Station News

The Connecticut Agricultural Experiment Station
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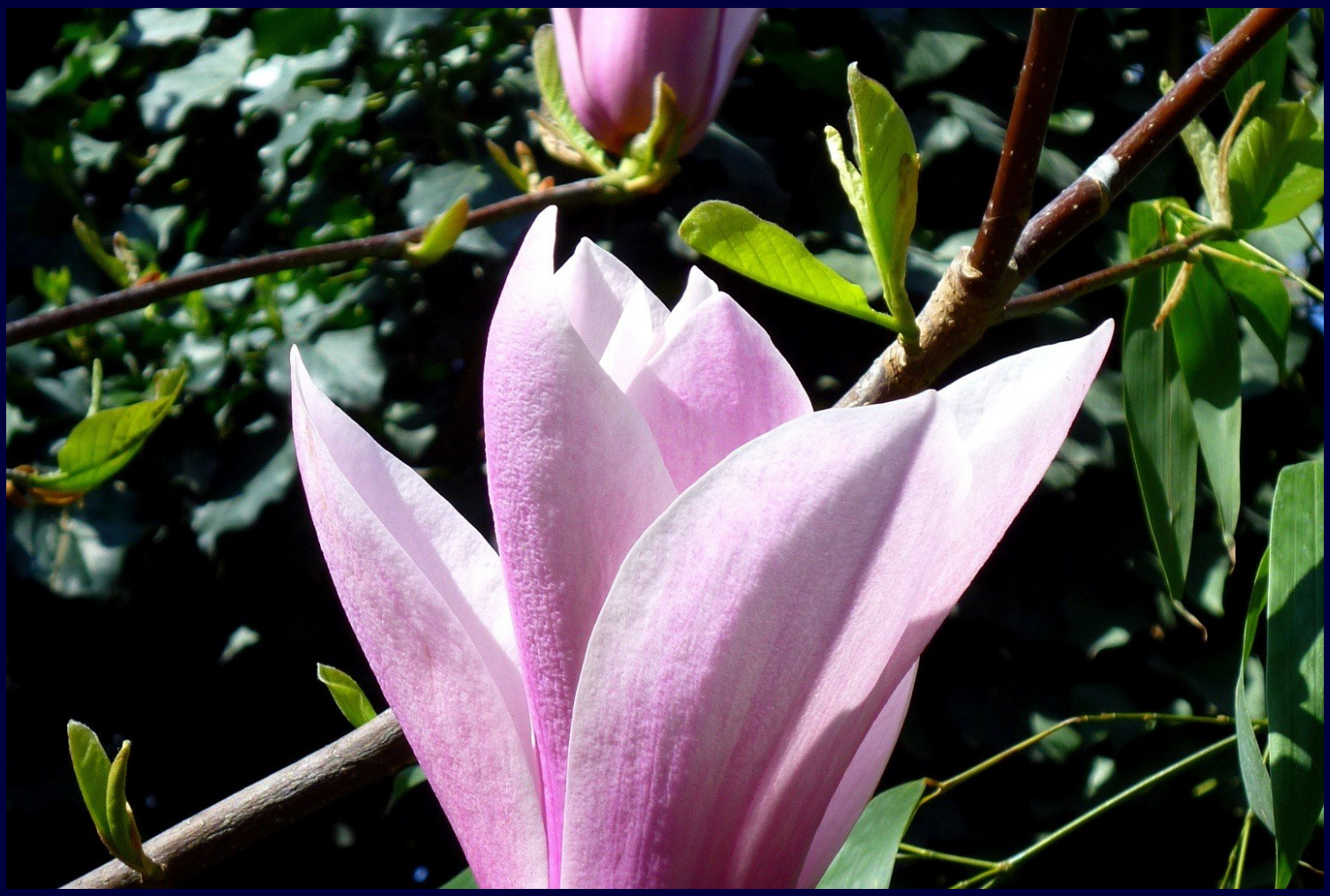


The mission of The Connecticut Agricultural Experiment Station is to develop, advance, and disseminate scientific knowledge, improve agricultural productivity and environmental quality, protect plants, and enhance human health and well-being through research for the benefit of Connecticut residents and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

CAES

The Connecticut Agricultural Experiment Station

Putting Science to Work for Society since 1875

This Issue

ADMINISTRATION

JASON C. WHITE, PH.D. along with **Nubia Zuverza-Mena, Ph.D., Jingyi Zhao, Ph.D., a**nd **Sara Nason, Ph.D.** participated in a Zoom meeting with collaborators at Yale University and the University of Minnesota for a joint NIEHS grant (February 4); participated in a Teams call with staff from the Department of Public Health, Department of Consumer Protection and the Department of Agriculture regarding potential study of PFAS levels in kelp (February 5); participated in the weekly NSF Center for Sustainable Nanotechnology (CSN) all hands call by Zoom (February 5, 12, 19); met by Zoom with colleagues at the University of Minnesota and Convergent Biosciences to discuss collaborative research (February 5, 25); spoke by with Paul Johson of FocusCuba about an upcoming visit to the Cuban Embassy in Washington DC to discuss collaboration on agricultural research, education and extension (February 6); participated in a Teams call with DEEP staff and members of the CT State Legislature's Environment Committee to discuss noenicitinoid pesticides (February 6, 24); travelled to the Cuban Embassy along with the Dean of UConn CAHNR and the Executive Director of AgInnovation Northeast to meet with officials and discuss collaborative work on agricultural research, education, and extension (February 10); hosted a Teams meeting of the CAES 150th anniversary committee (February 11); met by Teams with staff Attorneys from the Attorney General's Office to discuss the impacts of changes in federal funding (February 11); along with **Chaoyi Deng, Ph.D.** participated in a Zoom meeting with colleagues at Brookhaven National Laboratory to discuss collaborative research (February 12); participated by Zoom in the bimonthly meeting of the Farmland Preservation Advisory Committee meeting (February 13); along with **CHRISTIAN DIMPKPA, PH.D.** and **Sudhir Sharma, Ph.D.** participated in a Zoom call with colleagues at Johns Hopkins University and Stonybrook University to discuss collaborative research (February 13); hosted the monthly CAES j-visa recipient meeting (February 14); spoke with colleagues at the University of CT concerning funding of the Invasive Species Coordinator position (February 14; 24); along with **CHRISTIAN DIMPKPA, PH.D.** met by Zoom with collaborators at Johns Hopkins University and Stonybrook University to discuss a joint research proposal (February 17); met by Zoom with Dr. Hongda Chen of USDA NIFA to discuss funding and research programs (February 19); along with **CHRISTIAN DIMPKPA, PH.D.** met with staff scientists of Levo International to discuss collaborative research (February 19); spoke by phone with Ms. Traci Neal of the CT Farm Bureau regarding CAES programs (February 20); participated by Zoom in the PhD proposal defense of Mr. Xiupei Zhou of the University of Massachusetts (I am on his PhD committee)(February 21); spoke by Teams with Mr. Warren Schafer of Valent Biosciences regarding his upcoming visit to CAES (February 24); along with **Nubia Zuverza-Mena, Ph.D.** and **Mandeep Kaur, Ph.D.** met by Teams with colleagues at Rutgers University and the New Jersey Institute of Technology to discuss progress on a collaborative USDA project (February 24); met by Zoom with collaborators at the University of Minnesota regarding a PFAS remediation project in Belgium (February 25); travelled to the University of Texas El Paso and gave an invited seminar entitled "Nano-enabled agriculture: A path to global food security in a changing climate" and also met with collaborators and PhD students (February 25-28); and met by Zoom with staff at the Indian Embassy in Washington DC to discuss collaborative research (February 28).

PUBLICATIONS:

1. Oliveira, F. F.**,** Takeshita, V.**, Zuverza-Mena, N.,** Milagares, J.**, Tamez. C., Luiz da Silva, W.,** Oliveira, J. L.**,** Santo Pereira, A. E.**,** Fraceto, L. F.**,** Marques Rezende, J. A.**, Dimkpa, C., White, J. C. (**2025). Zein-based nanocarrier of the insecticide cyantraniliprole to control Bemisia tabaci MEAM1 (Whitefly). *ACS Agric. Sci. Technol.* DOI: 10.1021/acsagscitech.4c00751

Abstract: Bemisia tabaci, also known as whitefly, is a sap-sucking polyphagous insect that severely affects important crops worldwide. The growing demand for environmentally friendly and effective pest control measures necessitates new approaches to reduce the volume and frequency of insecticide application to crops while maintaining efficiency. This study aimed at developing and evaluating a biodegradable zein protein nanocarrier with the active ingredient (a.i.) cyantraniliprole (CNAP) for the control B. tabaci in tomato (Solanum lycopersicum). Synthesis of the nanoformulation (ZeinCNAP) resulted in spherical structures that remained stable over 56 days with an average hydrodynamic size of 157.6 nm, and a surface charge of 33.8 mV. The insect mortality by ZeinCNAP (30%) did not differ significantly from the commercial CNAP (42%) 48 h after spraying. However, when the ZeinCNAP dose was reduced to 1/10, insect mortality (39%) remained equivalent to the commercial CNAP at full dose 48 h after spraying (42%). The health aspects of the tomato plants treated with ZeinCNAP, including fresh mass, photosynthetic parameters, and oxidative stress, were analyzed and no significant negative effects were noted. The developed nanoinsecticide based on the zein platform and the active ingredient CNAP has significant potential for controlling on B. tabaci MEAM1 at reduced doses and can be considered safe for tomato plants. This work adds to a growing body of evidence demonstrating the potential of nanoscale carriers to significantly reduced the environmental burden associated with agrochemical use while still maintaining equivalent efficacy to conventional strategies.

2. Dong, C.**,** Cheng, Y.**,** Wu, M.**,** Wang, Q.**,** Zhang, Y.**,** **White, J. C.,** Xiang, H.**,** Cai, Y.**,** Li, Y.' Yu, B. (2025). Nanozeolite-coupled biochar-based controlled-release phosphorus fertilizer: Performance, release mechanism, and techno-economic analysis. *ACS Sus. Chem. Eng.* DOI: 10.1021/acssuschemeng.4c10901.

Abstract: Phosphorus fertilization is critical for crop production**,** however, traditional chemical phosphorus fertilizers (Chem-P) are highly inefficient, which leads to nutrient loss and environmental pollution. Here, a new nanozeolite-coupled biochar-based phosphorus fertilizer (ZEO/BC-PSRF) was developed using a simple disc granulation process, with kaolinite serving as a binder. The controlled-release performance of this fertilizer was evaluated through water release testing, where ZEO/BC-PSRF demonstrated the slowest phosphorus release, with only 29.4% being released after 24 h, compared with 43.8% for BC-PSRF (without nanozeolite), and 54.3% for Chem-P. Additionally, ZEO/BC-PSRF exhibited the best controlled-release performance in column leaching tests. A greenhouse pot experiment with tomato demonstrated that ZEO/BC-PSRF significantly enhanced seedling growth, and increased levels of vitamin C and lycopene in the harvested fruits compared with the BC-PSRF and Chem-P treatments. Mechanistic investigations suggest that the primary mechanism for the controlled release of phosphorus from ZEO/BC-PSRF is the enhanced adsorption of phosphorus onto the ZEO/BC. Further, ZEO/BC-PSRF maintained the highest available soil phosphorus content, promoting the growth of phosphorus-utilizing soil bacteria, and facilitating enhanced phosphorus uptake by tomato. An economic feasibility analysis confirmed the potential for cost-effective large-scale production, while a comparison of carbon emissions indicated that the application of ZEO/BC-PSRF had the capacity to reduce greenhouse gas emissions in contrast to traditional Chem-P. This study highlights the potential of combining biochar and zeolite as a sustainable and low-cost solution to enhance the efficacy of phosphorus fertilizers in agricultural production while simultaneously reducing carbon emissions.

3. Hussain, M.**,** Adeel, M.**,** **White, J. C.** (2025). Nano-selenium: A novel candidate for plant microbiome engineering. *Trends Plant Sci.* DOI: 10.1016/j.tplants.2025.02.002

Abstract: The soil microbiome drives plant health and productivity. A recent study mechanistically decoded a unique plant-microbe signaling cascade that enables selenium nanoparticles (SeNPs) formation by rhizosphere microbiota. These SeNPs boost maize performance

by enriching plant-beneficial bacteria in dose-dependent manner, offering new paradigm for nano-microbiome engineering to promote sustainable food production.

4. Kharaghani, D.**,** DeLoid, G. M.**,** He, P.**,** Swenor, B.**,** Huu Bui, T.**, Zuverza-Mena, N., Tamez, C., Musante, C.,** Verzi, M.**, White, J. C.,** Demokritou, P. (2025). Toxicity and absorption of polystyrene micro-nanoplastics in healthy and Crohn's disease human duodenum-chip models. *J. Haz. Mat.* 490, 137714.

Abstract: Micro and nanoplastics (MNPs) are widespread environmental and food web contaminants that are absorbed by the intestine and distributed systemically, but the mechanisms of uptake are not well understood. In a triculture small intestinal epithelial model, we previously found that uptake of 26 nm polystyrene MNPs (PS26) occurred by both passive diffusion and active actin- and dynamin-dependent mechanisms. However, studies in a more physiologically relevant model are
required to validate those results. Here, a microfluidic intestine-on-a-chip model was developed using primary human intestinal epithelial organoids from healthy and Crohn's disease donors, and used to evaluate the toxicity and mechanisms effectuating uptake of 25 nm polystyrene shell-gold core tracer MNPs (AuPS25). AuPS25 caused minimal toxicity after 24 h exposure in either healthy or Crohn's IOC models. RNAseq analysis of epithelial cells identified 9 genes dysregulated by AuPS25, including downregulation of IFI6 (interferon alpha-induced protein 6). Because IFI6 has important antiviral and immunosuppressive functions in the intestine, its downregulation suggests impairment of innate immune function, which could have important negative health consequences. Inhibitor studies revealed that AuPS25 uptake in the IOC occurred by both passive diffusion and active actin- and dynamin-dependent mechanisms, consistent with our previous findings in the triculture model.

5. Jiang, Z.**,** Zhang, S.**,** Tang, C.**,** Xiao, M.**,** Zhou, J.**,** Luo, Y.**,** Ge, T.**,** Yu, B.**,** Cai, Y.**, White, J. C.,** Li, Y. (2024). Sustained superiority of biochar over straw for enhancing soil biological-phosphorus via the mediation of phoD-harboring bacteria in subtropical Moso bamboo forests. *Forest Ecol. Manage.* 584, 122606.

Abstract: Soil organic carbon (SOC) is predominantly stored in subsoils; however, its stability and turnover are significantly influenced by external organic inputs. Nevertheless, the effects of straw and biochar amendments on the priming of SOC mineralization in the subsoil are not fully understood. Consequently, an incubation experiment was conducted for 40 d with soils sampled from three depths (0–20 cm, 20–40 cm, and 40–60 cm) in a subtropical Moso bamboo forest. Straw and biochar were applied as organic amendments, and the priming effects were quantified using 13C natural abundance methods. The straw consistently enhanced the SOC mineralizationI, which induced a positive priming effect that was most pronounced at the 20–40 cm depth. Conversely, biochar exhibited a depth- and time-dependent influence, initially suppressing the SOC mineralization, resulting in a negative priming effect with a lower value in subsoils (20–40 cm). but then transitioning to a positive priming effect over time. The drivers of these priming effects varied with the soil depth. In surface soils, SOC composition, particularly aromatic and O-alkyl carbon, were the primary determinants of the priming effect. However, in the 20–40 and 40–60 cm layers, soil properties, including ammonium nitrogen, available phosphorus, and water-extractable organic carbon exerted a greater influence. These findings highlight the complex roles of straw and biochar in shaping the priming effect across soil profiles, and underscore the importance of tailoring organic amendment strategies to specific soil depths to enhance carbon sequestration and support sustainable soil management in subtropical ecosystems.

6. Kong, M.**,** Wang, F.**,** Jing, H.**,** Liu, X.**, White, J. C.,** Shen, Y. (2025). Insights into tomato growth stimulation and induced resistance against Fusarium oxysporum f. sp. lycopersici by magnetite nanoparticles. *Environ. Technol. Innov.* 38, 104103.

Abstract: Nanotechnology applications in agriculture aim to safely and sustainably promote crop growth while mitigating damage from biotic stress and environmental impacts. Fungal pathogens, such as Fusarium oxysporum f. sp. lycopersici (Fol), cause significant yield losses in tomato production. This study investigated the effects of Fe3O4 nanoparticles (NPs) on tomato growth and resistance against Fol. Tomato seedlings were hydroponically grown with full nutrition and treated with 0.5 and 1.0 mg/L Fe3O4 NPs or equivalent concentrations of FeCl3; And the start pH of the media is controlled and maintained at 7.0. Plant growth parameters, disease severity, reactive oxygen species (ROS) accumulation, and expression of genes related to abscisic acid (ABA), salicylic acid (SA), and jasmonic acid (JA) pathways were analyzed. Treatment with 0.5 mg/L Fe3O4 NPs significantly increased root length, shoot length, and root hair number compared to untreated controls and FeCl3 treatments. Fe3O4 NPs downregulated ABA-related genes (FMO, MYB71, and DnaJ1), suggesting attenuation of ABA-mediated growth inhibition. Three conditions that Fe3O4 NPs alone, Fol inoculation alone, and Fe3O4 NPs followed by Fol challenge. Seedlings treated with 0.5 mg/L Fe3O4 NPs before Fol inoculation showed enhanced resistance compared to Fol-only treatment, with reduced disease severity and increased ROS accumulation. Fe3O4 NPs alone upregulated SA/JA-related and pathogenesis-related genes (EDS1, PAD4, LoxC, AOC, PI-II, and MYC2), priming plant immune responses. This priming effect was amplified when NP-treated plants were subsequently challenged with Fol, resulting in stronger defense responses compared to Fol-only treated plants. Fe3O4 NPs demonstrate potential as a multifunctional nano-fertilizer, simultaneously promoting tomato growth and disease resistance by modulating phytohormone pathways. Further research is needed to elucidate the mechanisms underlying these effects and assess the environmental impacts of nanomaterial application in agriculture. Harnessing the interactions between nanoparticles and plant physiology could lead to the development of sustainable strategies for improving crop productivity and resilience.

7. Karmous, I.**, Elmer, W. H.,** Scaley, J., **Zuverza-Mena, N., Vaidya, S.,** Tlahig, S., Bharadwaj, A.**, White, J. C., Dimkpa, C. O.** (2025). Plant-engineered ZnO and CuO nanoparticles exhibit pesticidal activity and mitigate Fusarium infestation in soybean: A mechanistic understanding. *Plant Phys. Biochem.* 221, 109672.

Abstract: Crop disease threatens food security and farmer livelihoods, resulting in the large-scale use of synthetic pesticides with a significant negative environmental footprint. Here, we synthesized CuO and ZnO nanoparticles (NPs) using Artemisia vulgaris extracts and evaluated the NPs for crop protection in soybean infested with Fusarium virguliforme (FV), the cause of soybean sudden death. Seeds were germinated in a Pro-mix media, then 7-day-old uniformly-sized plantlets were transferred into potting mix without or with FV amendment. CuONP or ZnONP were applied at 200 and 500 mg/L via either foliar or soil exposures. At 200 mg/L, both biogenic NPs enhanced soybean growth by 13%, compared to diseased controls. Compared to Zn or Cu salt, the Artemisia extract alone, and a commercial fungicide (Medalion Fludioxon), the ZnONP exhibited 3.8-, 2.5-, and 4.9-fold greater in vitro antifungal activity, respectively; the corresponding CuONP values were 1.2-, 1.0-, and 2.2- fold, respectively. Scanning electron microscopy (SEM) revealed significant morpho-anatomical damages to fungal mycelia and conidia. NP-treated FV lost their hyphal turgidity and uniformity, appearing collapsed or shrunken, with overt structural deformities. With ZnONP, the mycelia were misshapen, distorted, shriveled, broken, and lacked conidia. And with CuONP, mycelia were collapsed, and conidia were shriveled and disfigured. Together, these effects resulted in significantly reduced fungal growth. Leaf SEM showed fungal colonization of different infection sites, including the glandular trichome, palisade parenchyma, and vasculature. Foliar applied ZnONP resulted in a considerable presence of nanoscale and submicron ZnO on both the leaf surface and the stomata interiors, likely leading to particle and ion entry via several pathways, including ion diffusion across the cuticle/stomata.

SEM also suggested that ZnO/CuONPs trigger structural reinforcement and anatomical defense responses in both leaves and roots against fungal infection. Collectively, these findings provide important insights into novel and effective nanoscale mechanisms of crop protection against fungal pathogens, adding to a growing body of evidence demonstrating the viability of nano-enabled agriculture.

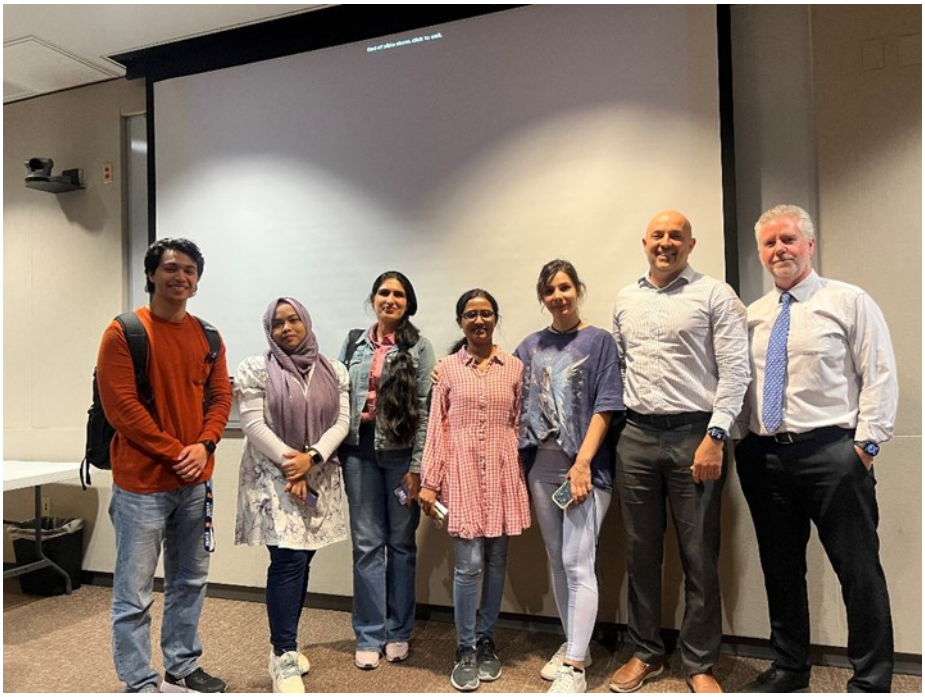
8. Wang, P., Das, P., Wang, L., Zhou, J., **Deng, C.,** Vera-Reyes, I., **Dimkpa, C. O., White, J. C., Wang, Y.** (2025). Prospects of Nano Phosphorus Fertilizers (NPF) in plant-based agriculture – Effects and mechanisms. *J. Nano. Res.* DOI: 10.1007/s11051-025-06261-x.

Abstract: Phosphorus (P) is a crucial macronutrient for plant growth, root development, and yield. Commercial P fertilizers have low efficiency of delivery and utilization and are lost from plant root zones by either low availability or leaching or surface runoff that leads to environmental damage. This review investigates how nano P fertilizers (NPF) can overcome the current inefficiencies of conventional formulations and thus, enhance plant yield while minimizing negative environmental impacts. NPF have significant potential for augmenting plant germination by more effectively penetrating seed coatings and facilitating greater water and nutrient uptake. The nanoscale nature of NPF also uniquely facilitates greater P absorption by roots, which in turn enhances chlorophyll synthesis, improves light absorption, and optimizes electron transport efficiency—key factors in boosting plant photosynthesis. Additionally, it stimulates overall physiological processes (e.g., secondary metabolite production, root exudation), increases antioxidant enzyme activities, and enhances plant yield. NPF can also minimize the accumulation of toxic elements by several mechanisms, including controlling contaminant bioavailability in soil by enhancing competing plant essential element (e.g., P, Ca) uptake. Moreover, NPF also mediate soil pH, which has important implications for soil biogeochemistry in low pH agricultural areas. Soil microbiomes and associated processes will often improve with NPF application relative to conventional P formulations. Although great potential has been demonstrated, a mechanistic understanding of certain aspects of NPF activity remains incomplete, including impacts across diverse crop species, environmental conditions, and soil types. However, NPF offer great potential as an important tool in the transformation of conventional agriculture, simultaneously lessening the usage of finite P resources, reducing the environmental footprint of agriculture, and improving future food security.

9. Bekah, D., Boyjoo, Y., Panpadoo, R. M., **White, J. C.,** Bhaw-Luximon, A. (2024). Nanostimulants and nanofertilizers for precision agriculture: Transforming food production in the 21st century. *Environ. Sci.: Nano* DOI: DOI: 10.1039/D5EN00055F.

Abstract: The risk of long-term global food insecurity is being exacerbated by climate change, as well as by a range of other socio-economic and political factors. Conventional agriculture has been heavily dependent on agrochemical use for decades, and although this has increased food production in a way that has benefited billions of citizens, the subsequent damage to terrestrial and aquatic ecosystems has been significant. This is in part due to agrochemical delivery and use efficiency levels that are often 30% or less, leading to over-application to achieve acceptable yield but that results in a significant negative environmental footprint of agriculture. Recent advances in agrochemical delivery have sought to mimic nanodrug delivery systems in health, where materials design and delivery is engineered to be efficient, precise and safe. Consequently, a number of agrochemical delivery strategies have been described in the literature, offering equivalent or enhanced efficacy with reduced environmental impact. Several recent studies have extended this work to targeting specific biotic and abiotic plant stresses, with the goal of developing more sophisticated nanostimulants and nanofertilizers that promote overall climate resilience in agricul-

ture. This paper will review and analyze the vast potential of these agrochemical delivery systems, including an assessment of future directions that could validate the widespread application of nano-enabled agriculture as a critical tool in combatting global food insecurity in a changing climate.



Jason C. White, Ph.D. at the University of Texas El Paso

ANALYTICAL CHEMISTRY

PUBLICATIONS:

1. Oliveira, F. F., Takeshita, V., **Zuverza-Mena, N.,** Milagares, J., **Tamez. C., Luiz da Silva, W.,** Oliveira, J. L., Santo Pereira, A. E., Fraceto, L. F., Marques Rezende, J. A., **Dimkpa, C., White, J. C.** (2025). Zein-based nanocarrier of the insecticide cyantraniliprole to control *Bemisia tabaci* MEAM1 (Whitefly). *ACS Agricultural Science and Technology* DOI: 10.1021/acsagscitech.4c00751

Abstract: *Bemisia tabaci*, also known as whitefly, is a sap-sucking polyphagous insect that severely affects important crops worldwide. The growing demand for environmentally friendly and effective pest control measures necessitates new approaches to reduce the volume and frequency of insecticide application to crops while maintaining the efficiency. This study aimed at developing and evaluating a biodegradable zein protein nanocarrier with the active ingredient (a.i.) cyantraniliprole (CNAP) for the control of *B. tabaci* in tomato (*Solanum lycopersicum)*. Synthesis of the nanoformulation (ZeinCNAP) resulted in spherical structures with an average hydrodynamic size of 143.06 ± 1.03 nm and a surface charge of 40.36 ± 0.7 mV remaining stable over 56 days. When plants were treated with three doses of ZeinCNAP (1/10, 1/2, and full) and commercial CNAP, followed by the release of adult whiteflies, the insect mortality by ZeinCNAP full dose (30 ± 0.9%) did not differ significantly from the commercial CNAP (42 ± 0.8%) 48 h after spraying. However, 72 h after spraying, the ZeinCNAP dose of 1/10, insect mortality (32 ± 1.1%) remained statistically equivalent to the commercial CNAP at full dose (49 ± 0.6%). When the plants were treated with commercial CNAP, ZeinCNAP, or water, aspects of fresh mass, photosynthetic parameters, and oxidative stress were analyzed at 24, 168, or 360 h after application, and no significant negative effects were noted in the analyzed parameters. The developed nanoinsecticide based on the zein platform and the active ingredient CNAP has significant potential for controlling on *B. tabaci* MEAM1 at reduced doses and can be considered safe for tomato plants. This work adds to a growing body of evidence demonstrating the potential of nanoscale carriers to significantly reduce the environmental burden associated with agrochemical use while still maintaining equivalent efficacy to conventional strategies.

2. Karmous, I., **Elmer, W. H., Zuverza-Mena, N., Vaidya, S.,** Tlahig, S., Scanley, J., Bharadwaj, A., **White, J. C., Dimkpa, C. O.** (2025). Plant-engineered ZnO and CuO nanoparticles exhibit pesticidal activity and mitigate Fusarium infestation in soybean: A mechanistic understanding. *Plant Physiology and Biochemistry* 221, 109672. DOI: 10.1016/j.plaphy.2025.109672

Abstract: Herein, CuO and ZnO nanoparticles (NPs) were biogenically synthesized using plant (Artemisia vulgaris) extracts. The biogenic NPs were subsequently evaluated in vitro for antifungal activity (200 mg/L) against Fusarium virguliforme (FV; the cause of soybean sudden death), and for crop protection (200-500 mg/L) in FV-infested soybean. ZnONPs exhibited 3.8-, 2.5-, and 4.9 -fold greater in vitro antifungal activity, compared to Zn or Cu acetate salt, the Artemisia extract, and a commercial fungicide (Medalion Fludioxon), respectively. The corresponding CuONP values were 1.2-, 1.0-, and 2.2 -fold, respectively. Scanning electron microscopy (SEM) revealed significant morpho-anatomical damage to fungal mycelia and

conidia. NP-treated FV lost their hyphal turgidity and uniformity and appeared structurally compromised. ZnONP caused shriveled and broken mycelia lacking conidia, while CuONP caused collapsed mycelia with shriveled and disfigured conidia. In soybean, 200 mg/L of both NPs enhanced growth by 13%, compared to diseased controls, in both soil and foliar exposures. Leaf SEM showed fungal colonization of different infection sites, including the glandular trichome, palisade parenchyma, and vasculature. Foliar application of ZnONP resulted in the deposition of particulate ZnO on the leaf surface and stomatal interiors, likely leading to particle and ion entry via several pathways, including ion diffusion across the cuticle/stomata. SEM also suggested that ZnO/CuO NPs trigger structural reinforcement and anatomical defense responses in both leaves and roots against fungal infection. Collectively, these findings provide important insights into novel and effective mechanisms of crop protection against fungal pathogens by plant-engineered metal oxide nanoparticles, thereby contributing to the sustainability of nano-enabled agriculture.

3. Wang, P., Das, P., Wang, L., Zhou, J., **Deng, C.,** Vera-Reyes, I., **Dimkpa, C. O., White, J. C., Wang, Y.** (2025). Prospects of nano phosphorus fertilizers (NPF) in plant-based agriculture – effects and mechanisms. *Journal of Nanoparticle Research* 27, 60. DOI: 10.1007/s11051-025-06261-x

Abstract: Phosphorus (P) is a crucial macronutrient for plant growth, root development, and yield. Commercial P fertilizers have low efficiency of delivery and utilization and are lost from plant root zones by either low availability or leaching or surface runoff that leads to environmental damage. This review investigates how nano P fertilizers (NPFs) can overcome the current inefficiencies of conventional formulations and, thus, enhance plant yield while minimizing negative environmental impacts. NPFs have significant potential for augmenting plant germination by more effectively penetrating seed coatings and facilitating greater water and nutrient uptake. The nanoscale nature of NPF also uniquely facilitates greater P absorption by roots, which in turn enhances chlorophyll synthesis, improves light absorption, and optimizes electron transport efficiency—key factors in boosting plant photosynthesis. Additionally, it stimulates overall physiological processes (e.g., secondary metabolite production, root exudation), increases antioxidant enzyme activities, and enhances plant yield. NPFs can also minimize the accumulation of toxic elements by several mechanisms, including controlling contaminant bioavailability in soil by enhancing competing plant essential element (e.g., P, Ca) uptake. Moreover, NPFs also mediate soil pH, which has important implications for soil biogeochemistry in low-pH agricultural areas. Soil microbiomes and associated processes will often improve with NPF application relative to conventional P formulations. Although great potential has been demonstrated, a mechanistic understanding of certain aspects of NPF activity remains incomplete, including impacts across diverse crop species, environmental conditions, and soil types. However, NPFs offer great potential as an important tool in the transformation of conventional agriculture, simultaneously lessening the usage of finite P resources, reducing the environmental footprint of agriculture, and improving future food security.

ENTOMOLOGY

PHILIP ARMSTRONG, SC.D. participated in the Northeast Regional Center for Excellence in Vector-Borne Diseases Training & Evaluation Center (NEVBD TEC) Leadership and Advisory Board meeting (February 12); met with other members of the Connecticut Mosquito Management Program from CT DPH, DEEP, DoAg, and UCONN to update the West Nile virus Response Plan (February 18); attended the Vector-Borne Zoonotic Disease symposium at Yale School of Public Health (February 21); spoke with a reporter from CT Public Radio about funding for the Active Tick Surveillance Program (February 24); and conducted biosecurity, biosafety, and incident response drills for BSL-3 laboratory members as a part of the annual training course (February 25).

ANGELA BRANSFIELD participated via Teams in the Montgomery County, Maryland Local Emergency Planning Committee meeting, where the presentation "Myths and Urban Legends of Biological Research" was hosted (February 19); participated via Zoom in Yale University's Biosafety Committee meeting (February 20); and provided BSL3 Laboratory refresher training on biosafety, biocontainment, security, and incident response (17 attendees) (February 25).

JAMIE L. CANTONI gave a brief personal presentation about her career path that brought her to the Station to participants of the new STEM initiative 'Next Gen Scientist', in collaboration with UConn's 4-H Extension Program (February 10, ~10 attendees); staffed the CAES table and shared information about the Station at the annual Connecticut Flower and Garden Show held at the Connecticut Convention Center (February 20).

KELSEY E. FISHER, PH.D. presented "Agricultural Entomology: An update on pollinators and pests" during the CAES Seminar Series (Feb 5, ~50 attendees); met with Dr. Sarah Lawson at Quinnipaic University about potential collaborations and grant opportunities (Feb 5, 19, 26); presented about bumblebees for third graders at Mackrell Elementary School with Mayor Borer (~100 students; Feb 7); met with Joy Vanderlek and the Cheshire Pollinator Pathway about a phenology observation study that will occur in 2025 (Feb 10); presented "Monarch butterfly biology, ecology, and conservation needs" to the Leete's Island Garden Club (Feb 11; 20 attendees); attended the Winter CAPS committee meeting (Feb 19); met and brainstormed with Erik Dopman (Tuffs University) and Brad Coates (USDA-ARS-CICGRU) about collaborative opportunities (Feb 21); met with a University of Connecticut graduate student about serving on their thesis committee (Feb 26); met with members of the NC246: Ecology and Management of Arthropods in Corn about a multistate field trial to study the impact of European corn borer on non-Bt field corn genetic lines.

ANDREA GLORIA-SORIA, PH.D. presented the talk "Mosquito genomics for vector control" as pat of the Department of Epidemiology of Microbial Diseases seminar series at the Yale School of Public Health on February 26 (60 attendees); attended the 3rd Annual VB&ZD Research Symposium, organized by the Vector-borne and Zoonotic Diseases and MalarYale networks at the Yale School of Public Health on February 21 (~150 attendees); participated in the BSL3 Laboratory refresher training on biosafety, biocontainment, security, and incident response on February 25 (17 attendees).

NOELLE KHALIL staffed a table at the Central Connecticut State University Career and

Internship Fair and discussed the work conducted in the Tick Testing Lab and internship/job opportunities with current students (February 18, ~50 students).

MEGAN LINSKE. PH.D. participated in a meeting with collaborators from BanfieldBio, Inc. and North Carolina State University to discuss blacklegged tick repellency trials and the upcoming field season (Feb 4 & 18); co-hosted and presented at the first meeting of the 'Next Gen Scientist' girls' STEM initiative, in collaboration with the University of Connecticut's 4-H Extension Program (Feb 10; ~10 attendees); hosted the Wildlife Society (TWS) Leadership Institute Committee meeting as an alumnus and Committee Chair (Feb 13); participated in a call with staff from the Centers for Disease Control and Prevention's Division of Vector-Borne Diseases on progress made on a funded integrated tick management and seasonal spray projects (Feb 19); participated in a collaborative meeting with BanfieldBio, Inc. to discuss the implementation of the recently awarded botanical acaricide grant and the subsequent research activities (Seattle, WA; Feb 24-26).

GOUDARZ MOLAEI, PH.D. attended the Northeast Regional Center for Excellence in Vector-Borne Diseases Training & Evaluation Center (NEVBD TEC) Leadership and Advisory Board meeting to discuss progress and plans for Year 3 of the funding (February 12); and attended the Vector-Borne Zoonotic Disease symposium at Yale School of Public Health (February 21).

TANYA PETRUFF provided a synopsis entitled "The State of Connecticut Mosquito Surveillance and Arbovirus Testing Program and Mosquito Rearing Facility" and gave a tour of the Slate mosquito labs and insectary to participants of the new girls' STEM initiative, Next Gen Scientist, in collaboration with the UConn 4-H Extension Program. (February 10; ~10 attendees)

GALE E. RIDGE, PH.D. presented at talk on invasive jumping worms to the Watertown Garden Club (February 19) (20 attendees); she delivered a virtual talk on Delusional Infestation to staff at the Connecticut Mental Health and Addiction Services, Western Connecticut Mental Health Network (February 21); and the New Haven Master Gardeners visited the insect information office on a station tour (February 25) (20 attendees).

CLAIRE E. RUTLEDGE, PH.D. presented a brief description of her research, and a tour of my laboratory along with other station scientists in an event 'Next Gen Scientist' (February 10; ~10 attendees); presented 'Spotted lanternfly in Connecticut' to the Regional Water Authority's Land Use Commitee (February 12, 15 attendees), presented 'Spotted lanternfly – what is it and what can we do about it?" (February 13, 80 attendees), taught the class 'Insects that attack trees and shrubs' in The Connecticut Tree Protective Association's Arboriculture 101 (February 13; 45 attendees); presented update on 2024 surveys to the Winter CAPS Commitee (February 19; 15 attendees); co-authored poster with Dr. Melody Keena 'Loss of male claspers and multiple mating in spotted lanternfly' presented at the USDA Interagency Research Forum on Invasive Species Annapolis MD, (February 25-28)

JOHN SHEPARD participated a Board of Directors meeting of the Northeastern Mosquito Control Association in Hyannis, MA (February 3) (12 attendees); participated in the BSL3 Laboratory refresher training on biosafety, biocontainment, security, and incident response (February 25) (17 attendees); presented the invited talk (via Zoom), "Jamestown Canyon Vi-

rus Comes into View: Recognizing the Threat from an Underrecognized Arbovirus" as part of the Work-in-Progress Series, hosted by New England Center of Excellence in Vector-Borne Diseases (February 26) (18 attendees).

PAULA WOLF taught the Honey Bee Pests & Diseases portion of Bee School for the Connecticut Beekeepers Association (February 1) (66 attendees); spoke to the Eastern Connecticut Beekeepers Association's online Bee School about the importance of hive registration and the state apiary program (February 5) (18 attendees); gave a presentation about doing mite checks and hive registrations at Mike's Beehives in Goshen and distributed mite wash kits (February 8) (7 attendees); gave a brief personal presentation to participants of the new STEM initiative 'Next Gen Scientist', in collaboration with UConn's 4-H Extension Program (February 10, ~10 attendees); spoke to the Eastern Connecticut Beekeepers Association's in-person Bee School about the importance of hive registration and the state apiary program (February 5) (17 attendees); attended the Winter CAPS committee meeting (Feb 19); staffed the CAES table and shared information about the Station at the annual Connecticut Flower and Garden Show held at the Connecticut Convention Center (February 20, 21 & 23); gave an Introduction to Beekeeping presentation to attendees of the Connecticut Flower & Garden Show (February 20) (23 attendees); presented Five Fascinating Behaviors of Honey Bees to attendees of the Connecticut Flower & Garden Show (February 21) (56 attendees); distributed mite wash kits and spoke with members of the Connecticut Beekeepers Association at their Winter Cluster meeting (February 22) (26 attendees); gave a live radio interview to Melissa in the Morning of WICC radio in a segment titled "Bee Populations Dying" (February 24).

TRACY ZARRILLO held a wild bee identification workshop in her lab with researchers from Rutgers University, the University of Massachusetts, and the University of Rhode Island (Feb 4, 7 attendees).

PUBLICATIONS:

1. **Zarrillo, T. A.**, **Stoner, K. A.**, and Ascher, J. S. (2025). Biodiversity of bees (Hymenoptera: Anthophila) in Connecticut (USA). *Zootaxa*, 5586(1), 1-138. DOI: 10.11646/zootaxa.5586.1.1

Abstract: In response to calls for national and regional updated inventories of bee species, we present a county-level checklist for 385 confirmed bee (Apoidea: Anthophila) species for Connecticut, USA, highlighting rare and regionally declining species, species that have specific habitat and/or host requirements, and species whose taxonomy and distribution we wish to clarify. We have compiled a comprehensive, digitized database of historic and current bee records from Connecticut to inform this checklist, which includes specimen records from museums, recent collections, and community science observations from iNaturalist.com. All images of bees from Connecticut on iNaturalist (18,471 observations) have been fully vetted by one or more of the authors, which is unprecedented for a state project. We summarize historical bee research in Connecticut and provide current information regarding the distribution of bee species, changes in status, phenology, habitat usage, and floral associations within the state. At least 43 of 385 species represented in collections or literature have not been detected in Connecticut since the year 2000. These and other species of conservation concern are discussed with reference to a quantitative assessment of changes in range within the state. In addition, we have calculated and report state-level ranks for 124 bee species in Connecticut. We corrob-

orate regional loss of species including *Coelioxys funerarius* Smith and *Holcopasites illinoiensis* (Robertson) and clarify and extend the distribution of numerous bee species in the Northeastern United States. Furthermore, we discuss morphospecies, excluded species, and species expected for Connecticut. We also validate synonymies reported previously online based on an unpublished manuscript by Roy Snelling for the following species: *Nomada depressa* Cresson (= *N. hoodiana* Cockerell; = *N. carinicauda* Cockerell; = *N. media* Mitchell); *Nomada obliterata* Cresson (= *N. decepta* Mitchell); *Nomada vicina* Cresson (= *N. beulahensis* Cockerell; = *N. vicina stevensi* Swenk). In addition, we recognize three new synonyms of *Nomada xanthura* Cockerell (= *N. ochlerata* Mitchell; = *N. detrita* Mitchell; = *N. mendica* Mitchell) and report the first *Nomada townesi* Mitchell from outside of Maryland. In addition to *N. townesi*, the following eleven native species are newly reported or recently confirmed for Connecticut: *Andrena* (*Cnemidandrena*) *parnassiae* Cockerell; *Andrena* (*Melandrena*) *sayi* Robertson; *Andrena* (*Trachandrena*) *rehni* Viereck; *Anthophora bomboides* Kirby; *Nomada armatella* Cockerell; *Nomada electella* Cockerell; *Nomada placida* Cresson; *Lasioglossum* (*Dialictus*) *cattellae* (Ellis); *Lasioglossum* (*Dialictus*) *ellisiae* (Sandhouse); *Lasioglossum* (*Dialictus*) *fattigi* (Mitchell); *Lasioglossum* (*Dialictus*) *trigeminum* Gibbs. The following recent arrivals among non-native species are confirmed: *Pseudoanthidium* (*Pseudoanthidium*) *nanum* (Mocsáry); *Coelioxys* (*Allocoelioxys*) *coturnix* Pérez; *Osmia* (*Osmia*) *taurus* Smith. This work is a stepping stone towards a larger, ongoing effort to clarify bee distribution and status in New England. As such, we also report updates for the bee fauna of the following states: Massachusetts—*Melissodes communis communis* Cresson; *Megachile* (*Eutricharaea*) *apicalis* Spinola), Maine—*Chelostoma philadelphi* (Robertson), and New Hampshire—*Lasioglossum nelumbonis* (Robertson).

2. Rochlin I., Kenney J., Little E., **Molaei G.** (2025). Public health significance of the white-tailed deer (*Odocoileus virginianus*) and its role in the eco-epidemiology of tick- and mosquito-borne diseases in North America. *Parasites & Vectors* 2025;18(1):43. DOI: 10.1186/s13071-025-06674-6.

Abstract: White-tailed deer (*Odocoileus virginianus*) are a ubiquitous species in North America. Their high reproductive potential leads to rapid population growth, and they exhibit a wide range of biological adaptations that influence their interactions with vectors and pathogens. This review aims to characterize the intricate interplay between white-tailed deer and the transmission cycles of various tick- and mosquito-borne pathogens across their range in the eastern United States and southeastern Canada. The first part offers insights into the biological characteristics of white-tailed deer, their population dynamics, and the consequential impacts on both the environment and public health. This contextual backdrop sets the stage for the two subsequent sections, which delve into specific examples of pathogen transmission involving white-tailed deer categorized by tick and mosquito vectors into tick-borne and mosquito-borne diseases. This classification is essential, as ticks and mosquitoes serve as pivotal elements in the eco-epidemiology of vector-borne diseases, intricately linking hosts, the environment, and pathogens. Through elucidating these associations, this paper highlights the crucial role of white-tailed deer in the transmission dynamics of tick- and mosquito-borne diseases. Understanding the interactions between white-tailed deer, vectors, and pathogens is essential for effective disease management and public health interventions.

3. Anderson J. F., Bransfield A., Misencik M. J., Jones S., Main A. J., **Armstrong P. M., Andreadis T. G., Molaei G.** (2025). Host-feeding behavior of mosquitoes (Diptera:

Culicidae) in North Dakota, 2003 to 2006. *Journal of Medical Entomology.* DOI: 10.1093/jme/tjaf021

Abstract: Mosquitoes are abundant near temporary, semipermanent, and permanent water in North Dakota and are associated with human and veterinary diseases. Little is known about the feeding habits of mosquitoes as related to the transmission of arboviruses. We report on the identification of vertebrate hosts of 9 species of mosquitoes collected in 2003 to 2006. Blood meals of 1,223 from 9 mosquito species were identified to vertebrate species by PCR assays using the mitochondrial *cytochrome b* gene. *Aedes dorsalis* (Diptera: Culicidae) and *Culiseta inornate* fed only on mammals, and *Aedes vexans* fed almost exclusively on mammals. *Aedes trivittatus* fed significantly more on mammals than on birds. *Culex tarsalis* acquired blood meals from the most diverse group of vertebrates, frequently fed on American Robins, and did not exhibit a seasonal shift of feeding on birds to mammals. The extensive feeding of *Cx. tarsalis* on passerine birds and the isolation of West Nile virus (WNV) from 2 specimens that had fed on passerines supports their role in horizontal transmission of WNV. This species also transmits western equine encephalitis virus. Host feeding by *Ae. trivittatus*, *Ae. vexans*, *Cs. inornata*, and Ae. dorsalis in relation to their possible importance in transmission of trivittatus virus, Cache Valley virus, Jamestown Canyon virus, Potosi virus, or snowshoe hare virus is presented. The identification of host feeding behavior pattern of specific species of mosquitoes enhances our understanding of the enzootic and epizootic nature of 7 viruses in North Dakota.

4. Xue Q., **Hasan K. S.**, **Dweck O.**, Ebrahim S. A. M., **Dweck H. K. M.** (2025). Functional characterization and evolution of olfactory responses in coeloconic sensilla of the global fruit pest *Drosophila suzukii*. *BMC Biology* (23):50. DOI: 10.1186/s12915-025-02151-9.

Abstract: When a species changes its host preference, it often requires modifications in its sensory systems. Many of these changes remain largely uninvestigated in the global fruit pest Drosophila suzukii (also known as spotted wing Drosophila, SWD). This species, which shares a last common ancestor with the model organism D. melanogaster—a species that prefers overripe fruits—~15 million years ago, has shifted its preference from overripe to ripe, soft-skinned fruits, causing significant damage to fruit industries worldwide. Here, we functionally characterized the coeloconic sensilla in D. suzukii and compared their responses to those of its close relatives, D. biarmipes and D. melanogaster. We find that D. suzukii's responses are grouped into four functional types. These responses are consistent across sexes and reproductive status. The odorant receptor co-receptor Orco is required for certain responses. Comparative analysis across these species revealed evolutionary changes in physiological and behavioral responses to specific odorants, such as acetic acid, a key indicator of microbial fermentation, and phenylacetaldehyde, an aromatic compound found in a diverse range of fruits. Phenylacetaldehyde produced lower electrophysiological responses in D. suzukii compared to D. melanogaster and elicited strong attraction in D. suzukii but not in any of the other tested species. The olfactory changes identified in this study likely play a significant role in the novel behavior of D. suzukii. This work also identifies phenylacetaldehyde as a potent attractant for D. suzukii, which can be used to develop targeted management strategies to mitigate the serious impact of this pest.

GRANTS AWARDED:

Enhancing Spotted Lanternfly Mitigation by Understanding the Effects of Temperature on Egg Viability – USDA Plant Protection Act 7721, Dr. Melody Keena USFS, Dr. Robert Trotter USFS, Dr. Claire Rutledge CAES $47,134 The primary purpose of this suggestion is to produce a validated phenology model based on the response of each life stage of the spotted lanternfly (SLF, *Lycorma delicatula*) to a broad range of temperatures and hosts in order to support three key tasks including: 1) Identify when to monitor for SLF, 2) Predict the timing of life-stages suitable for control measures and 3) To identify the regions of the US that provide suitable conditions for SLF populations and are therefore at risk to invasion by this species. We are also conducting additional work on temperature treatments that could provide tools to make eggs inviable.

Measuring the Impact of Egg Parasitoids on Emerald Ash Borer and Other Agrilus pests in the U.S. - Dr. Jian Duan USDA ARS, Dr. Kamal Ghandi University of Georgia, Dr. Todd Johnson Louisiana State University, Dr. Jeremy Andersen University of Massachusetts Amherst, Dr. Toby Petrice USFS Dr. Therese Poland USFS – USDA Plant Protection Act 7721 USDA ARS $244,214 The proposed research aims to (1) determine the host association of O. agrili with EAB and other Agrilus pests infesting their common host trees such as ash, birch, oak and sugarberry in the EAB biocontrol release sites across a gradient of latitudes, (2) quantify impacts of O. agrili on EAB population densities in the long-term EAB biocontrol sites established in Michigan (2008-2010) and the Northeastern states (2015-2017) including Connecticut, Massachusetts, and New York.

Bee identification workshop in the Zarrillo Wild Bee Lab, February 4. L to R: Fred Morrison, Tracy Zarrillo, Joan Milam, David Mantack, Michael Veit, Max McCarthy, Casey Johnson, and Emma Tondre.

ENVIRONMENTAL SCIENCE & FORESTRY

SCOTT C. WILLIAMS, PH.D. as the Northeast Section Representative, participated in a meeting to review applications for the Professional Certification Review Board of The Wildlife Society (February 3); participated in a meeting with BanfieldBio on a collaborative NIH SBIR grant investigating tick repellent formulations to be integrated into fabrics (February 4); participated in a meeting with MaineHealth staff about the systemic treatment of white-tailed deer to managed blacklegged ticks (February 6); participated in a meeting with BanfieldBio on a collaborative CDC grant investigating the effectiveness of botanical formulations in managing ticks in peridomestic habitats (February 11); gave invited lecture on host-targeted integrated tick management strategies to members of the Menunkatuck Chapter of The National Audubon Society (110 attendees) (February 11); participated in a meeting with BanfieldBio on a collaborative NIH SBIR grant investigating tick repellent formulations to be integrated into fabrics (February 18); participated in a meeting with staff from the CDC Division of Vector-Borne Diseases on progress made on a funded integrated tick management project (February 19); traveled to Seattle, WA to meet with the BanfieldBio team and strategize on collaborative CDC and NIH-funded integrated tick management research (February 23-26); spoke with staff from Genesis Laboratories on collaborative host-targeted integrated tick management research (February 27); spoke with the Town of Greenwich Environmental Analyst on deer and deer management (February 28).

JOSEPH P. BARSKY participated in the 2025 Annual New England Society of American Foresters Winter Meeting Planning Committee meeting (February 10, 24, virtual); with **Raffaela Nastri**, staffed the CAES booth at the Connecticut Flower and Garden Show (150 booth visitors) (February 21); interviewed by Robert Davidson of Treegaurdiannews.com for a blog post on forest health and invasive species (February 28).

JESSICA E. BROWN, PH.D. presented "Rodent hosts demonstrate varied responses to blacklegged tick parasitism" as part of The Connecticut Agricultural Experiment Station's lunch seminar series (50 attendees) (February 19).

GREGORY J. BUGBEE gave invited talk entitled "Composting" to the Woodbridge Garden Club at the Woodbridge Public Library (40 attendees) (February 4); gave invited talk entitled "Container Gardening Indoors and Out" to the New Hartford Garden Club at the New Hartford Fire Station (35 attendees) (February 5); gave invited talk entitled "Invasive Aquatic and Terrestrial Plants" to CT DEEP trainees at Northwest Regional Workforce Investment Board in Waterbury (20 attendees) (February 18) and again at the Work Force Alliance in New Haven (10 attendees) (February 28); interviewed by Mariana Durafour of the Chronicle on CT Aquatic Invasive Species Grants (February 19); via teleconference, served as cochair of meetings of the Northeast Aquatic Nuisance Species Panel (February 7 and 21); via teleconference participated United States Army Corps of Engineers CT River hydrilla demonstration project and Massachusetts hydrilla expansion workgroup meetings (January 7, 12, 18, 19, 20, 26); spoke on "Soil Testing" as part of a tour for master gardeners tour at CAES (25 attendees) (February 25).

RILEY S. DOHERTY participated in the CAES 150th Anniversary Committee meeting (February 11); presented an invasive aquatic plant workshop with **Gregory Bugbee** for pro-

spective CT DEEP State Park seasonal employees at the Waterbury Job Center (February 18); participated in the U.S. Army Corps of Engineers Pameacha Pond stakeholders meeting (February 18); participated in the U.S. Army Corps of Engineers CT River hydrilla education and outreach meeting (February 18); participated in the Connecticut Federation of Lakes Board of Directors meeting (February 19); attended Project Delivery Team meeting with the US Army Corps of Engineers to discuss the CT River Hydrilla Demo Project (February 26).
JEREMIAH R. FOLEY, IV, PH.D. hosted a northern *Hydrilla* biological control research collaborative with Dr. Nate Harm (U.S. Army Corps) and Dr. Dean Brooks (USDA ARS Australian Biological Control Laboratory) on the potential for introducing new biological control agents for *Hydrilla* in U.S. water bodies, focusing on the feasibility of integrating pre-approved herbivores into existing management strategies (February 14).

SUSANNA KERIÖ, D.SC. gave a talk to Middletown Garden Club about "Mycorrhizal Inoculations for Urban Tree Health" (18 attendees) (February 20); attended a call to discuss re-submission of a collaborative NSF grant proposal on oak adaptation led by Dr. Tara Trammell (University of Delaware) with a team of scientists from USFS, CUNY, and John Hopkins University (February 24); attended a call to plan the CT Urban Forest Council's conference in collaboration with Tree Warden's Association of CT, CT Tree Protective Association, and Connecticut College (February 28).

SARA L. NASON, PH.D. met virtually with colleagues and students from the University of Minnesota (Dr. Christy Haynes, Riley Lewis, and Cheng-Hsin Huang) and CAES (**JASON WHITE, PH.D.**, **Nubia Zuverza-Mena, Ph.D.**, **Jingyi Zhou, Ph.D.**) to discuss an ongoing funded collaboration on nanomaterial enhancement of PFAS phytoremediation (February 3); as Chair, led virtual meetings for the Best Practices for Non-Targeted Analysis working group (February 4, 18); met virtually with Bryan Berger and Michael Timko (University of Virginia), Fred Corey (Mi'kmaq Nation), Chelli Stanley (Upland Grassroots), Randy Martin (Central Aroostook Soil and Water Conservation District), and Katie Richards (Maine PFAS Labs) to discuss EPA funded collaborative work on PFAS (February 7); with members of the CAES Department of Analytical Chemistry, participated in an A2LA Assessment for ISO 17025:2017 accreditation (February 25-27).

ITAMAR SHABTAI, PH.D. with **Alice Zhou, Ph.D.**, with met with colleagues at Yale University to discuss a collaborative project (February 4); met with colleagues from Purdue University, Virginia Tech, and Advanced Photon Source to discuss a joint DOE grant proposal (February 6); with **Alice Zhou, Ph.D.**, met with staff scientists at the Environmental Molecular Sciences Laboratory (EMSL) to discuss microscopy methods for an ongoing Exploratory Project Program (February 10); met with colleagues at Cornell University, EMSL, and the Joint Genome Institute to discuss a shared grant proposal (February 13); with **Blaire Steven, Ph.D.** and collaborators from UConn, attended a monthly EPA-funded project meeting (February 27).

ELISABETH B. WARD, PH.D. presented an invited talk titled "Connecticut's Changing Forests" at the Meigs Point Nature Center at Hammonasset Beach State Park (65 participants) (February 1); presented an invited talk titled "Connecticut's Forest Health Program: Year in Review and Future Research Directions" at the Yankee Division Society of American Foresters Winter Meeting in Sturbridge, MA (45 participants) (February 7); met with members of the Woodbridge Parks Association to discuss collaborations on beech stand management

(February 10); participated in the Forest Ecosystem Monitoring Cooperative monthly state partner meeting (February 13); organized a site visit at Great Mountain Forest with collaborators from Wesleyan University, the Yale School of the Environment, and Great Mountain Forest to discuss project on nonstructural carbohydrate responses to beech leaf disease (February 26); met with members of the Woodbridge Parks Association at Alice Newton Memorial Park to discuss project on beech stand management (February 28).

SUMMER WEIDMAN gave a presentation entitled "Updated Techniques for Mapping Aquatic Plants" at the Annual Invasive Species Forum hosted virtually by the Invasive Species Centre (40 attendees) (February 19); gave an aquatic plant identification workshop as part of a CT DEEP training at the New Haven American Jobs Center (11 attendees) (February 28); participated in a virtual meeting with the US Army Corps of Engineers to discuss CT River Hydrilla (February 26).

LEIGH J. WHITTINGHILL, PH.D. participated in the UConn Cooperative Extension 4-H Next Gen Scientist STEM initiative visit to CAES (February 10); participated in a UConn Department of Plant Science and Landscape Architecture oral comprehensive exam as a dissertation committee member (February 21); attended a meeting of the Soil Health Committee of the CT Council on Soil and Water Conservation to discuss the status of the soil health plan (February 27).

YINGXUE (CHARLIE) YU, PH.D. attended the workshop "SoilCon25: Building the Foundation for Agricultural Resiliency" (February 11); served on the Ph.D. proposal defense committee for Xueyu Zhou at Washington State University (February 25).

PUBLICATIONS:

1. Yang, Y., Liu, M., **Pignatello, J. J.** (2025). Interactions between selenium species and pyrogenic carbonaceous materials in water and soil relevant to selenium control and remediation: a molecular-level perspective. *Environmental Pollution*: 125831. DOI: 10.1016/j.envpol.2025.125831

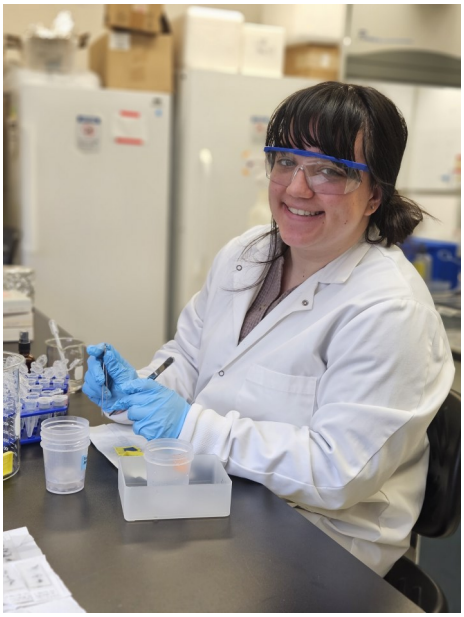
Abstract: Selenium (Se) has dual impacts on living organisms, as an essential element at low concentrations but a toxin at high concentrations. Current technologies for treating Se in real applications are not cost effective. Pyrogenic carbonaceous materials (PCM) with high surface area and redox properties have been proposed to remove Se. The objective of this review is to evaluate recent developments in fabrication of PCM and functionalized PCM for Se sorption and reduction in environmental remediation, as well as their potential impacts on crop growth. The sorptive removal of Se by PCM relies on the combined effects of electrostatic interactions, steric constraints, and complexation with metal species. The reduction property of PCM facilitates the conversion the ionic Se into solid state. The sorption of Se on PCM can also find applications in crop growth and the inhibition of heavy metal ions. We provide an outlook of terminal treatment of Se on PCM including immobilizing Se as solid species or applying PCM with sorbed Se as micronutrient soil amendment.

2. Norris, K. E., **Pignatello, J. J.**, Vialykh, E. A., Sander, M., McNeill, K., Rosario-Ortiz, F. L. (2025). Recent developments on the three-dimensional structure of dissolved organic matter: Toward a unified description. *Environmental Science & Technology*: 59(6): 2928 –

2936. DOI: 10.1021/acs.est.4c09627

Abstract: Advancing a common understanding about the chemical composition, size, and three-dimensional (3D) structure of dissolved organic matter (DOM) is paramount to deciphering its impact on and involvement in environmental processes, such as the fate and transport of contaminants and carbon cycling. Traditionally, DOM has been described as a collection of solvent-10 separated molecules or macromolecules. More recently, DOM has been depicted as a "supramolecular assembly," a collection of individual molecules and associations of molecules held together by non-covalent interactions. The supramolecular assembly model has been broadly invoked to rationalize certain behaviors and properties of DOM, yet the complexity of DOM has made it difficult to fully unravel the nature and contributions of its intermolecular interactions. Discussed in this perspective is evidence regarding thermodynamic drivers of intermolecular associations, DOM molecular size, sorption of organic contaminants to DOM, and optical properties of DOM. While single observations may be rationalized by former structural models, such as the supramolecular assembly model, combined evidence shows that the 3D structure of DOM is best described by a mixed dynamic assembly model (MDAM). The MDAM depicts DOM as a collection of solvent-separated molecules and small, tightly knit assemblies (<10 kDa) held together by strong hydrogen bonds, which may form large assemblies (>10 kDa) through weak intermolecular interactions only at specific pH values, high ionic strength, or high DOM concentration.

NEW DEPARTMENTAL STAFF:



JULIA CELIO is a Master's Student in the Biomedical Sciences program at Quinnipiac University and in February started her internship in **Susanna Keriö, D.Sc.'s** lab. Her internship project focuses on mycorrhizal colonization in urban maple roots. Julia is interested in human pathology and she is eager to develop her skills in histology and microscopy. Julia has her roots in Italy and she enjoys traveling.

MADDIE WATTS has recently joined the Office of Aquatic Invasive Species as a Research Technician I under the mentorship of **Jeremiah Foley, Ph.D.** She recently earned a B.A. in Earth and Environmental Science and Environmental Studies from Lehigh University. During her undergraduate studies, Maddie conducted research under the guidance of her advisor, focusing on changes in peatland moisture in Alaska and its correlation with wildfire variability. Maddie was first introduced to environmental research through internships at the Rodale Institute, which focuses on organic agriculture across large-scale agricultural trials. Her work as a seasonal employee at CAES involved field research on the effects of *Hydrilla* on greenhouse gases and the carbon cycle, as well as assisting with pre- and post-treatment aquatic plant sur-

veys and monitoring for the Army Corps of Engineers' Connecticut River *Hydrilla* Management Program. Maddie is from Erie, Pennsylvania, where she lived just five minutes from Lake Erie. It was there that she developed her love for the environment, spending time outdoors and on the water sailing, kayaking, and swimming. In her free time, Maddie enjoys reading, hiking, and exploring her new home in New Haven. She is excited to expand her knowledge in aquatic biology and ecology while working on the beautiful Connecticut River.

PLANT PATHOLOGY AND ECOLOGY

WASHINGTON DA SILVA, PH.D participated, as the scientific member, in the Connecticut Farm Wine Development Council Meeting via Zoom (10 attendees) (February 6); participated, as a committee member, in the Ph.D. general exam for Daniel Cerritos at UCONN (6 attendees) (January 27); visited the Universidade Federal do Rio Grande do Norte located in the city of Natal in Brazil (February 8-15) and gave two seminars and met with local melon growers, faculty members, and students to discuss ongoing projects on Melon Diseases (100 adults). Mr. Jarlan Silva from the **da Silva Lab** successfully defended his Master's thesis via Google Meetings (22 attendees) (February 25) - Kudos to Jarlan, who is now a Ph.D. student! Elena Huber (a sophomore student at Amity Regional High School in Woodbridge, CT) won first place the CT-STEM fair for the Environmental category, she presented a poster of the research she has been conducted at the **da Silva Lab** testing several essential oils on controlling *Bipolaris sorokiniana*, a major pathogen of wheat and barley, Elena will now compete in the CSEF fair. Way to go, Elena! A publication from the **da Silva Lab,** Tiny but Mighty: Nanoscale Materials in Plant Disease Management (https://doi.org/10.1094/PDIS-05-23-0970-FE), was the Most-Read Plant Disease Articles of 2024!

YONGHAO LI, PH.D. presented "Selection and Care of Houseplants" at the 44th Annual Home and Garden Show in Uncasville (February 15, 15 adults); presented "Backyard Small Fruits" at the 44th Annual Home and Garden Show in Uncasville (February 15, 30 adults and one kid); presented "Recap 2024, Bedding Crop Diseases to Prepare for 2025" at the Spring Bedding Plants Workshop in New Haven (February 18, 24 adults); gave a lecture "Diseases of Trees" for the CTPA Arboriculture 101 courses in New Haven (February 20, 37 adults); presented "Organic Plant Disease Control" at the CT NOFA's 43rd Winter Conference in virtual (February 25, 16 adults); with **Felicia Millet**, talk about plant disease diagnosis and seed testing to New Haven Master Gardeners Class CAES Tour (February 25, 16 adults); presented "Selection and Care of Houseplants" for the UConn-Tolland County Master Gardner Program in virtual (February 26, 12 adults).

ROBERT MARRA, PH.D. gave a presentation on "Beech Leaf Disease in Japan: Observations from a two-month collecting trip" to the Beech Leaf Disease Working Group, via Zoom (21 February) (~50 participants); presented "Ecology of Forest Fungi" to the Long Hill Garden Club in Trumbull (24 February)(35 participants); participated in the monthly meeting of Divisional Forum Representatives of the American Phytopathological Society, via Zoom (25 February)(8 participants).

FELICIA MILLETT participated in the NPDN National Data Repository data upload guidelines Course development Working Group Meeting (7adults) (February 5); participated in the Next Gen Scientist STEM Program in Jones (5 students) (February 10); presented "Growing Mountain Laurels in Connecticut" at the 44th Annual Home and Garden Show at Mohegan Sun (12 adults) (February 14); hosted the NPDN Proficiency Committee monthly meeting (4 adults) (February 18); staffed the CAES booth with **Jamie Cantoni** at the Connecticut Flower & Garden Show at the Connecticut Convention Center in Hartford (February 20); presented "Growing Annuals from Seed" for the Colchester Garden Club (13 adults) (February 24); gave a tour of the Seed Testing Lab to the New Haven Master Gardener Club (20 adults) (February 25); and was interviewed by Sloan Brewster (Republican-American, Hearst Connecticut Media Group) on the microgreen industry in Connecticut (February 28).

QUAN ZENG, PH.D. participated in the advisory board meeting of the USDA-SCRI project "An all-stage fire blight control: remote sensing, DNA, enzyme and plant activator technologies for cankers, blossom blight and shoot blight." (Feb 24) (13 Participants).

PUBLICATIONS:

dos Santos Silva, J. L., Alves Bento, E., de Moura, A. P., Costa Alves, T. R., Pereira da Silva, I. V., da Costa Fernandes, J., da Silva Filho, S. M., Gomes Souza, V. M., **da Silva, W.,** de Queiroz Ambrósio, M. M. (2025). First report of *Fusarium falciforme* and *Fusarium pernambucanum* causing root and stem rot on papaya plants in Brazil. *Plant Disease*. DOI: https://doi.org/10.1094/PDIS-08-24-1621-PDN

Abstract: *Carica papaya* L. cultivation represents a significant agricultural sector in northeast Brazil, with annual production reaching 571,693 tons. In August 2023, papaya plants (hybrid Tainung 01) in the production stage showed dark brown symptoms on roots and stems, wilt progression, and collapse of the plants, with incidence rates of 20-50% across sampled sites. Fungal isolation from symptomatic tissue from multiple production areas yielded ten *Fusarium* isolates. Molecular characterization via sequencing of EF-1α and RPB2 genetic markers, combined with morphological analysis on differential media (PDA, SNA, CLA), identified seven isolates as *Fusarium falciforme* (99% bootstrap support) and three as *F. pernambucanum*. Pathogenicity tests were conducted utilizing infested soil methodology, with characteristic symptom development observed at 30 and 60 days post-inoculation for stem and root tissues, respectively. Koch's postulates were fulfilled through successful re-isolation and identification of the causal organisms. This study constitutes the first documented occurrence of *F. falciforme* (FSSC 3 + 4) and *F. pernambucanum* (FIEC 17) as etiological agents of papaya root and stem rot in Brazil, expanding upon previous research that had only identified the involvement of the *Fusarium solani* species complex without species-level resolution. These findings provide critical information for the development of targeted disease management strategies in Brazilian papaya production systems.

VALLEY LABORATORY

JATINDER S AULAKH, PH.D. published a manuscript entitled "Ornamental Plant Safety and Weed Control with Indaziflam" in the Weed Technology Journal (February 18, 2025); and attended the Invasive Plant Council zoom Meeting (February 19, 2025); and presented a co-authored presentation "Characterization and Management of Glyphosate-Resistant Waterhemp from New York and Connecticut" at the Weed Science Society Meeting held in Vancouver, Canada (February 24 to 27, 2025).

RICHARD COWLES, PH.D. presented "Armored scales and their management," and "Getting a good start" to the Pennsylvania Christmas Tree Growers' Association, Boalsville, PA, Feb. 7 (100 participants). He discussed "New and old pests," with the Connecticut Groundskeepers Association, Plantsville, CT, Feb. 18 (350 attendees). He presented "Facts and fallacies of organics" to the Glastonbury Garden Club, Feb. 20 (20 attendees). He was a keynote speaker for the Minnesota Christmas Tree Association and discussed "Getting a good start," "Climate change and effects on plants and pests," and "Questions and answers," Feb. 28 (50 attendees).

NATHANIEL WESTRICK, PH.D. presented a talk entitled "Managing Anthracnose Crown Rot: an emerging issue in the Northeast" to the North American Strawberry Growers Association in Kailua-Kona, Hawaii (Feb 4)(200 attendees); presented on CAES career opportunities at the Central Connecticut State University Scientific Career Fair (Feb 18)(150 attendees); presented boxwood research update at the quarterly meeting of the Boxwood Blight Insight Group (Feb 19)(15 attendees): presented on a scientific career panel at Quinnipiac University (Feb 25)(25 attendees).

PUBLICATIONS:

1. Aulakh, J.; Witcher, A.; Kumar, V. (2025). Ornamental Plant Safety and Weed Control with Indaziflam. *Weed Technology*, 2025. Available online at : https://www.cambridge.org/core/services/aop-cambridge-core/content/view/CD12809D86CB16F51CDEE46DB75811CD/S0890037X25000120a.pdf/ornamental-plant-safety-and-weed-control-with-indaziflam.pdf

Abstract: Indaziflam was evaluated in Connecticut and Tennessee, USA, for weed control and safety of container-grown ornamental plants. Indaziflam was applied at 49, 98, or 196 g ha-1 to container grown ornamental plants on an outdoor gravel pad and preemergence or early postemergence to weeds in greenhouse. Ornamental plants were treated twice annually in 2020 and 2021 in Connecticut, and in 2019 and 2020 in Tennessee, with approximately six weeks between applications. Chinese pyramid juniper, common juniper, eastern hemlock, eastern white pine, and Norway spruce in Connecticut, USA, and 'Andorra Compacta' creeping juniper and 'Black Dragon' Japanese cedar, 'Blue Rug' creeping juniper, and 'Blue Pfitzer' Chinese pyramid juniper in Tennessee, USA, were not injured with indaziflam regardless of rate applied. Preemergence application of indaziflam reduced densities of creeping woodsorrel, hairy bittercress, giant foxtail, and large crabgrass 72 to 100%, depending upon the indaziflam rate applied, by 28 d after treatment (DAT). When applied early postemergence, indaziflam provided 97 to 99% control of creeping woodsorrel (1- to 2-leaf), fringed willowherb (4- to 6-leaf), hairy bittercress (cotyledon to 1-leaf), and mouse-ear chickweed (2- to 4-leaf) by 28 DAT. Compared with the nontreated control, the total fresh shoot biomass reduction was 86 to 100% and 78 to 100% following preemergence or postemergence applications. Indaziflam offers a new site-of-action with excellent safety and weed control in the tested ornamental plants.

JOURNAL ARTICLES APPROVED FEBRUARY 2025

Aikpokpodion, P. E., Womack, N., Das, R., Hsiao, B. S., and **Dimkpa, C. O.** Controlling nutrient loss in plant-soil system using effluents from a zero-waste nitro-oxidation process up-cycling of agrowaste feedstocks. *Environmental Science and Technology*.

Corso, G., **Triplett, L. R.**, and Gage, D. Neuromorpha vorax: characterization of a cosmopolitan protist with an unexpectedly complex life-cycle belonging to Glissomonadida Clade-U/Group-TE. *Nature Communications*.

dos Santos Silva, J. L., Alves Bento, E., de Moura, A. P., Costa Alves, T. R., Pereira da Silva, I. V., da Costa Fernandes, J., da Silva Filho, S. M., Gomes Souza, V. M., **da Silva, W.,** de Queiroz Ambrósio, M. M. (2025). First report of *Fusarium falciforme* and *Fusarium pernambucanum* causing root and stem rot on papaya plants in Brazil. *Plant Disease*.

dos Santos Silva, J. L., Alves Bento, E., de Moura, A. P., Costa Alves, T. R., Pereira da Silva, I. V. Gomes Souza, V. M., Ávila Filha, V. M., Silva Ribeiro, J. W., **da Silva, W.**, de Queiroz Ambrósio, M. M. Characterization and aggressivity of Fusarium spp. associated to root rot and stem rot in Carica papaya in Northeast Brazil. *Plant Disease*.

Ghribi, S.; Degli Esposti, L.; **Steven, B.**; Yuan, J.; **White, J.C.**; Jaisi, D.P.; Adamiano, A.; Iafisco, M. Functionalization of amorphous and crystalline calcium phosphate nanoparticles with urea for phosphorus and nitrogen fertilizer applications. *Journal of Agricultural and Food Chemistry*.

Morinaga G., Balcazar D., Badolo A., Iyaloo D., Tantely L., Mouillaud T., Sharakhova M., Geib S.M., Paupy Ch., Ayala D, Powell J.R., **Gloria-Soria A.**, Soghigian J. From macro to micro: De novo genomes of Aedes mosquitoes enable comparative genomics among close and distant relatives. *Genome, Biology, and Evolution*.

Yao, X.; Shen, Y.; Hu, P.; Stitgen, A.; Satterfield, L.; Sigmon, L.R.; **Deng, C.**; Jilani, S.Z.; Rosenzweig, Z.; Fairbrother, D.H.; Giraldo, J.P.; **Elmer, W.**; **White, J.C.**; Haynes, C.H. Uptake and impact of carbon dots and their copper complex on tomato growth. *ACS Applied Nano*.

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