# Station News

The Connecticut Agricultural Experiment Station
Volume 14 Issue 1 | January 2024

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

CAES

The Connecticut Agricultural Experiment Station

*Putting Science to Work for Society since 1875*

## This Issue

# ADMINISTRATION

**JASON C. WHITE, PH.D.,** along with **Yi Wang, Ph.D.** met by Zoom with collaborators at the University of Massachusetts to discuss a progress of a USDA collaborative project (December 1); participated by Zoom in the bi-monthly faculty call for the NSF Center for Sustainable Nanotechnology (CSN) (December 1, 15); met by Teams with collaborators at the University of Minnesota and Katana Agriscience Corporation to discuss collaborative research (December 1, 7, 21); along with **Nubia Zuverza-Mena, Ph.D., Sara Nason, Ph.D., and Jasmine Jones**, attended 2023 NIEHS Superfund Basic Research Program (SRP) Annual Grant Recipient Meeting in Albuquerque NM (December 3-6); hosted a Zoom call with collaborators from the University of Birmingham UK to discuss a collaborative grant proposal (December 8); along with **CAES VICE DIRECTOR, LINDSAY TRIPLETT, PH.D.,** met with the Minister of Agriculture of Jamaica and his colleagues, discussed CAES research programs, and opportunities for collaboration (December 11); participated in a Teams call with a large number of colleagues from the European Union to discuss a potential European Horizon grant submission (December 12); along with **CHRISTIAN DIMKPA, PH.D.** and **Shital Vaidya, Ph.D.,** hosted a Zoom call with collaborators at Johns Hopkins University to discuss progress on a joint USDA nanoscale phosphorus project (December 12); met by Teams with the CT Commissioner of Agriculture to discuss PFAS testing of agricultural soils (December 12); hosted the monthly CSN Nanochem-plant working group call (December 12); met by Teams with staff from the Department of Consumer Protection Division of Drug Control to discuss the Adult Use Cannabis program (December 12, 13); along with **Blaire Steven, Ph.D.,** participated in a Zoom call with colleagues at the University of Delaware and the National Research Council of Italy to discuss collaborative research on a new USDA project (December 13); participated in the weekly CSN all hands Zoom call (December 13); along with **Raja Muthuramalingam, Ph.D., CHRISTIAN DIMKPA, PH.D.,** and **Nubia Zuverza-Mena, Ph.D.,** participated in a Zoom call with collaborators at the Brazilian Agricultural Research Corporation and discussed future collaborative research (December 14); attended the Bond Commissioner meeting at the Legislative Office Building and secured funding for the CAES New Haven greenhouse renovation project (December 15); travelled to the University of Minnesota in Minneapolis MN to meet with collaboratives and discuss joint research projects (December 18); participated in a Teams call with Representative Gresko of Stratford to discuss issues of relevance to the Environment Committee (December 19); hosted the monthly CAES j-visa recipient meeting (December 20); hosted the quarterly CAES Safety Committee meeting (December 21); participated in a Zoom call with collaborators at Johns Hopkins University and discussed joint research (December 21); along with **Susanna Kerio, Ph.D.,** participated in a Teams call with Prof. Ali Nikbakht of Isfahan University of Technology in Iran and discussed future collaborative research (December 22); and along with Department of Analytical Chemistry staff, hosted an undergraduate student from the University of Rhode Island and gave a tour and description of nanotechnology programs (December 22).

## PUBLICATIONS:

**1.** Lian, J.; Huang, X.; Cheng, L.; Zhai, X.; Wu, R.; Chen, Y.; **Deng, C.; Wang, Y.;** Pan, J.; Shohag, M.J.I.; Xin, X.; He, Z.; Yang, X. **White, J.C**. (2023). A bespoke ZnO NPs synthesis platform to optimize their performance for improving grain yield, zinc biofortification and Cd mitigation in wheat. *ACS Sus. Chem. Eng.* https://doi.org/10.1021/acssuschemeng.3c04045.

**Abstract:** Nanomaterials (NMs) as fertilizers have tremendous potential for improving crop production, mineral nutrition and food safety in sustainable agriculture. However, custom synthesis of NMs to optimize performance is still a bottleneck. Three types of ZnO NPs (nZnO-1, nZnO-2 and nZnO-3) with different physicochemical properties were synthesized by a thermal decomposition method and were foliar applied on wheat to investigate efficacy on grain yield, Zn biofortification and Cd alleviation under field conditions. nZnO-3 significantly increased wheat grain (15.2%) and biological yield (9.5%) compared to the control. Both nZnO-2 and nZnO-3 not only significantly improved the Zn content in the whole wheat grain (21.0% and 15.6%) and starchy endosperm (31.8% and 13.1%), but also enhanced the bioavailability (40.9% and 43.3%) and estimated daily intake (EDI) of Zn (55.1% and 23.8%) relative to the control. Notably, although nZnO-3 significantly reduced Cd concentration in whole wheat grain (17.2%), the enriched Zn, Fe and decreased phytate would also collectively reduce the Cd bioavailability in wheat flour. In addition, foliar spray of ZnO NPs improved nutritional quality of wheat grains by increasing the crude protein and nutrient (S, Mn, Fe, Cu) content. Taken together, these findings demonstrate a feasibility of Zn biofortification coupled with improved wheat grain yield and reduced Cd content through the foliar application of custom synthesized ZnO NPs.

**2.** Xu, X.; Liang, A.; Li, H.; Shang, H.; Qian, K.; **White, J.C**.; Ma, C.; Xing, B. (2023). Foliar applied ZnO quantum dots boost pumpkin (*Cucurbita moschata* Duch.) growth and positively alter endophytic and rhizosphere microbial communities. *ACS Sus. Chem. Eng. 11, 23,* 8503–8516. https://doi.org/10.1021/acssuschemeng.3c00954

**Abstract:** Systematically understanding the impact of nanomaterials (NMs) on the health and activity of plant-associated microorganisms is needed for the sustainable development of efficient nano-enabled agrochemicals. The present study investigated the effects of foliar exposure to different sizes of ZnO particles, including ZnO quantum dots (ZnO QDs, 5 nm), ZnO nanoparticles (ZnO NPs, 50 nm), bulk-scale ZnO particles (ZnO BPs) and Zn ions at equivalent Zn molar concentration on the endophytic and rhizosphere microbial communities of pumpkin seedlings. ZnO QDs increased total plant biomass by 24.6% as compared to other Zn treatments. ZnO QDs also increased the pigment content, elevated micronutrient (Zn, Fe and B) uptake and triggered the activities of antioxidant enzymes (CAT, POD and PPO) as compared to controls. The composition and diversity of the endophytic and rhizosphere bacterial or fungal communities were significantly altered as a function of ZnO NMs size. LEfSe analysis results show that the beneficial host microbes Steroidobacter (1.05%) and Paenibacillus (0.59%) were enriched in pumpkin seedlings treated with ZnO QDs, which may lead to greater plant growth, nutrient acquisition, and stress resistance. Co-occurrence networks indicate that ZnO QDs increased the node numbers and link numbers of the bacterial networks by 46.94% and 123.38% in the roots, which could further stabilize the microbial community and confer resistance to environmental disturbance. Our overall findings demonstrate that ZnO QDs could enhance plant growth both directly by positively impacting crop physiology and indirectly by modulating beneficial endophytic and rhizosphere microorganisms. These findings add to the growing body of

evidence demonstrating that nano-enabled strategies can be a promising and sustainable approach to increase crop growth and resistance to stress.

**3.** Li, H.; Guo, Y.; Liang, A.; Xu, X.; Shang, H.; Li, C.; Cai, Z.; Han, L.; Zhao, J.; **White, J.C**.; Ma, C.; Xing, B. 2023. Commonly used engineered nanomaterials improve soil health via suppressing soil-borne Fusarium and positively altering soil microbiome. *ACS Environ. Sci. Eng.* https://doi.org/10.1021/acsestengg.3c00501

**Abstract:** The use of engineered nanomaterials (NMs) as novel antimicrobial agents has garnered significant attention in agriculture. The antimicrobial properties of 50 mg/kg metal oxide (CuO and ZnO NPs)- and carbon (rGO and MWCNT)-based NMs on two soil borne fungal pathogens, Fusarium oxysporum f. sp. Lactucae and Fusarium oxysporum f. sp. Lycopersici, were evaluated over a 21 day incubation period. Both metal- and carbon-based NMs reduced the dehydrogenase activity Fusarium-infested soil by more than 40% relative to the infested controls; the efficacy of antifungal efficacy was: CuO NPs>ZnO NPs>rGO>MWCNT. Similar decreases in the soil activities of urease (UE), sucrase (SC), acid phosphatase (ACP), and polyphenol oxidase (PPO) suggest that NMs could effectively inhibit Fusarium growth in soil over time. The total available metal fractions, including acid extractable fraction, Fe/Mn oxidation state and the fraction bound to organic matter, were increased by 5.99-7.29% with metal-based NM compared to the infested controls. The Shannon index of microbial communities in the infested soils with metal-based NMs were increased by 12.2-23.5% relative to infested controls. Similarly, carbon-based NMs increased the Shannon index of the fungal community by 10.18-29.86%. Importantly, the relative abundance of Fusarium was decreased with both metal- and carbon-based NM. NMs also increased the relative abundance of beneficial microorganisms in infested soil, such as Pseudomonas, which was increased by 29.7-96.2% with metal-based NM relative to the untreated controls. These findings demonstrate that NMs at appropriate dose could suppress the Fusarium abundance and subsequent crop damage while simultaneously fostering the development of beneficial microorganisms in soil.

Jasmine Jones, Sara Thomas, Ph.D. and Jason White, Ph.D. with collaborators from the


University of Minnesota and University of Massachusetts attending the 2023 NIEHS Superfund Basic Research Program (SRP) Annual Grant Recipient Meeting in Albuquerque NM.

# Analytical Chemistry

**Eliézer de Oliveira** from Brazil has joined the Department of Analytical chemistry on December 04, 2023, as visiting researcher. He is pursuing his Ph.D. at the University of Campinas, Brazil. His Research interests include the development of LC-MS/MS methods, sample preparation, pesticides translocation, and use of strategies for improve pesticide mobility. Mr. Eliézer would be at CAES for 6 months where the focus of his study will be on soil mobility of nanoencapsulated abamectin for nematicidal purposes.

**Luyao Qin** from Chinese Academy of Agricultural Science in China has joined the Department of Analytical Chemistry on December 20, 2023, as a postdoctoral visiting researcher. Her Research interests include: 1) remediation of contaminated soils, 2) heavy metal uptake, translocation, and accumulation in soil-plant system, 3) ecological risk assessment of contaminated agricultural soils, 4) mitigation measures and regulations of heavy metals in agro-soil contaminations. Luyao Qin will be at CAES for three years where the focus of her study will be on nano-material application on agricultural soil-plant system.

# Entomology

**GOUDARZ MOLAEI, PH.D.** attended the first joint meeting between the Northeast Regional Center of Excellence in Vector-Borne Diseases (NEVBD) and Training and Evaluation Center (TEC) Leadership and advisory board to discuss the NEVBD-TEC programming (December 11); attended the CDC Cross-Centers of Excellence for Vector-Borne Diseases Working Group on Public Health Entomology and reviewed the training activities and priorities and discussed training needs assessment collaborations (December 18); and, as a member of the stakeholders advisory council, attended the quarterly meeting of the New England Center of Excellence in Vector-Borne Diseases (NEWVEC) and discussed the projects' updates and progress (December 18).

**PHILIP ARMSTRONG, PH.D.** gave a talk titled "An Overview of Jamestown Canyon Virus: Epidemiology and Ecology of an Emerging Arbovirus" at the Annual Northeastern Mosquito Control Association Meeting held in Mystic, CT (December 5).

**ANGELA BRANSFIELD** participated via Zoom in Yale University's Biosafety Committee meeting (December 14); and participated in a CAES Health and Safety Committee meeting (December 21).

**HANY DWECK, PH.D.** presented a talk on chemoreception in fruitflies at Quinnipiac University (December 5).

**DAVID GIESBRECHT, PH.D.** presented a talk on "genomic approaches to better understand insecticide resistance in *Culex pipiens*" at the Northeast Mosquito Control Association Annual Meeting in Mystic, Connecticut (December 4-6).

**MEGAN LINSKE, PH.D.** participated in the Northeast Regional Center of Excellence in Vector-Borne Diseases (NEVBD) and Training and Evaluation Center (TEC) Leadership Meeting to discuss current and future projects and advancements (December 11); participated in a meeting with Ms. Briana Brady and Ms. Clare Turner from the University of Connecticut's Natural Resources and the Environment Department to discuss upcoming internship opportunities (December 13 and 18); participated in a call with staff from the Centers for Disease Control and Prevention (CDC) Division of Vector-Borne Diseases on progress made on a funded integrated tick management project (December 20); and participated in a meeting with Banfield Bio, Inc. and North Carolina State University to discuss updates in field and laboratory trials (December 27).

**TANYA PETRUFF** gave a talk entitled "Evaluation of New Trapping Sites Established After the EEE Outbreak of 2019" at the 2023 annual meeting of the Northeastern Mosquito Control Association in Mystic, Connecticut (December 4-6).

**GALE RIDGE, PH.D.** attended a two-day virtual workshop sponsored by the National Academies of Sciences, Engineering, and Medicine on mitigating arboviral threats and strengthening public health preparedness (December 12-13); and attended a webcast sponsored by the National Academies of Sciences, Engineering, and Medicine on assessment of the impact of social media on the health and wellbeing of adolescents and children (December 13).

**JOHN SHEPARD** participated at the Board of Directors meeting of the Northeastern Mos-

quito Control Association (NMCA) (December 3); presented "Arbovirus Activity in Connecticut, 2023" and "Jamestown Canyon Virus: Key Mosquito Species in the Northeast" at the 69th Annual Meeting of the NMCA, Mystic, CT, (December 4-6); and will continue to serve as 2nd Vice President of the NMCA in 2024.

**VICTORIA SMITH, PH.D.** participated in a webinar, sponsored by the US EPA Center for Integrated Pest Management, on beech leaf disease (December 5); was interviewed by students from the Mill River Park Collaborative about spotted lanternfly (December 7); and participated in a national task force, with representatives from USDA-Plant Protection and Quarantine, Oregon Dept. of Agriculture, Ohio Dept. of Agriculture, and Virginia Dept. of Agriculture and Consumer Services, to develop best management practices, FAQ's, model regulations, and pest alerts, on box tree moth, held on the Venture Campus of North Carolina State University, Raleigh, NC (December 10-13).

**TRACY ZARRILLO** participated in a virtual meeting with Ms. Casey Johnson of the University of Rhode Island to discuss an NRCS pollinator habitat project (December 1); was interviewed by Ms. Tabitha Baker of the University of Connecticut's journalism program about bee decline and climate change (December 4); participated in a virtual meeting with Dr. Neil Cobb of the Biodiversity Outreach Network to discuss the 'Tropics to Tundra' wild bee project (December 4); and participated in a virtual meeting of the Invertebrate Taxa Team for the upcoming Connecticut State Wildlife Action Plan to discuss invertebrate species of greatest conservation need in Connecticut (December 5).

**KIRBY C. STAFFORD III, PH.D. (EMERITUS)** participated in a meeting of the NEVBD-TEC (Training Evaluation Center) meeting as an Advisory Board Member (December 11).

## GRANTS:

**KELSEY E. FISHER, PH.D.** was awarded the 2023 Louis A. Magnarelli Postdoctoral Fellowship for the project "Habitat suitability and connectivity for *Bombus* spp. in Connecticut" (Dec 14); and was selected as a recipient of the North American Pollinator Protection Campaign (NAPPC) Lepidoptera Grant for the proposal "Strategic mowing to enhance monarch butterfly oviposition and larval survival rates in Connecticut" ($10,000, December 19).

**DAVID GIESBRECHT, PH.D.** was awarded the 2023 Northeast Mosquito Control Association's McColgan grant in-aid ($2,000, December 4-6).

## PUBLICATIONS:

**1. LaReau J.C.**, Hyde J., **Brackney D.E.**, **Steven B.** (2023). Introducing an environmental microbiome to axenic *Aedes aegypti* mosquitoes documents bacterial responses to a blood meales. *Appl Environ Microbiol. 89(12):e0095923.* DOI: https://doi.org/10.1128/aem.00959-23

**Abstract:** The blood meal of the female mosquito serves as a nutrition source to support egg development, so is an important aspect of its biology. Yet, the roles the microbiome may play in blood digestion are poorly characterized. We employed axenic mosquitoes to investigate how the microbiome differs between mosquitoes reared in the insectary versus

mosquitoes that acquire their microbiome from the environment. Environmental microbiomes were more diverse and showed larger temporal shifts over the course of blood digestion. Importantly, only bacteria from the environmental microbiome performed hemolysis in culture, pointing to functional differences between bacterial populations. These data highlight that taxonomic differences between the microbiomes of insectary-reared and wild mosquitoes are potentially also related to their functional ecology. Thus, axenic mosquitoes colonized with environmental bacteria offer a way to investigate the role of bacteria from the wild in mosquito processes such as blood digestion, under controlled laboratory conditions.

# Environmental Science & Forestry

**SCOTT WILLIAMS, PH.D.** participated in a Zoom call with collaborators from the CDC-funded Northeast Vector-Borne Disease Training and Evaluation Center (TEC) about steps forward on field-testing the efficacy of a reservoir-targeted vaccine against *Borrelia burgdorferi* (December 5); gave invited presentation to members of the New England Regional Center of Vector-borne Diseases about past experiences with reservoir-targeted vaccine efforts against *Borrelia burgdorferi* and potential research avenues moving forward (15 attendees) (December 5); met with staff from MaineHealth about collaborative research on integrated host-targeted systemic acaricide treatment against blacklegged ticks at the Northeast Mosquito Control Association Meeting in Mystic, CT (December 5); participated in a Zoom call with staff with Yale University Pathology and Comparative Medicine about modeling Covid-19 infection in deer and mice in Connecticut (December 8); participated in a Leadership Meeting for the CDC-funded Northeast Vector-Borne Disease TEC (December 11); met with a University of Connecticut undergraduate student regarding building her resume with experience in field work (December 13); met with a University of Connecticut undergraduate student regarding building her resume with experience in field work and a potential internship (December 18); participated in a Zoom call with staff from the CDC Division of Vector-Borne Diseases on progress made on a funded integrated tick management project (December 20).

**JOSEPH P. BARSKY** participated in the quarterly virtual meeting of the New England Society of American Foresters Executive Board (December 13).

**GREGORY BUGBEE** interviewed by Brian Smith as part of a podcast on the CAES Office of Aquatic Invasive Species (December 20); interviewed by Ed Mahoney of the Hartford Current on CAES work with Northeastern University on remote sensing of *Hydrilla* in the Connecticut River (December 21).

**JEREMIAH FOLEY, IV, PH.D.** was interviewed by Northeastern Global News about his role as an advisor to a group of 19 mechanical and computer engineering students working on their capstone project. The project centers around developing an autonomous rover with the ability to detect *Hydrilla* underwater using hyperspectral analysis. The article "Northeastern students develop robotic boat to attack invasive plants" was published by "The ROBOT REPORT" (December 17).

**SUSANNA KERIÖ, PH.D.** met with staff from Bartlett Tree Service to discuss a grant proposal (December 1); participated in an NSF grant discussion led by Tara Trammell , Ph.D. (University of Delaware) with a team of scientists (December 5, 12, 19); administered the State of Connecticut certifying arborist exam (December 13); attended the CT Urban Forest Council's conference committee meeting (December 21); met with Ali Nikbakht, Ph.D. (Isfahan University of Technology, Iran) and Jason White, Ph.D. to discuss collaboration on nanotechnology in tree care (December 22).

**SARA NASON, PH.D.** participated in the NORMAN (network of reference laboratories, research centers and related organizations for monitoring of emerging environmental substances) Workshop on Chemical Pollutants and Biodiversity (December 6); participated in the Toxicology Rounds seminar at the CT Public Health Laboratory (December 7); participated in the CT PFAS testing Laboratory Capacity and Capability discussion group meeting

(December 12); participated in virtual meetings for the Best Practices for Non-Targeted Analysis working group (December 12-15, 19).

**ELISABETH WARD, PH.D.** participated in the Beech Leaf Disease working group meeting (December 4); participated in the Master Woodland Managers partners meeting (December 5); participated in the Connecticut Council on Soil and Water Conservation Soil Health Committee meeting (December 12); participated in the Forest Ecosystem Monitoring Cooperative Joint Steering Committee/State Coordinators Committee meeting (December 13); shared Connecticut Forest Health updates from **Carole Cheah, Ph.D., Claire Rutledge, Ph.D., Victoria Smith, Ph.D., Jeffrey Ward, Ph.D.**, and **Joseph P. Barsky** at the annual Forest Ecosystem Monitoring Cooperative conference in Burlington, VT (250 participants) (December 14); met with Danica Doroski (Urban Forestry Coordinator, CT DEEP) and Annie Mixsell (Tree Warden, City of New Haven) to discuss management of beech leaf disease in forested urban natural areas (December 20); presented an invited seminar titled "Linking plant mycorrhizal associations to soil organic matter dynamics in forests: The role of ericoid mycorrhizal plants and fungi" at the New York Botanical Garden (30 participants) (December 21).

**JEFFREY WARD PH.D.** participated in a meeting of the Great Mountain Forest Trustees in Norfolk (December 9).

**LEIGH WHITTINGHILL, PH.D.** participated in the Connecticut State Consulting Committee for Agricultural Science and Technology Education quarterly meeting as the CAES representative (December 7); participated in the CT Council on Soil and Water Conservation Soil Health Committee meeting (December 12); participated in the CAES DEI committee meeting (December 12).

**YINGXUE (CHARLIE) YU, PH.D.** presented oral presentation "Transport of Biodegradable Nanoplastics Affected by Weathering and Proteins in Unsaturated Porous Media" at the American Geophysical Union Annual Conference, San Francisco, CA (50 attendees) (December 11-15); hosted visiting Washington State University Ph. D. student Xueyu Zhou working on column transport experiments (December 26-29).

## PUBLICATIONS:

**1.** Earnest, R., Hahn, A. M., Feriancek, N. M., Brandt, M., Filler, R. B., Zhao, Z., Breban, M. I., Vogels, C. B. F., Chen, N. F. G., Koch, R. T., Porzucek, A. J., Sodeinde, A., Garbiel, A., Keanna, C., Litwak, H., **Stuber, H. R.**, **Cantoni, J. L.**, Pitzer, V. E., Olarte Castillo, X. A., Goodman, L. B., Wilen, C. B., **Linske, M. A.**, **Williams, S. C.**, and Grubaugh, N. D. (2023). Survey of white-footed mice (*Peromyscus leucopus*) in Connecticut, USA reveals low SARS-CoV-2 seroprevalence and infection with divergent betacoronaviruses. *npj Viruses 1*: 10. DOI: 10.1038/s44298-023-00010-4.

**Abstract**: Diverse mammalian species display susceptibility to SARS-CoV-2. Potential SARS-CoV-2 spillback into rodents is understudied despite their host role for numerous zoonoses and human proximity. We assessed exposure and infection among white-footed mice (*Peromyscus leucopus*) in Connecticut, USA. We observed 1% (6/540) wild-type neutralizing antibody seroprevalence among 2020–2022 residential mice with no cross-

neutralization of variants. We detected no SARS-CoV-2 infections via RT-qPCR but identified non-SARS-CoV-2 betacoronavirus infections via pan-coronavirus PCR among 1% (5/468) of residential mice. Sequencing revealed two divergent betacoronaviruses, preliminarily named *Peromyscus coronavirus*-1 and -2. Both belong to the *Betacoronavirus 1* species and are ~90% identical to the closest known relative, *Porcine hemagglutinating encephalomyelitis* virus. In addition, to provide a comparison, we also screened a species with significant SARS-CoV-2 infection and exposure across North America: the white-tailed deer (*Odocoileus virginianus*). We detected no active coronavirus infections and 7% (4/55) wild-type SARS-CoV-2 neutralizing antibody seroprevalence. Low SARS-CoV-2 seroprevalence suggests white-footed mice may not be sufficiently susceptible or exposed to SARS-CoV-2 to present a long-term human health risk. However, the discovery of divergent, non-SARS-CoV-2 betacoronaviruses expands the diversity of known rodent coronaviruses and further investigation is required to understand their transmission extent.

**2.** Safanelli, J. L, Sanderman, J., Bloom, D., Todd-Brown, K., Parente, L. L., Hengl, T., Adam, S., Albinet, F., Ben-Dor, E., Boot, C. M., Bridson, J. H., Chabrillat, S., Deiss, L., Dematte, J. A. M., Demyan, M. S., Dercon, G., Doetterl, S., van Egmond, F., Ferguson, R., Garrett, L. G., Haddix, M. L., Haefele, S. M., Heiling, M., Hernandez-Allica, J., Huang, J., Jastrow, J. D., Karyotis, K., Machmuller, M., Malefetsane, K., Margenot, A., Matamala, R., Miesel, J. R., Mouazen, A. M., Nagel, P., Patel, S., Qaswar, M., Ramakhanna, S., Resch, C., Robertson, J. A. H., Roudier, P., Sabetizade, M., **Shabtai, I.**, Sherif, F., Sinha, N. K., Six, J., Summerauer, L., Thomas, C. L., Toloza, A., Tomczyk, B., Tsakiridis, N. L., van Wesemael, B., Woodings, F., Zalidis, G., Żelazny, W. R. (2023). An interlaboratory comparison of mid-infrared spectra acquisition: Instruments and procedures matter. *Geoderma 440*: 116724. DOI: 10.2139/ssrn.4548803.

**Abstract**: Diffuse reflectance spectroscopy has been extensively employed to deliver timely and cost-effective predictions of a number of soil properties. However, although several soil spectral laboratories have been established worldwide, the distinct characteristics of instruments and operations still hamper further integration and interoperability across mid-infrared (MIR) soil spectral libraries. In this study, we conducted a large-scale ring trial experiment to understand the lab-to-lab variability of multiple MIR instruments. By developing a systematic evaluation of different mathematical treatments with modeling algorithms, including regular preprocessing and spectral standardization, we quantified and evaluated instruments' dissimilarity and how this impacts internal and shared model performance. We found that all instruments delivered good predictions when calibrated internally using the same instruments' characteristics and standard operating procedures by solely relying on regular spectral preprocessing that accounts for light scattering and multiplicative/additive effects, e.g., using standard normal variate (SNV). When performing model transfer from a large public library (the USDA NSSC-KSSL MIR library) to secondary instruments, good performance was also achieved by regular preprocessing (e.g., SNV) if both instruments shared the same manufacturer. However, significant differences between the KSSL MIR library and contrasting ring trial instruments responses were evident and confirmed by a semi-unsupervised spectral clustering. For heavily contrasting setups, spectral standardization was necessary before transferring prediction models. Non-linear model types like Cubist and memory-based learning delivered more precise estimates because they seemed to be less sensitive to spectral variations than global partial least square regression. In summary,

the results from this study can assist new laboratories in building spectroscopy capacity utilizing existing MIR spectral libraries and support the recent global efforts to make soil spectroscopy universally accessible with centralized or shared operating procedures.

**OTHER DEPARTMENTAL NEWS:**

On September 22, 2023, **Summer Stebbins** and Benjamin Weidman got married at Wickham Park in Manchester, CT. Congratulations Summer!

# Plant Pathology & Ecology

**WASHINGTON DA SILVA, PH.D.** taught principles of virology (lectures and Labs), a discipline that he offers every December to graduate students from the Department of Plant Sciences at the Universidade Federal Rural do Semi-arido (UFERSA) in Mossoro, Brazil (15 attendees) (December 4-22).

**YONGHAO LI, PH.D.** instructed "Phytophthora bleeding canker" in the Review Night of the Connecticut Tree Protective Association Arboriculture 101 Course in New Haven (30 attendees) (December 7), with **Felicia Millett**, talked about the Plant Disease Information Office with The Jamica Minister of Agriculture, Fishing, and Mining as a part of the CAES tour (6 attendees) (December 11), participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (7 attendees) (December 13), participated in the Plant Diagnostic Network Northeast Reginal Monthly Meeting via Zoom (17 attendees) (December 14)

**ROBERT MARRA, PH.D.** served as examiner for oral exams for TPX Arborist Certification (March 13).

**FELICIA MILLETT** participated in the monthly meeting of the Beech Leaf Disease Working Group (46 attendees) (December 4); assisted students in the CTPA Arboriculture 101 course on Review Night in New Haven (30 attendees) (December 7); participated in the NPDN National Meeting Workshops and Fieldtrips Sub-Committee Meeting (6 attendees) (December 11); gave tour of seed testing in the PDIO Lab to the Jamica Minister of Agriculture, Fishing, and Mining as a part of the CAES tour (6 attendees) (December 11); and participated in the NPDN Proficiency Committee Meeting (6 attendees) (December 19).

**QUAN ZENG, PH.D.** participated the Phytopathology Senior Editors' meeting through Zoom (December 4), participated the Microbiology Spectrum Editors' meeting through Zoom (December 4), hosted Mr. Evan Lentz (UConn fruit extension educator) for a visit and discussed collaboration opportunities (Dec 11).

**PUBLICATIONS:**

1. **Li, Y.** (2023). Dollar spot of turf grass in home lawns. *CAES Fact Sheet*.

DOI:https://portal.ct.gov/-/media/CAES/PDIO/Fact-Sheets/Dollar-Spot-of-Turfgrass-in-Home-Lawns.pdf

**2. Li, Y.** (2023). Gray snow mold of turf grass in home lawns. *CAES Fact Sheet*.

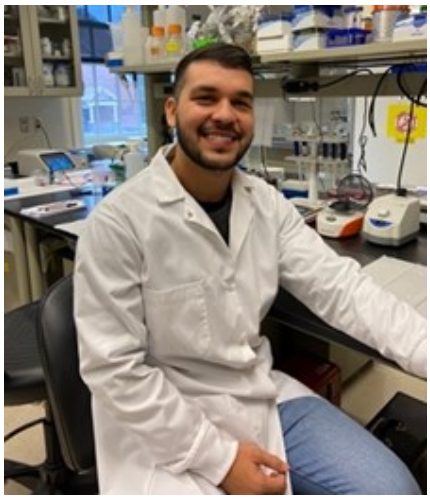
DOI:https://portal.ct.gov/-/media/CAES/PDIO/Fact-Sheets/Gray-Snow-Mold-of-Turfgrass-in-Home-Lawns.pdf

**GRANTS:**

**RAQUEL ROCHA, PH.D.** in collaboration with Claudia Dias-Arieira, Ph.D. from State University of Mariga-Brazil was awarded a CAPES-PrInt grant for $13,300 for a joint project to study virulence mechanisms of root-knot nematodes. The award will be used to host the student Monique Rodrigues e Silva to perform experiments at CAES in 2024.

## OTHER DEPARTMENTAL NEWS:

**Jarlan Silva** a Master's student in plant sciences at the Universidade Federal Rural do Semi-arido (UFERSA) joined the Department of Plant Pathology and Ecology working with **Washington Da Silva, Ph.D.** Jarlan will work on the identification of several isolates of fusaria that cause disease in papaya in the state of Rio Grande do Norte in Brazil.



**Igor da Silva** an undergraduate student in Agronomy at the Universidade Federal Rural do Semi-arido (UFERSA) joined the Department of Plant Pathology and Ecology working with **Washington Da Silva, Ph.D.** Igor will stay at the da Silva Lab for three months to be trained on molecular techniques to identify fungal species.

# Valley Laboratory

**CAROLE CHEAH, PH.D.**, was interviewed by Michayla Savitt, for Connecticut Public Radio on impacts of climate change on hemlocks and hemlock woolly adelgid (December 6) (https://www.nhpr.org/2023-12-28/milder-winters-mean-more-of-this-insect-invading-cts-hemlock-trees).

## GRANT:

NSF-BSF: Synthetic mycorrhizal community (SynMC) and parasitism management in rhizosphere ecosystems guided by systems biology of mycoparasitism. PI: Jeffrey P. Townsend, Yale University, CoPIs: Zheng Wang, Yale University, and **DEWEI LI**, CAES, BSF collaborator PI: Oded Yarden, The Hebrew University of Jerusalem. CAES portion of the grant: $131,660, 2023-2025.

## PUBLICATIONS:

**1.** Hyde, K.D., Abdel-Wahab, M.A., Abdollahzadeh, J., **Li, DW**, et al. (2023). Global consortium for the classification of fungi and fungus-like taxa. *Mycosphere 14(1),* 1960–2012, DOI: MYCOSPHERE_14_1_23-1.pdf

**Abstract:** The Global Consortium for the Classification of Fungi and fungus-like taxa is an international initiative of more than 550 mycologists to develop an electronic structure for the classification of these organisms. The members of the Consortium originate from 55 countries/regions worldwide, from a wide range of disciplines, and include senior, mid-career and early-career mycologists and plant pathologists. The Consortium will publish a biannual update of the Outline of Fungi and fungus-like taxa, to act as an international scheme for other scientists. Notes on all newly published taxa at or above the level of species will be prepared and published online on the Outline of Fungi website (https://www.outlineoffungi.org/), and these will be finally published in the biannual edition of the Outline of Fungi and fungus-like taxa. Comments on recent important taxonomic opinions on controversial topics will be included in the biannual outline. For example, 'to promote a more stable taxonomy in Fusarium given the divergences over its generic delimitation', or 'are there too many genera in the Boletales?' and even more importantly, 'what should be done with the tremendously diverse 'dark fungal taxa?' There are undeniable differences in mycologists' perceptions and opinions regarding species classification as well as the establishment of new species. Given the pluralistic nature of fungal taxonomy and its implications for species concepts and the nature of species, this consortium aims to provide a platform to better refine and stabilise fungal classification, taking into consideration views from different parties. In the future, a confidential voting system will be set up to gauge the opinions of all mycologists in the Consortium on important topics. The results of such surveys will be presented to the International Commission on the Taxonomy of Fungi (ICTF) and the Nomenclature Committee for Fungi (NCF) with opinions and percentages of votes for and against. Criticisms based on scientific evidence with regards to nomenclature, classifications, and taxonomic concepts will be welcomed, and any recommendations on specific taxonomic issues will also be encouraged; however, we will encourage professionally and ethically responsible criticisms of others' work. This biannual ongoing project will provide an outlet for advances in various topics of fungal classification, nomenclature, and taxonomic concepts and lead to a community-agreed classification scheme for the fungi and fungus-like taxa. Interested parties should contact the lead author if they would like to be involved in future outlines.

**2.** He, J., **Li, D-W**, Cui, W-L, Zhu, L-H Lin Huang. (2024). Seven novel *Alternaria* species causing leaf blight of Chinese fir, *Cunninghamia lanceolata*. *MycoKeys 101*: 1–44. https://doi.org/10.3897/mycokeys.101.115370

**Abstract;** Chinese fir (*Cunninghamia lanceolata*) is a special fast-growing commercial tree species in China and has significant ecological and economic value. However, it experienced damage from leaf blight caused by pathogenic fungi of the genus *Alternaria*. To determine the diversity of *Alternaria* species associated with leaf blight of Chinese fir in China, infected leaves were collected from five major cultivation provinces (Fujian, Henan, Hunan, Jiangsu and Shandong provinces). A total of 48 fungal strains of *Alternaria* were obtained. Comparison of morphology and phylogenetic analyses, based on nine loci (ITS, SSU, LSU, GAPDH, RPB2, TEF1, Alt a1, endoPG and OPA10-2) of the representative isolates as well as the pairwise homoplasy index tests, revealed that the fungal strains belonged to seven undescribed taxa of *Alternaria*, which are described here and named as *Alternaria cunninghamiicola* **sp. nov.**, *A. dongshanqiaoensis* **sp. nov.**, *A. hunanensis* **sp. nov.**, *A. kunyuensis* **sp. nov.**, *A. longqiaoensis* **sp. nov.**, *A. shandongensis* **sp. nov.** and *A. xinyangensis* **sp. nov.** In order to prove Koch's postulates, pathogenicity tests on detached Chinese fir leaves revealed significant pathogenicity amongst these species, of which *A. hunanensis* is the most pathogenic to Chinese fir. This study represents the first report of *A. cunninghamiicola*, *A. dongshanqiaoensis*, *A. hunanensis*, *A. kunyuensis*, *A. longqiaoensis*, *A. shandongensis* and *A. xinyangensis* causing leaf blight on Chinese fir. Knowledge obtained in this study enhanced our understanding of *Alternaria* species causing leaf blight on Chinese fir and was crucial for the disease management and the further studies in the future.

**3.** He J, **Li D.-W.**, Cui W.-L., Zhu, L.-H., Huang, L. (2024). Morphological and phylogenetic analyses reveal three new species of *Fusarium* (Hypocreales, Nectriaceae) associated with leaf blight on *Cunninghamia lanceolata* in China. *MycoKeys 101*: 45–80. https://doi.org/10.3897/mycokeys.101.113128

**Abstract:** Chinese fir (*Cunninghamia lanceolata*) is a special fast-growing commercial tree species in China with high economic value. In recent years, leaf blight disease on *C. lanceolata* has been observed frequently. The diversity of *Fusarium* species associated with leaf blight on *C. lanceolata* in China (Fujian, Guangxi, Guizhou, and Hunan provinces) was evaluated using morphological study and molecular multi-locus analyses based on RNA polymerase second largest subunit (*RPB2*), translation elongation factor 1-alpha (*TEF-1α*), and RNA polymerase largest subunit (*RPB1*) genes/region as well as the pairwise homoplasy index tests. A total of five *Fusarium* species belonging to four *Fusarium* species complexes were recognized in this study. Two known species including *Fusarium concentricum* and *F. fujikuroi* belonged to the *F. fujikuroi* species complex, and three new *Fusarium* species were described, i.e., *F. fujianense* belonged to the *F. lateritium* species complex, *F. guizhouense* belonged to the *F. sambucinum* species complex, and *F. hunanense* belonged to the *F. solani* species complex. To prove Koch's postulates, pathogenicity tests on *C. lanceolata* revealed a wide variation in pathogenicity and aggressiveness among the species, of which *F. hunanense* HN33-8-2 caused the most severe symptoms and *F. fujianense* LC14 led to the least severe symptoms. To our knowledge, this study also represented the first report of *F. concentricum*, *F. fujianense*, *F. fujikuroi*, *F. guizhouense*, and *F. hunanense* causing leaf blight on *C. lanceolata* in China.

# JOURNAL ARTICLES APPROVED DECEMBER 2023

Ahmed, T., Noman, M., Ma, C., **White, J. C.**, Wang, Q., and Li, B. Quantum dots: A novel class of materials to manage plant diseases. *Trends in Plant Science*.

**Aikpokpodion, P. E.**, Hsiao, B., and **Dimkpa, C. O.** Mitigation of nitrogen loss in a plant-soil system by facile incorporation of nanocellulose and zinc. *Environmental Research*.

**Arsenault, T. L.**, **Prapayotin-Riveros, K.**, **Ammirata, M. A.**, **White, J. C.**, and **Dimkpa, C. O**. Compliance testing of hemp (*Cannabis sativa* L.) cultivars for total Delta-9 THC and total CBD using gas chromatography with flame ionization detection. *Plants*.

Huang, C.-H., Lewis, R., **Nason, S**., **Thomas, S.**, **Zuverza-Mena, N.**, O'Keefe, T., Tuga, B., Paredes-Beaulieu, A., Dalluge, J., **White, J. C.**, and Haynes, C. Designing ultraporous mesostructured silica nanoparticles for the remediation of Per- and Polyfluoroalkyl Substances. *ACS Nano*.

Jiang, Y., Sun, Y., Zhou, P., **White, J. C.**, Rui, Y., and Zhang, P. Recycled lithium battery nanomaterials as a sustainable nanofertilizer: Reduced peanut allergenicity and improved seed quality. *Nature Sustainability*.

**Li, Y.** Dollar spot of turfgrass in home lawns. *CAES Fact Sheet*.

**Li, Y.** Gray snow mold of turfgrass in home lawns. *CAES Fact Sheet*.

**Vaidya, S.**, **Deng, C.**, **Wang, Y.**, **Zuverza-Mena, N.**, **Dimkpa, C.**, and **White, J. C.** Nanotechnology in agriculture: A solution to global food insecurity in a changing climate? *NanoImpact*.

**Westrick, N.** and **Salvas, M.** First report of strawberry anthracnose crown rot caused by *Colletotrichum siamense* in New England. *Plant Disease*.

**Yu, Y.**, Qafoku, O., Kovarik, L., and Astner, A. F. Mobility of biodegradable nanoplastics in unsaturated porous media affected by protein-corona. *Environmental Science and Technology*.

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