by *Ae. aegypti* occurred via a series of founder events. We present findings on genetic diversity, structure, and demographic history using data from 70 *Ae. aegypti* populations in North America that were genotyped at 12 microsatellite loci and/or ~20,000 single nucleotide polymorphisms, the largest genetic study of the region to date.

We find evidence consistent with colonization driven by serial founder effect (SFE), with Florida as the putative source for a series of westward invasions. This scenario was supported by (1) a decrease in the genetic diversity of *Ae. aegypti* populations moving west, (2) a correlation between pairwise genetic and geographic distances, and (3) demographic analysis based on allele frequencies. A few *Ae. aegypti* populations on the west coast do not follow the general trend, likely due to a recent and distinct invasion history. We argue that SFE provides a helpful albeit simplified model for the movement of *Ae. aegypti* across North America, with outlier populations warranting further investigation.

2. Yang, Z., Chen, L., Zhang, G., Zhu, J., Sun, S., Shan, C., Pan, B., **Pignatello, J. J.** (2022). Mn(II) acceleration of the picolinic acid-assisted Fenton reaction: new insight into the role of manganese in Fenton AOPs. *Environ. Sci. Technol*. *56*(10), 6621-6630. DOI: 10.1021/acs.est.1c08796

Abstract: The homogeneous Fe-catalyzed Fenton reaction remains an attractive advanced oxidation process for wastewater treatment, but sustaining the Fe(III)/Fe(III) redox cycle at a convenient pH without the costly input of energy or reductants remains a challenge. Mn(II) is known to accelerate the Fenton reaction, yet the mechanism has never been confidently established. We report a systematic kinetic and spectroscopic investigation into Mn(II) acceleration of atrazine or 2,4,6-trichlorophenol degradation by the picolinic acid (PICA)-assisted Fenton reaction at pH 4.5–6.0. Mn(II) accelerates Fe(III) reduction, superoxide radical ($HO_2^{\bullet}/O_2^{\bullet-}$) formation, and hydroxyl radical ($HO^{\bullet}$) formation. A Mn(II/III)-H_2O_2 redox cycle as an independent source of reactive oxygen species, as proposed in the literature, is shown to be insignificant. Rather, Mn(II) assists by participating directly and catalytically in the Fe(III)/Fe(II) redox cycle. Initially, Mn(II) (as $Mn^{II}(PICA)^{+}$) reacts with a ferric hydroperoxo species, PICA-Fe^{III}-OOH. The resulting binuclear complex undergoes intra-molecular electron transfer to give Fe(II), which generates $HO^{\bullet}$ from H_2O_2, plus MnO_2^{+}, which decomposes to $HO_2^{\bullet}/O_2^{\bullet-}$ (an Fe(III) reductant) and Mn(II), completing the catalytic cycle. This scheme may apply to other Fenton-type systems that go through an Fe^{III}-OOH intermediate. The findings here will inform the design of practical and sustainable Fenton-based AOPs employing Mn(II) in combination with chelating agents.

PLANT PATHOLOGY AND ECOLOGY

1. Banerjee, B., **Zeng, Q.**, Yu, M., Hsueh, B. Y., Waters, C. M., and Yang, C. H. (2022). Quorum-sensing master regulator VfmE is a c-di-GMP effector that controls pectate lyase production in phytopathogen *Dickeya dadantii*. *Microbiology Spectrum*, *10*(2). DOI: 10.1128/spectrum.01805-21

Abstract: *Dickeya dadantii* is a phytopathogenic bacterium that causes diseases on a wide range of host plants. The pathogen secretes pectate lyases (Pel) through the type II secretion system (T2SS) that degrades the cell wall in host plants. The virulence of *D. dadantii* is controlled by the second messenger cyclic diguanylate monophosphate (c-di-GMP), and the homeostasis of c-di-GMP is maintained by a number of diguanylate cyclases and phosphodiesterases. Deletion of a phosphodiesterase *ecpC* repressed *pelD* transcription, and such repression can be suppressed by an additional deletion in *vfmE*. VfmE is an AraC type of transcriptional regulator in the Vfm quorum-sensing system. Our results suggest that VfmE is a c-di-GMP effector that functions as an activator of *pel* at low c-di-GMP concentrations and a repressor of *pel* at high c-di-GMP concentrations through regulation of the transcriptional activator SlyA. Multiple sequence align-

ment with known c-di-GMP effectors identified an RWIWR motif in VfmE that we demonstrate is required for the c-di-GMP binding. Mutation of R93D in the RxxxR motif eliminates the c-di-GMP-related phenotypes in Pel activity. Our results show that VfmE is not only a quorum-sensing regulator but also a c-di-GMP effector, suggesting that *D. dadantii* integrates the c-di-GMP signaling network with the Vfm quorum-sensing pathway during environmental adaptation.

VALLEY LABORATORY

1. **Kodati, S.**, **Cowles, R. S.**, **LaMondia, J.** (2022). Survival of conidia of the boxwood blight pathogen *Calonectria pseudonaviculata* under different relative humidity conditions. *Plant Health Progress*. DOI: 10.1094/PHP-12-21-0142-RS

Abstract: Boxwood blight, caused by *Calonectria pseudonaviculata*, is a significant disease affecting both nursery production and landscape boxwood plantings. C. pseudonaviculata conidia are produced in clumps in an extracellular mucilaginous matrix. Local spread of the pathogen is by dispersal of conidia in water splash or direct contact dispersal, but the effects of relative humidity (RH) on survival and germination of dispersed conidia over time is unknown. We investigated the effects of 15, 40, 80, and 100% RH on survival of individual conidia or conidia aggregated in clumps over time. Conidia were transferred to a dry glass surface and scored for the incidence of survival and percentage germination over 3, 6, and 9 days. Conidia in clumps had higher incidence of survival and percent germination than individual conidia. RH significantly and positively influenced germination, and survival, as measured by presence/absence of germination by individual conidia, but not by clumps of conidia. Individual conidia survived for at least 6 days at all RH tested. No germination was observed for any individual conidium exposed to 15% RH for 9 days, whereas conidia in clumps survived and germinated at all RH levels for at least 9 days. This study indicates that simply pruning or working in infected boxwoods under dry conditions may be insufficient to limit the spread of the pathogen and ultimately, disease. Further measures such as frequent disinfestation of tools with alcohol or fungicide application before or after possible spread of conidial clumps may be necessary.

2. **Kodati, S.**, Allan-Perkins, E., **Cowles, R. S.**, and **LaMondia, J.** (2022). The effect of temperature, leaf wetness period, and cultivar susceptibility on boxwood blight disease development and sporulation. *Plant Disease*. DOI: 10.1094/pdis-05-22-1022-re

Abstract: Boxwood blight causes great losses to the boxwood nursery industry and landscapes in 30 states in the USA. Understanding the epidemiological factors governing disease development will be important for disease forecasting and design of best management practices. We evaluated the effect of leaf wetness period (lwp) and temperature on lesion development and sporulation on three boxwood cultivars under controlled conditions to develop predictive models for disease development. We conducted detached leaf assays at 18 to 27°C, and various lwp, with the cultivars *Buxus sempervirens* 'Suffruticosa' (highly susceptible), *Buxus* × 'Green Velvet' (moderately susceptible), and *B. microphylla* var. *japonica* 'Winter Gem' (less susceptible). Detached leaves were inoculated with 200 conidia in 50 µL of suspension and disease incidence was recorded at 3 – 13 d post inoculation (dpi). Cultivar, lwp, temperature, and most interactions significantly influenced disease development. A minimum of 5 h of leaf wetness was required for any disease. Lesion development increased most rapidly between 12

– 15 h and continued to increase to about 21 h of leaf wetness. Temperatures between 21 and 25°C were optimal for lesion development. There was about a 7 -d lag between appearance of lesions and maximal incidence of sporulation. The two less-susceptible cultivars had fewer lesions than 'Suffruticosa' under the same infection conditions; in addition, leaf lesions of 'Winter Gem' exhibited delayed sporulation and sporulation from a smaller proportion of symptomatic leaves. Response surfaces were developed for each cultivar to predict the disease incidence using the lwp and dpi. Our findings will help refine disease forecast models to improve management of boxwood blight.

3. Wan, Y., Si, Y.-Z., **Li, D.-W.**, Huang, L., Zhu, L.-H. (2022). First report of *Diaporthe cercidis* causing leaf blotch of *Acer pictum* subsp. *mono* in China. *Plant Disease*, *106*(4),1296. DOI: 10.1094/PDIS-04-21-0744-PDN

Abstract: *Acer pictum* subsp. *mono* (Maxim.) H. Ohashi is a common deciduous tree widely distributed in Northeast and Northern China, including the Yangtze River Basin (Liu et al. 2014). A foliar disease with ~90% incidence (19/21 trees) occurred on *A. pictum* subsp. *mono* in a community park in Nanjing, Jiangsu, China in July 2019. On average, ~80% of the leaves per tree were infected. Symptoms initially appeared as brown, necrotic lesions at leaf tips; half the leaf would become dark brown and, finally, almost all of leaves were infected. Pieces of leaf tissue (3 to 5 mm^2) cut from lesion margins were surface sterilized in 75% ethanol for 30 s and 1% NaClO for 90 s, rinsed with sterile H_2O three times, and placed on PDA at 25°C in the dark. The same fungus was isolated from 92% of samples. Pure cultures were obtained by single-spore isolation. Three representative isolates (WJF1, -3, and -4) were obtained; WJF1 was deposited in China's Forestry Culture Collection Center (CFCC 54806), and WJF3 and -4 were deposited at the Nanjing Forestry University (NFU 083 and NFU 084). The culture on PDA was white, with white vigorous aerial mycelia at the edge. Black pycnidia developed on alfalfa stems at 25°C under a 14/10 h light/dark cycle for 20 days. Conidiophores were hyaline, branched, septate, straight, 16.4 to 34.7 × 1.5 to 3.0 µm (*n* = 30). Conidiogenous cells were 9.0 to 24.6 × 1.3 to 2.3 µm (*n* = 30). α-Conidia were 7.0 ± 0.6 × 2.2 ± 0.2 µm (*n* = 30), fusiform, hyaline, smooth, and multiguttulate. ß-Conidia were 25.5 ± 4.3 × 1.3 ± 0.1 µm (*n* = 30), hyaline, smooth, and hamate. Morphological characteristics of all three isolates matched *Diaporthe* spp. (Gomes et al. 2013). DNA of three isolates was extracted, and the ITS and partial sequences of *EF1-a*, *CAL*, ß-*tub*, and histone H3 (*HIS*) genes were amplified with primers ITS1/ITS4 (White et al. 1990), EF1-728F/EF1-986R, CAL228F/CAL737R (Carbone et al. 1999), ßt2a/ßt2b, and CYLH3F/H3-1b (Crous et al. 2004; Glass and Donaldson 1995), respectively. Sequences of WJF1, -3, and -4 were deposited in GenBank (WJF1: MW301339 for ITS, MW363932 to MW363935 for *EF1-a*, ß-*tub*, *HIS*, and *CAL*; WJF3: MW453062 and MW561566 to MW561569; WJF4: MW453063 and MW561570 to MW561573). BLAST results showed that the ITS, *EF1-a*, ß-*tub*, *HIS*, and *CAL* sequences of WJF1 were similar to *Phomopsis liquidambari* C. Q. Chang, Z. D. Jiang & P. K. Chi JQ676191 (540/540; 100%); *Diaporthe huangshanensis* H. Zhou & C. L. Hou MN224671 (291/292; 99%); *D. pescicola* Dissan., J. Y. Yan, Xing H. Li & K. D. Hyde MK691230 (438/438; 100%); *D. spinosa* Y. S. Guo & G. P. Wang MK726170 (437/438; 99%); and *D. cercidis* C. M. Tian & Qin Yang MK691114 (452/452; 100%), respectively. BLAST results are in the supplementary materials. Maximum -likelihood and Bayesian posterior probability analyses using IQtree v. 1.6.8 and Mr. Bayes v. 3.2.6 with the concatenated sequences placed WJF1, -3, and -4 in the clade of *D. cercidis*. Based on the five-locus phylogeny and morphology, they

were identified as *D. cercidis*. Pathogenicity was tested on potted 3-year-old seedlings. Healthy leaves were wounded with a sterile needle and inoculated with 10 µl of 10^6 conidia/ml suspension and control leaves with sterilized H_2O. In total, 12 seedlings were used (3 per treatment) and five leaves were inoculated per seedling. Plants were covered with plastic bags, and sterilized H_2O was sprayed into the bags twice a day; they were kept in a greenhouse at 25 ± 2° C/16 ± 2°C (day/night). In 5 days, all inoculated leaves had lesions similar to those in the field. *D. cercidis* was reisolated from inoculated leaves and was confirmed based on morphological characteristics and ITS sequence analysis. No symptoms were observed on control leaves and no fungus was isolated. *D. cercidis* was previously reported on twigs of *Cercis chinensis* (Yang et al. 2018) and causing pear shoot canker (Guo et al. 2020). This is the first report of *D. cercidis* causing leaf blotch on *A. pictum* subsp. *mono*. Pathogen identification is imperative for diagnosing and controlling this potentially high-risk disease on *A. pictum* subsp. *mono* and for future studies.

4. Zhu, L.-H., Xu, W., Huang, L., Ye, J.-L., **De-Wei Li**. (2022). Pathogenicities and biological characters of *Septotinia populiperda* causing leaf blotch of willows. *Plant Disease*, *106*(4), 1262-1270. DOI: 10.1094/PDIS-07-21-1537-RE

Abstract: *Salix babylonica* is an important landscape tree in China and has been widely planted. In this study, the pathogenicity of *Septotinia populiperda* causing leaf blotch of *Sa. babylonica* to four willow species (*Sa. matsudana*, *Sa. chaeomoloides*, *Sa. matsudana* f. *tortuosa*, and *Sa. suchowensis*) and *Populus tomentosa* (Chinese white poplar) was determined. Its sexual stage and biological characteristics were studied. Leaves from four willow species and *P. tomentosa* were inoculated with mycelial plugs. Typical leaf blotches with sporodochia were produced on all inoculated leaves. Among the isolates studied, some developed conidia but sclerotia were rare. The sclerotia developed apothecia after induction at 4°C for 3 months in an incubator and 2 more months outdoors from January to March. The biological characteristics of *S. populiperda* showed that mycelium grew better on complete medium than on potato dextrose agar, Czapek's agar, and minimal medium. For mycelial growth, the optimal carbon source was dextrose and the optimal nitrogen source was yeast powder. Conidia germination rate was 59.4% at 24 h. The conidia germinated best in a 4% willow leaf extraction. The optimal temperature for conidia germination was 25°C, and the optimal pH was 4.

JOURNAL ARTICLES APPROVED MAY 2022

Bransfield, A. B., **Misencik, M. J.**, **Brackney, D. E.**, **Armstrong, P. M.** Limited capacity for *Aedes aegypti* to mechanically transmit chikungunya virus and dengue virus. *American Journal of Tropical Medicine and Hygiene*.

Cantu, J. M., Ye, Y., Hernandez-Viezcas, J. A., **Zuverza-Mena, N.**, **White, J. C.**, Gardea-Torresdey, J. L. Tomato fruit nutritional quality is altered by the foliar application of various metal oxide nanomaterials. *Nanomaterials*.

Cao, Y., Ma, C., Yu, H., Tan, Q., Mo, A., **White, J. C.**, Xing, B. The role of sulfur nutrition in plant response to metal(loid) stress: Facilitating biofortification and phytoremediation. *Critical Reviews of Environmental Science and Technology*.

Cowles, R. S. "Hacks" for DIY projects. *The Real Tree Line*.

Cowles, R. S. The greater of two weevils. *The Real Tree Line*.

Fearer, C. J., Conrad, A. O., **Marra, R. E.**, Georskey, C., Villari, C., Slot, J., Bonello, E. A combined approach for early in-field detection of beech leaf disease using near-infrared spectroscopy and machine learning. *Frontiers in Forests and Global Change*.

LaMondia, J. A. One hundred years of research and service at the Tobacco Station/Valley Laboratory. *CAES Bulletin*.

Li, H., Liao, Y.-C.-Z., Zhang, M.-Y., **Li, D.-W.**, Zhu, L.-H. First report of *Erysiphe alphitoides* causing powdery mildew of *Akebia quinata* in China. *Plant Disease*.

Lui, Y., Kornig, C. G., Qi, B., Schmutzler, O., Staufer, T., Sanchez Cano, C., Magel, E., **White, J. C.**, Feliu, N., Gruner, F., Parak, W. J. Size- and ligand-dependent transport of nanoparticles in *Matricaria chamomilla* as demonstrated by mass spectroscopy and X-ray fluorescence imaging. *ACS Nano*.

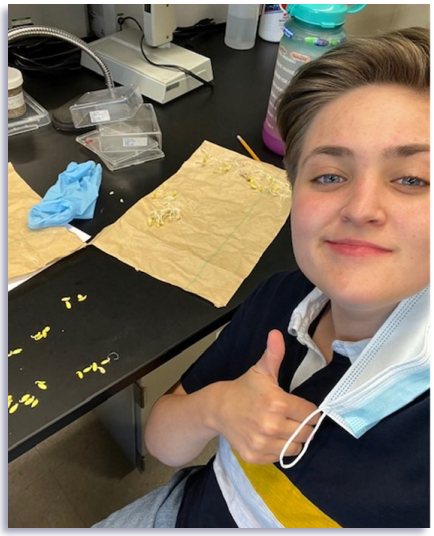
Ranciato, J., **Prapayotin-Riveros, K.**, **Tamez, C.**, **Dimkpa, C. O.**, **White, J. C.** Analysis of animal feed products sold in Connecticut during 2020. *CAES Technical Bulletin*.

Zhang, S., Zhou, J., Chen, J., Ge, T., Cai, Y., Yu, B., Wang, H., **White, J. C.**, Li, Y. Changes in soil CO_2 and N_2O emissions in response to urea and biochar-based urea in an intensively managed Moso bamboo forest. *Agriculture, Ecosystems and Environment*.

NEW STUDENTS, STAFF, AND VOLUNTEERS MAY 2022

MS. HANNAH BROWN resumed at the Department of Analytical Chemistry (DAC) as a 2022 Yale Conservation Scholar during the end of May. She graduated from the University of Florida (UF) in the spring of 2022 with BS degrees in biology and chemistry. She plans to start a Master of Agronomy program at UF in Fall 2022. She will be interning in DAC for the summer of 2022 working on a variety of different projects related to the analysis and development of different nanoparticles and evaluating their effects on agricultural crops.

MR. SIMON DUGGAN joined the Department of Analytical Chemistry (DAC) as a new seasonal employee working with **Dr. Sara Nason** and **Dr. Nubia Zuverza-Mena** on a project examining stormwater impacts on contaminants in treated wastewater. He also worked at DAC in summer 2021 as part of the Center for Sustainable Nanotechnology.



EMELIA PETTIT is a seasonal assistant in the Plant Disease Information Office working with **Dr. Yonghao Li** and **Ms. Katherine Dugas**. She is currently an Environmental Science major at Wheaton College MA, with an anticipated minor in Environmental Studies. She is a rising sophomore who's interested in plant science, dendrology, and ecology. She previously attended an agricultural education high school. She was heavily involved, spending many study halls in the school greenhouse, and competing in the FFA state Forestry Career Development Event at Lockwood Farm, sparking her interest in The CAES. In her free time, she plays rugby and enjoys gardening and musicals.

MS. MADELEINE DUMAS, a previous member of the **da Silva Laboratory** and currently a Ph.D. student in the Department of Plant Pathology and Plant-Microbe Biology at Cornell University, has been awarded the prestigious Thressa and Earl Stadtman Fellowship. The Stadtmans gifted an endowment to Cornell to recognize and support outstanding female and underrepresented minority graduate students in CALS with a commitment to research. Madeleine, a native of Durham, CT, is a first-generation college graduate from an agricultural background. She graduated cum laude from UConn in 2020 and was first introduced to research through a one-year-long internship in the **da Silva Lab** at CAES working with plant viruses. In June 2021, she was awarded The State University of New York (SUNY) Graduate Diversity Fellowship and admitted to Cornell to pursue her Ph.D. in the Casteel Lab. Her research is focused on elucidating the molecular mechanisms behind vector fecundity and viral pathogenesis in plant host organisms. Kudos Madeleine!

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