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 collaborators at the University of Minnesota met by Teams with CT Innovations to discuss nanotechnology and agriculture (June 2, 18, 26); along with **Nubia Zuverza-Mena, Ph.D., Sara Nason, Ph.D. and Jingyi Zhou, Ph.D.** met by ZOOM with collaborators at Yale University and the University of Minnesota to discuss progress on a collaborative NIEHS grant (June 3); along with **Chaoyi Deng, Ph.D. and Hina Ashraf, Ph.D.** participated in the weekly NSF Center for Sustainable Nanotechnology ZOOM call (June 4, 18, 25); met with collaborators at the University of Minnesota and 3M to discuss a collaborative PFAS phytoremediation project (June 5, 13); travelled to Cuba to meet with officials at the Ministry of Agriculture, the Ministry of Higher Education, and various research institutes to set up a collaborative research, education and extension program on agriculture (June 9-12); met by ZOOM with a venture capital firm based in Asia to discuss the safety and efficacy of nanotechnology in agriculture (June 17); participated by Teams in a meeting of the Board of the International Phytotechnologies Society to discuss the upcoming 2026 scientific meeting of the society (June 17); along with **Sudhir Sharma, Ph.D.** met with colleagues at Columbia University to discuss collaborative research (June 17); along with **Yi Wang, Ph.D. and CHRISTIAN DIMKPA, PH.D.** met with colleagues at Lehigh University to discuss collaborative research (June 18); met with collaborators at Convergent BioScience to discuss product research and development (June 18); hosted the quarterly CAES Safety Committee meeting (June 27).

PUBLICATIONS:

1. Zhou, J., Tang, C., Xiao, M., Ge, T., Luo, Y., Dong, Y., Yu, B., Cai, Y., **White, J. C.,** Li, Y. (2025). Nitrogen-induced suppression of methane accumulation is counteracted by biochar in a subtropical forest soil. *Environ. Res.* 285, 122290

Abstract: Subtropical forests are significant contributors to N2O emissions with consequences for climate regulation. Biochar application has emerged as a promising strategy to mitigate soil N2O emissions, yet its effects and the underlying mechanisms under nitrogen (N) deposition in subtropical forests remain poorly understood. A comprehensive 3-year field study within a subtropical forest reveals that N deposition led to a significant increase in soil N2O emissions by 14.6–25.1% annually. However, biochar application resulted in a substantial reduction of these emissions, ranging from 8.0–20.8% each year. Notably, the mitigation effect of biochar was particularly pronounced when N deposition was occurring, leading to an even greater reduction in N2O emissions by 14.2–22.0% annually. This mitigation effect is attributed to biochar's capacity to lower the nitrification and denitrification rates of soil via reducing levels of ammonium N and water-soluble organic N. Additionally, biochar decreased the abundance of critical microbial genes, including AOAamoA, nirK and nirS, and reduced the activity of key enzymes such as nitrate and nitrite reductase. These findings highlight the potential of straw biochar to effectively mitigate soil N2O emissions in subtropical forests experiencing N deposition, offering important insights for supporting ecosystem sustainability under global climate change.

2. Ahmed, T., Noman, M., Qi, Y., Gardea-Torresdey, J. L., **White, J. C.,** Qi, X. (2025). Sunlight-activated T6P precursor: a potent biostimulant for smart agriculture. *Trends Plant. Sci*. https://doi.org/10.1016/j.tplants.2025.06.012.

Abstract: Biotic and abiotic environmental stresses significantly jeopardize crop production worldwide. Recently, Griffiths et al. demonstrated that a sunlight-activated trehalose 6-phosphate (T6P) precursor, DMNB-T6P, improved wheat yield by regulating T6P signaling pathways under both water sufficient and deficient conditions. This finding offers a scalable technology as an efficient companion to chemical fertilizers for improving crop resilience and productivity.

3. Jiang, Y., Sun, Y., A, C., Zhou, P., Li, Y., Wang, Q., **White, J. C.,** Rui, Y., Zhang, P. (2024). Root-soil-microbe interactions mediate phosphorus and iron uptake from lithium iron phosphate nanomaterials. *Appl. Soil Ecol.* 213:106295.

Abstract: Addressing the critical challenge of global food security requires innovative agricultural strategies to simultaneously enhance crop productivity and quality while mitigating negative environmental impacts. This study introduces a novel approach to alleviate iron (Fe) deficiency in peanut and phosphorus (P) deficiency in maize by incorporating lithium iron phosphate nanoparticles (n-LiFePO4) recycled from lithium batteries into intercropping systems of these species. Soil was amended with 50 and 250 mg/kg of n-LiFePO4 in monocropped maize, monocropped peanut and intercropped systems. Intercropping promoted the growth of peanut, with an increase of dry weight of roots and shoots by 41% and 102%, respectively. It is noteworthy that addition of n-LiFePO4 of 50 mg/kg further enhanced the beneficial effects of intercropping, increasing the fresh and dry weight of roots by 57% and 80%, respectively, compared with controls. n-LiFePO4 at 250 mg/kg still showed positive effects, although 250 mg/kg Fe2+ inhibited the development of maize and peanut. n-LiFePO4 significantly increased the efficacy of P and Fe, resulting in substantial growth improvements for both peanut and maize. Mechanistically, this enhancement can be attributed not only to the sustained release of P and Fe from n-LiFePO4, but also to the stimulation of maize root exudation. This modified exudate profile positively influenced rhizosphere soil pH and promoted a more diverse bacterial community that contributed to the enrichment of solubilized P, production of Fe carriers, and the promotion of legume nitrogen fixation by beneficial bacterial flora. These findings demonstrate that n-LiFePO4 can be used to improve agricultural production through microbial modulation and sustained nutrient release, and that such effects are enhanced in intercropping systems.

4. Kandhol, N., Singh, V. P., Parkash Dhankher, O., **White, J. C.,** Tran, L.-S. P., Tripathi, D. K. (2025). Nanomaterial-based gene editing in plants: An upcoming genetic revolution? *Tends Plant Sci.* https://doi.org/10.1016/j.tplants.2025.04.012.

Abstract: The pressure on agriculture from a changing climate, increasing global population, and decreasing cultivable soils demand a suite of novel technologies that will enable increased efficiency and production. Plant genetic engineering offers a range of viable methods to improve crop yield, quality, and resistance to abiotic/biotic stresses while simultaneously decreasing the unsustainable use of pesticides and fertilizers. However, conventional gene delivery methods such as electroporation, biolistic bombardment, polyethylene glycol-, Agrobacterium- and clustered regularly interspaced short palindromic repeats (CRISPR)-mediated genetic transformation systems suffer from a range of limitations, including species dependency, collateral tissue damage, undesirable DNA integration into the host genome, low transformation efficiencies, and high cost. The integration of nanotechnology with existing molecular technologies offers a promising strategy to enable the development desired agronomic traits while simultaneously overcoming the shortcomings of conventional genetic approaches. Nanomaterials, due to their tuneable size and physicochemical properties, are able to effectively penetrate biological barriers and can be conjugated with a wide range of cargos for the introduction the desired traits into plants. Nanoscale carriers have great potential as effective vectors for the delivery of nucleic acids,

including plasmid DNA (pDNA), double stranded (ds)RNA, small interfering RNA (siRNA), microRNAs and proteins into either protoplasts or intact cells. Nanomaterial-conjugation strategies may be used to protect sensitive cargo from degradation by ultraviolet light or cellular enzymes, thereby enabling more efficient delivery of genetic cargo of interest into plant cells after spraying, injection or co-culture. In spite of significant interest and recognized potential, a number of challenges and unanswered remain, including standardization of materials, dosage and exposure periods, environmental health and safety (EHS) evaluation, and consideration for possible accumulation and trophic chain transfer of nanomaterials within the food chain. However, given the magnitude of global food insecurity and the great potential of nano-enabled genetic engineering, active and intense research in this area is highly warranted.

5. Ghribi, S., Degli Esposti, L., Steven, B., Yuan, J., **White, J. C.,** Jaisi, D.P., Adamiano, A., Iafisco, M. (2025). Functionalization of amorphous and crystalline calcium phosphate nanoparticles with urea for phosphorus and nitrogen fertilizer applications. *J. Agric. Food Chem.* https://doi.org/10.1021/acs.jafc.5c03970.

Abstract: The development of nano-fertilizers has gained significant attention due to their potential to enhance nutrient delivery to plants while mitigating the environmental impact of intensive agriculture. In this study, we investigated the urea-functionalization of two types of calcium phosphate (CaP) nanoparticles - crystalline hydroxyapatite (HAP) and amorphous calcium phosphate (ACP) - to develop a nano-fertilizer capable of simultaneously and controllably releasing both phosphorus and nitrogen. We characterized their physico-chemical properties and evaluated their capacity as controlled-release nano-fertilizers by assessing urea and phosphorous release kinetics. In a leaching test using a vermiculite column, ACP-Urea significantly slowed urea release compared to free urea and retained over 95% of phosphorus after 48 hours. In contrast HAP-Urea exhibited urea release behavior similar to free urea. Greenhouse experiments with corn (Zea mays) demonstrated that ACP-Urea (P at 200 mg/kg) increased dry biomass and relative chlorophyll content by at least 50% and 30%, respectively, compared to both ACP and monocalcium phosphate (MCP), used as reference, combined to free urea. Further analysis indicated that differences in soil parameters and plant growth responses were primarily attributed to the physico-chemical properties of the materials rather than significant shifts in rhizosphere bacterial communities. These findings highlight the potential of ACP nanoparticles as effective nitrogen carriers for slow-release nano-fertilizers in sustainable agriculture.

6. Noman, M., Ijazb, U., Ahmed, T., Hao, Z., Wang, Y., Wang, J., Islam, M. S., Ijaze, A., **White J. C.,** Wang, J. (2025). Nanobiohybrid-enabled smart platforms for biostimulation and immunoengineering of plants. *Mat. Today Bio* 33:101989.

Abstract: Conventional agricultural practices have become increasingly impractical due to their high inefficiency and overuse, posing serious threats to ecosystem stability and health. Nanohybrids refer to a class of composite materials comprised of nanomaterials combined with diverse materials, including inorganic, polymeric, or biological materials, resulting in hybrid structures with unique functional features such as greater mechanical strength, catalytic activity, and biocompatibility, thus providing advanced frameworks with a vast variety of applications in the agriculture sector. Nanohybrids can augment the functional capabilities of plants, such as photosynthesis and stress tolerance, enabling crops to thrive under diverse climatic conditions. Additionally, nanohybrid-based agricultural practices can improve growth and productivity of crops by providing them with essential nutrients in a more controlled and precise manner. Importantly, nanohybrid-based systems can shield plants against biotic (pest and pathogen attacks) and abiotic (drought, salinity, temperature, and pH etc.) stressors by activating sophisticated, interconnected, and intricate antioxidative or genetic defense responses. Here, we provide a critical overview of nanohybrid-enabled

strategies for improving agriculture practices and plant health under biotic and abiotic environmental challenges. We also highlight the transformative potential of nanohybrid-based smart agrochemicals for developing sustainable and eco-stable agricultural systems, thereby ensuring global food security.

7. Lyu, Y., Guo, Z., Li. Z., Li, F.-G., Lynch, I., **White, J. C.,** Zhang, P. (2025). Prediction of metal nanoparticle interactions with soil properties: Machine learning insights into soil health dynamics. *ACS Nano* https://doi.org/10.1021/acsnano.5c04197

Abstract: Metal nanoparticles (MNPs) offer great potential to enable precision and sustainable agriculture. However, a comprehensive understanding of the interaction between multiple MNPs and soil properties, including impacts on overall soil health, remains elusive. Here, 4 different interpretable machine learning models were employed to systemically analyze the interactive effects of 7 soil physicochemical properties, 3 MNPs properties, and 3 external factors on key soil health indictors, including pH, soil microbial biomass, Shannon index, and enzyme activities. In addition to the soil organic matter (SOM) and clay (SC), which has received extensive attention, the soil cation exchange capacity (SCEC) and exposure duration (ED) also have significant interactive effects on the toxicity of MNPs in soil. The SCEC determines soil's ability to fix and adsorb metal ions dissolved from MNPs, thereby affecting toxicity. Importantly, these behaviors show opposite effects as the ED changes. This study predicts the impact of MNPs on soil health indicators across 12 United States Department of Agriculture (USDA) classified soil orders from a global perspective. Not surprisingly, the impact of MNPs on soil health is highly dependent on soil properties, with effects varying across different soil types globally. Entisols are the most abundant and widespread soil and are characterized by low water hold capacity and SOM content; here, pH was particularly sensitive to MNPs exposure. Mollisols and Inceptisols represent important cultivated lands in Europe, the United States, Canada, and China; their microbial biomass and diversity were found to be sensitive to long-term exposure to MNPs. By conducting global predictions across diverse soil types, this research provides important information to support more science-based and data driven environmental management and sustainable agricultural practices.

8. Xu, Y., Chen, Y., Coa, Y., **White, J. C.,** Yue, H., Ma, C., Yan, W., Xing, B. (2025). *Salix jiangsuensis* 'J172' enhanced lead tolerance under flooding stress by regulating the rhizosphere bacterial assembly and functions. *Environ. Poll.* 381: 126625.

Abstract: Lead (Pb) contamination threaten soil ecosystems, and the increased risk of flooding due to climate change may influence soil functions and metal bioavailability. However, the response of rhizosphere soil microbial communities to these combined stresses remains unclear. Here, fast-growing willow (Salix × jiangsuensis 'J172') was planted in soils with Pb contamination (control, 400 and 800 mg · kg^{-1}) under non-flooded (NF) and flooded (IF: intermittent flooding and CF: continuous flooding) conditions for 60 d. At Pb800 contamination, IF and CF markedly decreased the soil available Pb by 17.7 % and 14.1 % ($p < 0.05$), respectively, compared to NF con- dition. Flooding (CF and IF) conditions increased bacterial phylogenetic diversity compared to NF, with IF exhibiting greater impact (10.6 %, $p < 0.05$). For assembly process, the bacterial community under CF condition exhibited a shift towards a more deterministic process compared to NF, although stochastic mechanisms were still dominant (normalized stochasticity ratio >0.5). Increased abundance of Pb tolerance genes and sulfate-reduction function under CF conditions promoted a decrease in soil Pb availability ($R^2 > 0.5$, $p < 0.05$). Compared to NF, the bacterial functional redundancy index, which characterizes the stability of ecological functions, was reduced by 7.1–25.9 % under CF condition, regardless of Pb contaminations, while IF increased this index with Pb800. The findings provide valuable insight into the mechanisms underlying the response of soil bacterial communities for the studied Salix species to com-

bined stresses of flooding and Pb, and enhance the comprehension of rhizosphere micro-ecological processes in remediation woody plants under complex multi- stress exposure scenarios.

9. Gao, S., Shang, H., Deng, C., Eggleston, I., **White, J. C.,** Hashemi, M., Wang, Y., Xing, B. (2025). Enhancing leafy green vegetable growth and quality through the foliar application of copper oxide nanoparticles. *Environ. Technol. Innov*. 39 104310.

Abstract: The use of nanotechnology to promote crop yield has attracted increasing attention in agriculture. The present work investigates the effects of copper oxide nanoparticles (CuO NPs) on Chinese cabbage (Brassica pekinensis (Lour.) Rupr.) and spinach (Spinacia oleracea L.). In a greenhouse study, foliar treatment with CuO NPs (80 mg/L) significantly increased the fresh shoot biomass of Chinese cabbage and spinach by 27.13% and 25.11% respectively, compared to bulk CuO and by 25.95% and 24.34% respectively, compared to CuSO4. No significant increases were observed with foliar treatments of CuSO4 and bulk CuO, relative to the untreated control. Notably, CuO NPs increased the leaf concentrations of Fe, Mg, and Zn, as well as the levels of important organic compounds such as vitamin C and carotene, compared to the bulk CuO and CuSO4 treatments, suggesting the potential for significant nano-enabled biofortification. Specifically, nanoscale CuO increased the leaf concentration of carotene in spinach by 21.79% and 18.09 compared with the bulk CuO and CuSO4, respectively, and the concentration of leaf vitamin C in Chinese cabbage by 33.59% and 29.81%, respectively. Taken together, our findings provide valuable information on the use of foliar nanoscale CuO for improving the yield and quality of leafy green vegetables.

10. McKeel, E., Deng, C., Kim, H.-I., Jeon, S., Giraldo, J.P., **White, J. C.,** Klaper, R. (2025). Seed infiltration with polymer functionalized carbon dots induces a biotic stress response in tomato (*Solanum lycopersicum* L.). *ACS Agric. Sci. Technol.* https://pubs.acs.org/action/showCitFormats?doi=10.1021/acsagscitech.5c00203&ref=pdf.

Abstract: Global food security is a pressing issue in our society. Maintaining food security in coming years will require improving crop yield, as well as increased resiliency to abiotic and biotic stress. Nanoscale materials have increasingly been proposed as a tool which could be used to meet these challenges. However, much research is needed to optimize nanoparticle design and crop application for this to become a reality. In this study, we investigated the impact of polymer-functionalized carbon dots on tomatoes (Solanum lycopersicum L.). Tomato seeds were vacuum infiltrated with carbon dots, then grown for three weeks before collection of phenotypic and transcriptomic data. No changes to fresh biomass or chlorophyll content were observed, indicating that these particles can be applied without overt harm to the plant at early growth stages. In addition, changes in gene expression suggest that polymer-functionalized carbon dots can initiate the expression of biochemical pathways associated with a pathogen resistance response in tomato plants. Specifically, genes involved in ethylene signaling, ethylene production, and camalexin synthesis were upregulated. These findings suggest that seed priming with carbon dots may improve plant tolerance to biotic stress by modulating ethylene signaling pathways. Carbon dots could also be loaded with nutrients or other agrochemicals to create a multifunctional platform. Future work should focus on understanding the mechanisms by which nanoparticles can modulate ethylene signaling, enabling use of this knowledge to develop sustainable and effective nanoparticles for agricultural applications.

11. Das, M., Calderon, L., Singh, D., Majumder, S., Bazina, L., Vaze, N., Trivanovic, U., DeLoid, G., **Zuverza-Mena, N.**, **Kaur, M.**, Konkol, J., Tittikpina, N. K., Tsilomelekis, G., Sadik, O., **White, J. C.,** Demokritou, P. (2025). Development and characterization of reference environmentally relevant micro-nano-plastics for risk assessment

studies. *NanoImpact* , 38, DOI: 10.1016/j.impact.2025.100567.

Abstract: Micro- and nano-plastics (MNPs) have become ubiquitous environmental pollutants. Extensive toxicological studies of MNPs have been conducted in recent years. However, because of the difficulties involved in extraction and collection of MNPs from environmental media, most of these studies have employed simplistic, pristine, spherical, micro- or nano-sized commercial MNPs, whose properties, including morphology, surface chemistry, and size, do not adequately approximate those of environmentally relevant MNPs. Here, we describe the development and use of methods for the synthesis of well characterized, environmentally relevant MNPs across the life cycle of a plastic material, in a reproducible and property-controlled manner. Multiple degradation scenarios, including mechanical fragmentation (cryogenic milling), UV weathering, and thermal disintegration (incineration) were applied to virgin plastic materials (polyvinyl chloride, PVC; and polyethylene terephthalate, PET) to simulate the life cycle pathways that likely occur in the environment over time. The MNPs generated from these degradation processes were size fractionated using both "dry" and "wet" separation methods. Detailed physicochemical characterization of the size fractionated reference MNPs was performed to determine size, morphology, chemical and elemental compositions, and hydrophobicity. Microbiological sterility and endotoxin content of reference MNPs were also assessed. Protocols for storage of reference MNPs in controlled oxygen and moisture conditions for future use in toxicological studies are also described. The methodology developed in this study can be used to reproducibly synthesize environmentally relevant reference MNPs across the life cycle of plastic materials for use in risk assessment studies.

12. Sharma, S., Bolan, S., Hou, D., Mukherjee, S., Zhou, P., Yang, X., **White, J. C., Zuverza-Mena, N.,** Zhang, T., Chen, J., Xu, Q., Wei, X., Lyu, S., Lakma, S., Vithanage, M., Rinklebe, J., Wang, H., Siddique, K. H. M., Bolan, N. (2025). Titanium – metal of the future or an emerging environmental contaminant? *Explora: Environ. Res.* https://dx.doi.org/10.36922/EER025130027

Abstract: Naturally occurring and anthropogenic sources, such as ore (minerals), waste disposal and mine tailings, can introduce titanium (Ti) into both soils and aquatic environments. Ti is the ninth most abundant element in nature (0.63% w/w) and is found in igneous rocks. The major Ti minerals include rutile, brookite, anatase, ilmenite, and titanite. TiO2 is classified as potentially carcinogenic to humans (Group 2B) by the International Agency for Research on Cancer (IARC). Ti is being increasingly used in aviation and aerospace, and also used for biomedical applications, including joint replacement and tooth implants. Titanium dioxide (TiO2) nanoparticles are one of the most important Ti compounds, entering the environment through various pathways, including biosolid applications, and have been shown to cause deleterious effects on soil microorganisms and, consequently, on soil functioning and health. Ti intake can cause toxicity (above optimum levels) to plants, soil, aquatic organisms, animals and human. Dust inhalation of TiO2-NPs by humans may cause chest pain, coughing, and breathing difficulty, and dermal contact may cause irritation. In order to control the main anthropogenic input sources of Ti in the environment, it is critical to develop affordable technologies for Ti removal during wastewater treatment. This comprehensive review examines the presence, sources, biogeochemical behavior, and potential risks of Ti in the environment and provides an in-depth outline of the network visualization bibliography to graphically represent the relationships between key publications, research areas, and authors. Additionally, future research priorities are suggested for sustainable management of Ti contamination.

Jason C. White, Ph.D. visiting the Cuban Ministry of Agriculture, Ministry of Higher Education, and several agricultural research institutes.

ANALYTICAL CHEMISTRY

PUBLICATIONS:

1. Buurma, E. E., Vaidya, S. R., Pilotto, L., **Dimkpa, C. O., White, J. C.,** Fellet, G., Howard, D., Fairbrother, H. D. (2025). Differential effects of biodegradable polymers and polymer-phosphorus composites on tomato performance and phosphorus uptake. *ACS Agricultural Science and Technology*. DOI: 10.1021/acsagscitech.5c00285

Abstract: While biopolymers have the potential to enhance agrochemical delivery and mitigate environmental impacts such as runoff, previous plant studies have often been limited to examining single biopolymers in isolation. This approach has hindered effective comparisons of plant outcomes due to variations in plant type, growth duration, and soil characteristics. The current study addresses this gap by incorporating six separate milled biopolymers: pectin, starch, chitosan, polycaprolactone (PCL), polylactic acid (PLA), or polyhydroxybutyrate (PHB) into soil and directly comparing their impacts on tomato (Solanum lycopersicum) plants cultivated under identical environmental parameters. Plant outcomes were also studied when biopolymers were modified via the inclusion of two phosphorus (P) salts, forming two types of Polymer-P-containing salt composites with amorphous CaPO4 (CaP) and CaHPO4 (DCP). Our results revealed that chitosan-based treatments significantly improved tomato root and shoot biomass, with increases of 200–300% compared to the control plants. Chitosan-CaP and Chitosan-DCP also enhanced P uptake, though the effect was significantly more pronounced in the former, suggesting a synergy between chitosan and CaP. Neither Chitosan-P-containing salt treatment, however, mitigated P leaching from soil when compared to CaP or DCP applied in isolation. The two most hydrophilic biopolymers, pectin and starch, as well as their P-salt-containing counterparts, showed the most substantial reductions in biomass (□80%) with respect to control plants, while similarly lowering P uptake and P retention in soil compared to CaP- and DCP-only plants. PCL- and PHB-based treatments also adversely influenced biomass and plant P, though these effects were not as drastic as those observed with pectin and starch. PLA-based soil amendments had no effect on any plant performance metric, though PLA-CaP, specifically, was the only treatment to appreciably mitigate P leaching (−63%). Based on these findings, subsequent tomato growth experiments were conducted over a longer 8-week period with CaP, DCP, Chitosan, Chitosan-CaP, and Chitosan-DCP. While all chitosan-treated plants showed similar enhancements in biomass, plants treated with Chitosan-CaP and Chitosan-DCP were the only ones to fruit, demonstrating the benefit of using chitosan in conjunction with a P source as compared to either treatment in isolation. These findings contribute to an expanding body of evidence that biopolymer carriers can offer a more sustainable approach to improving the precision of nutrient delivery, while also highlighting the pivotal role of biopolymer and nutrient type in the development of these carriers.

2. Das, M., Calderon, L., Singh, D., Majumder, S., Bazina, L., Vaze, N., Trivanovic, U., DeLoid, G., **Zuverza-Mena, N., Kaur, M.**, Konkol, J., Tittikpina, N. K., Tsilomelekis, G., Sadik, O., **White, J. C.,** Demokritou, P. (2025). Development and characterization of reference environmentally relevant micro-nano-plastics for risk assessment studies. *NanoImpact* , 38, DOI: 10.1016/j.impact.2025.100567.

Abstract: Micro- and nano-plastics (MNPs) have become ubiquitous environmental pollutants. Extensive toxicological studies of MNPs have been conducted in recent years. However, because of the difficulties involved in extraction and collection of MNPs from environmental media, most of these studies have employed simplistic, pristine, spherical, micro- or nano-sized commercial MNPs, whose properties, including morphology, surface chemistry, and size, do not adequately approximate those of environmentally relevant MNPs. Here, we describe the development and use of methods for the synthesis of well characterized, environmentally relevant MNPs across the life cycle of a plastic material, in a reproducible and prop-

erty-controlled manner. Multiple degradation scenarios, including mechanical fragmentation (cryogenic milling), UV weathering, and thermal disintegration (incineration) were applied to virgin plastic materials (polyvinyl chloride, PVC; and polyethylene terephthalate, PET) to simulate the life cycle pathways that likely occur in the environment over time. The MNPs generated from these degradation processes were size fractionated using both "dry" and "wet" separation methods. Detailed physicochemical characterization of the size fractionated reference MNPs was performed to determine size, morphology, chemical and elemental compositions, and hydrophobicity. Microbiological sterility and endotoxin content of reference MNPs were also assessed. Protocols for storage of reference MNPs in controlled oxygen and moisture conditions for future use in toxicological studies are also described. The methodology developed in this study can be used to reproducibly synthesize environmentally relevant reference MNPs across the life cycle of plastic materials for use in risk assessment studies.

ENTOMOLOGY

PHILIP ARMSTRONG, SC.D. was interviewed by CT public radio (June 5) and NBC CT (June 6) about the start of the CT Mosquito Monitoring Program; attended the Dissertation Committee Meeting for Yale PhD student Nicole Feriancek (June 10); provided updates for the monthly meeting of the NEVBD TEC leadership team (June 11); gave the NEVBD trainee seminar about career pathways in public health entomology (June 13); was interviewed by WTIC (June 24), News Channel 3 (June 24), NBC Connecticut (June 24), news channel 12 (June 25), Univision (June 25), and Fox 61 (June 26) about the early detect of West Nile virus in Connecticut.

ANGELA BRANSFIELD participated via Zoom in Yale University's Biosafety Committee meeting (June 26); spoke to attendees of the Arts and Ideas Festival Tour about the BSL-3 laboratory and the viral testing and diagnostic efforts as part of the CT Mosquito Surveillance Program (40 attendees, June 26); and participated in a CAES Health and Safety Committee meeting (June 27).

JAMIE L. CANTONI attended a North America Invasive Species Management Association (NAISMA) webinar on the invasive freshwater jellyfish, *Craspedacusta sowerbii,* in North American lakes (June 18); was interviewed by a medical student undertaking a community-focused project at Newtown's Primary Care Clinic to boost awareness of tickborne illnesses, current tick activity and surveillance efforts, and public safety practices (June 23); participated in the International Festival of Arts and Ideas as a tour guide, introducing the participants to the Station's grounds and escorting them around the Station to several key scientist speakers (40 attendees; June 26).

KATHERINE DUGAS was interviewed by Alexandra Sifferlin, journalist from the New York Times about Delusional Infestation (June 6); interviewed two prospective IIO volunteers from the Cedarhurst School Passage Program (June 17 and June 24); attended the summer CAPS Committee Meeting in Jones Auditorium to hear updates on current CAPS and USDA surveys (June 23, 9 attendees); conducted a Lyme Land Trust insect identification hike at the Roaring Brook Preserve in Lyme (June 22, 12 attendees); and hosted visitors in the IIO from the New Haven annual festival of Arts and Ideas (40 attendees) (June 26).

KELSEY E. FISHER, PH.D. attended and participated in the Sweet Corn Integrated Pest Management Working Group Meeting in Ellicott City, MD (June 3-4); attended and participated in the Northeast Pollinator Working Group meeting (June 10); discussed a monitoring beneficial insects workshop with members of Connecticut National Estuarine Research Reserve (June 11); hosted a collaborator, Emily Bick, Ph.D., from University of Wisconsin Madison (June 11); served as a committee member and attended a MS student's committee meeting at University of Connecticut Department of Plant Science and Landscape Architecture (June 12); met and brainstormed with Erik Dopman (Tuffs University) and Brad Coates (USDA-ARS-CICGRU) about collaborative opportunities (June 12, 13, 24); met with the Terrestrial authorship team about a chapter for "United By Nature", a national knowledge assessment of nature and its benefits (formerly known as the National Nature Assessment) (June 27); met with Dr. Sarah Lawson at Quinnipiac University, Tracy Zarrillo, and Caleb Bryan about collaborations and grant opportunities (June 27).

MEGAN LINSKE, PH.D. co-hosted a visit by research collaborator Dr. Michael Banfield for ongoing integrated tick management strategy research (June 2); participated in meetings with collaborators from BanfieldBio, Inc. and North Carolina State University to discuss blacklegged tick repellency trials and botanical acaricide development and application (June 3, 10, & 17); was interviewed by Nicole Nalepa and Scott Haney on WFSB's *Mommy Monday* to discuss emerging and established ticks and their associated risks (June 9); participated

in the Northeast Regional Center for Excellence in Vector Borne Diseases Training and Evaluation Center (NEVBD-TEC) leadership call (June 11); hosted the Wildlife Society Leadership Institute Committee monthly meeting as Chairperson (20 attendees; June 12); joined a progress call with staff from the Centers for Disease Control and Prevention's Division of Vector-Borne Diseases to discuss ongoing integrated tick management and seasonal spray initiatives (June 18).

GOUDARZ MOLAEI, PH.D. was interviewed by CT Voices News on the longhorned tick activity in Connecticut (June 5); attended the monthly meeting of the NEVBD TEC leadership team and provided updates on the CAES projects (June 11); submitted an application to the Yale IRB Committee for a joint project with Drs. Lauren Pischel and James Shepherd on Alpha-Gal syndrome in Connecticut (June 24); presented an invited talk to the NEWVEC Center of Excellence, "The Rising Tide of Tick- and Mosquito-Borne Illnesses and Our Research and Surveillance Engagement to Mitigate the Impacts" (June 25); met and discussed progress on the joint manuscript with the tentative title, "Nanopore Sequencing Enables Broad Detection and Surveillance of Tick-Borne Pathogens in *Ixodes scapularis*" with Dr. Paul Wolujewicz of Quinnipiac University (June 26); and hosted two groups of Arts and Ideas Festival visitors and discussed public services, surveillance, and research at the CAES Tick Testing Laboratory (June 26).

RAFFAELA NASTRI hosted the summer CAPS Committee Meeting in Jones Auditorium to give updates on the current CAPS surveys, hear updates from the USDA, DEEP, and CAES, and plan for next years' surveys (June 23, 9 attendees).

GALE E. RIDGE, PH.D. was interviewed by Chaz and AJ from WPLR about ticks and their medical importance in Connecticut (June 3); was interviewed by Alexandra Sifferlin, journalist from the New York Times about Delusional Infestation (June 6); interviewed two prospective volunteers from the Cedarhurst School Passage Program who we accepted as volunteers in archiving the Stations insect collection for the month of July (June 17 and June 24), attended a North America Invasive Species Management Association (NAISMA) webinar on the invasive freshwater jellyfish (*Craspedacusta sowerbii*) in North American lakes (June 18); and hosted visitors from the New Haven annual festival of Arts and Ideas (40 attendees) (June 26).

DR. KIRBY C. STAFFORD III participated in a Northeast Regional Center for Excellence in Vector-Borne Diseases Teaching and Evaluation Center (NEVBD TEC) Leadership and Advisory Board (NEVBD-TEC) Leadership call (June 11).

PAULA WOLF participated in the Apiary Inspectors of America East Region Quarterly Meeting (June 2nd); presented an invited talk "The State Apiarist's Role in Promoting Honey Bee Health" at the Annual Meeting of the New London County Agricultural Extension Council (June 2nd, 20 attendees); participated as a panelist in the Northeast USA Honey Bee Update, a virtual Q & A session for beekeepers throughout New England put on by the Apiary Inspectors (June 6th, 108 attendees); participated in Apiary Inspectors of America virtual meeting (June 11); participated in a virtual meeting of the Apiary Inspectors of America discussing swarm protocols at ports (June 16th); participated in CT Beekeepers Association's Bee Talks Virtual Q & A session for CT Beekeepers (June 19th, 28 attendees); participated in the Summer CAPS Committee Meeting in Jones Auditorium to give updates on the current CAPS surveys, hear updates from the USDA, DEEP, and CAES, and plan for next years' surveys (June 23, 9 attendees); engaged with attendees of the Cherry Lawn Community Garden's 50th Anniversary event with the observation hive (June 28th).

TRACY ZARRILLO attended and participated via Zoom in a meeting of the Forest Bee Collaborative to discuss the project and make plans for future publications (June 3); worked as a native bee taxonomic expert at the Rhode Island Natural History Bioblitz (June 6,7); attended

and participated in a meeting of the Northeast Pollinator Working Group (June 10); met with Dr. Sarah Lawson at Quinnipiac University, Tracy Zarrillo, and Caleb Bryan about collaborations and grant opportunities (June 27); attended and participate in a meeting with Casey Johnson of University of Rhode Island to about collaborations (June 30).

PUBLICATIONS:

1. Powell J. R., **Gloria-Soria A.** and Soghigian J. (2025). Recognition of Mosquito Subspecies: the Case for Aedes aegypti (Diptera: Culicidae). *Journal of Medical Entomology*. tjaf067, https://doi.org/10.1093/jme/tjaf067.

Abstract: We address the recent proposal by Harbach and Wilkerson to eliminate all Culicidae (mosquito) subspecies names. We defend and promote the use of subspecies for the important vector *Aedes aegypti* (L.): *Aedes aegypti aegypti* and *Ades aegypti formosus.* Harbach and Wilkerson would raise the latter to *Aedes formosus.* We briefly review evidence on this group with relation to various species concepts and find little or no support for this species designation. The 2 forms fit most concepts of subspecies and we advocate continued use of subspecies. Workers on other culicid groups may wish to retain subspecies when accurate, useful, and stable (historical continuity).

2. Mantack, D. P. and **Zarrillo, T**. (2025). First record of Melitta eickworti Snelling & Stage 1995 (Hymenoptera: Apoidea: Melittidae) in Connecticut, USA. *Specimen*, Number 44. https://doi.org/10.56222/28166531.2025.44

Abstract: New distributional records of bee species contribute to a more comprehensive understanding of their biogeography, host plant associations, and conservation status (Colla et al., 2012). *Melitta eickworti* Snelling & Stage is a rarely encountered oligolectic bee, native to eastern North America, known for its association with *Vaccinium stamineum* L. (deerberry), a plant in the family Ericaceae (Snelling & Stage, 1995). *Melitta eickworti* has been documented in the United States in New York (type locality), Georgia, Maryland, New Jersey, North Carolina (Snelling & Stage, 1995), Massachusetts (Veit et al., 2021), Virginia (M.F. Veit, pers. comm.), and West Virginia (Droege & Maffei, 2025). This species was previously unknown in Connecticut (Zarrillo et al. 2025); therefore, we are documenting the first confirmed occurrence of *M. eickworti* in Connecticut in this report, expanding its known distribution and emphasizing the importance of continued surveys for rare bee species.

ENVIRONMENTAL SCIENCE & FORESTRY

SCOTT C. WILLIAMS, PH.D. hosted a visit by research collaborator Dr. Michael Banfield of BanfieldBio and at his request, met with **Kirby Stafford III, Ph.D.** and **Anuja Bharadwaj, Ph.D.** to discuss their past work with nootkatone as an integrated tick management abatement strategy (June 2); participated in a meeting with BanfieldBio, Inc. on a collaborative CDC grant investigating botanical extracts in their potential to manage ticks in peridomestic habitats (June 3); as vice-Chair, participated in an evening public hearing for the Town of Guilford Inland Wetlands Commission (June 3); as the Northeast Section Representative, participated in a meeting to review applications for the Professional Certification Review Board of The Wildlife Society (June 4); as Chairman, ran the evening meeting of the Town of Guilford Land Acquisition Commission (June 5); met with East Haddam Fishing and Game Club President Gary Rogers and Certified Forester Eric Hansen about potential projects to improve/enhance wildlife habitat (June 6); participated in a meeting with BanfieldBio on a collaborative NIH SBIR grant investigating tick repellent formulations to be integrated into fabrics (June 10); participated in a collaborative Zoom call with staff from MaineHealth, Genesis Laboratories, Inc., and White Buffalo, Inc. about ongoing work in a CDC-funded integrated tick management project (June 11); as vice-Chair, participated in an evening meeting of the Town of Guilford Inland Wetlands Commission (June 11); participated in a Zoom call with staff from Yale University's Department of Ecology and Evolutionary Biology about ongoing collaborative tick-borne disease abatement research (June 12); gave invited lecture speaking about systemic treatment of white-tailed deer for tick abatement in the second part of a three-part lecture series titled "Oh Deer! Managing the White-Tailed Deer Population in Greenwich" hosted by the Town of Greenwich, CT Conservation Commission (35 attendees) (June 12); participated in a meeting with BanfieldBio, Inc. on a collaborative CDC grant investigating botanical extracts in their potential to manage ticks in peridomestic habitats (June 17); participated in the meeting of the State of Connecticut Management Advisory Council (June 18); participated in a meeting with staff from the CDC Division of Vector-Borne Diseases on ongoing progress made on a funded integrated tick management project (June 18); as vice-Chair, participated in an evening public hearing for the Town of Guilford Inland Wetlands Commission (June 19); participated in a Zoom call with staff from the US Fish and Wildlife Service, University of North Dakota, and US Geological Survey on the use of systemic acaricides in treatment of rodents against ectoparasites (June 23); participated in a meeting with BanfieldBio on a collaborative NIH SBIR grant investigating tick repellent formulations to be integrated into fabrics (June 24); participated in an evening meeting of the Town of Guilford Conservation Commission (June 25).

NATALIE BAILEY participated in a Zoom call with BanfieldBio to discuss the development of a botanical acaricide (June 3, 17); participated in a collaborative Zoom call with members of the Banfield Biologic NIH SBIR-funded tick repellent fabric team (June 10, 24).

JOSEPH P. BARSKY participated in the Forest Ecosystem Monitoring Cooperative monthly state coordinators conference call (June 9); as Chair, ran the quarterly Board of Directors meeting of the New England Society of American Foresters (June 17).

JESSICA E. BROWN, PH.D. participated in a Zoom meeting with The Wildlife Society's Leadership Institute to discuss mentoring and leadership with alumni of the program (June 30).

GREGORY J. BUGBEE gave an invited lecture entitled "Invasive Aquatic Plants of Connecticut" at an aquatic plant workshop held at the Rogers Lake Clubhouse in Lyme (15 attendees) (June 11); provided testimony on the potential for wake boats to disrupt lake ecosystems at a town meeting held at the Hale Ray High School in Moodus (75 attendees) (June 25);

provided guidance at United States Army Corps of Engineers CT River hydrilla demonstration project workgroup meetings (June 3, 17).

RILEY S. DOHERTY participated in the Connecticut Federation of Lakes board of directors meeting (June 18); participated in the US Army Corps of Engineers weekly CT River Hydrilla planning meetings (June 4, 18, 25).

JEREMIAH R. FOLEY, IV, PH.D. attended Western Connecticut State University's Applied Stewardship presentations, where Eliana S. Petterson (OAIS intern) presented a research update (June 13); participated in virtual meetings with the U.S. Army Corps of Engineers (USACE) to discuss Connecticut River *Hydrilla* (June 18, 25); met with Dr. Nate Harms (USACE) to further develop the outline for a roadmap for biological control of Connecticut River *Hydrilla* (June 26).

SUSANNA KERIÖ, D.SC. administered the arborist examinations for the Tree Protection Examining Board (June 11).

JACQUELYN LAREAU created several biological illustrations included in the textbook "Three Mosquitoes: The Biology of Deadly Insects" by Dr. Jeffrey R. Powell published by John Hopkins Press (June 17).

SARA L. NASON, PH.D. met with Rob Heimer (Yale) to discuss a newly funded project on drugs of abuse (June 4); met with Gary Zrelack and John Torre at the Eash Shore Water Pollution Abatement Facility (New Haven) to discuss collaborative work (with RAEES AHMAD) (June 6); hosted a visit from Nabarun Dasgupta (University of North Carolina) and Rob Heimer (Yale) to discuss upcoming work of drugs of abuse (June 9); as the chair, led virtual meetings for the Best Practices for Non-Targeted Analysis working group (June 10, 17); met virtually with Bryan Berger and Michael Timko (University of Virginia), Fred Corey (Mi'kmaq Nation), Chelli Stanley (Upland Grassroots, and Katie Richards (Maine PFAS Labs), and others to discuss the reinstatement of our EPA grant (June 20).

ITAMAR SHABTAI, PH.D. met with colleagues from Cornell University of Jerusalem to discuss an ongoing collaborative project (June 6, 13); met with a colleague from the Hebrew University of Jerusalem to discuss a United States-Israel Binational Agricultural Research and Development Fund (BARD-ISUS) grant proposal (June 16); held a video chat with a colleague at Argonne National Laboratory to discuss μ-CT work at the Advanced Photon Source synchrotron (June 24); met with a colleague at Purdue University to discuss a grant proposal to the Foundation of Food and Agriculture Research (June 27).

BLAIRE STEVEN, PH.D. attended the American Society of Microbiology (ASM) Microbe meeting in Los Angeles (June 19–23), as Branch Councilor of the Connecticut Valley ASM, attended the Branch Councilors meeting (June 19), attended the Committee on Microbial Sciences meeting as a member of ASM leadership (June 20), and attended the *Microbiology Spectrum* editors meeting on (June 21).

MADELINE WATTS met virtually with collaborators from the University of Florida Center for Aquatic Invasive Plants and the U.S. Army Engineer Research and Development Center to coordinate upcoming studies (June 2); attended the Army Corps' Connecticut River Hydrilla Demonstration Project meeting (June 4); established field sites for an experiment on *Trapa natans* (water chestnut) control (June 11–12); met with an aquaculture consultant to review progress on the tank system installation at Lockwood Farm (June 18); attended a second Army Corps Connecticut River Hydrilla Demonstration Project meeting (June 25).

SUMMER WEIDMAN participated in the virtual Connecticut River Watershed Partnership meeting (June 11); gave an aquatic plant identification workshop to the Rogers Lake Authority

in Lyme (15 attendees) (June 11); chaired the virtual meeting of the Guilford Conservation Commission Lake Quonnipaug Subcommittee (June 17).

LEIGH J. WHITTINGHILL, PH.D. gave a presentation to the Common Ground High School summer interns about the collaborative research that Common Ground is participating in with CAES (6 attendees) (June 24); attended the CT Council on Soil and Water Health quarterly meeting (June 26).

YINGXUE (CHARLIE) YU, PH.D. with collaborators from the Environmental Molecular Sciences Laboratory (EMSL) to discuss nanoplastic quantification with Py-GC/MS (June 26).

JING YUAN, PH.D. attended the American Society for Microbiology (ASM) Microbe 2025 conference in Los Angeles (June 19–23), delivered a talk titled "Nanopore Adaptive Sequencing Recovers Full Bacterial Genomes from the Mosquito Microbiome" (30 attendees) (June 20), and presented a research poster titled "Non-Linear Response in Microbiome Structure and Soil Respiration Along a Gradient of Soil Water-Filled Pore Space" (June 21).

GRANTS/AWARDS:

Susanna Keriö D.Sc. in collaboration with **Nathaniel Westrick Ph.D.** was awarded a **$5,000** grant from the Connecticut Chapter of The American Chestnut Foundation to study hypovirulence in chestnut blight management. The project will document the presence of hypoviruses of the chestnut blight pathogen (*Cryphonectria parasitica*) in a 50-year-old field plot with American chestnut trees at Lockwood Farm. The plot was planted in 1976 by **Richard Jaynes Ph.D.** (CAES retired) and other CAES staff. In 1978-1981, **Dr. Jaynes**, **Sandra Anagnostakis Ph.D.** (CAES retired), and other CAES staff treated the trees with hypovirulent strains carrying viruses that slow down the growth of the pathogen and support tree survival. In 2013, **Dr. Anagnostakis** reported that the viruses were still present in the plot. The current project will identify which viruses are present in the trees, which has potential for applications in biocontrol of chestnut blight.

SARA L. NASON, PH.D. received a grant from the National Institutes of Health-National Institute on Drug Abuse titled "Applying a multiple methods approach to examine spatial and temporal variability in a state's illicit drug market" award 1R01DA062622. 6/1/2025-2/28/2030. PI: Robert Heimer, Yale University. CAES subaward: **$1,483,993**.

PUBLICATIONS:

1. Seenthia, N. I., **Abdelraheem, W.**, Beal, S. A., **Pignatello, J. J.**, Xu, W. (2025). Simultaneous adsorption and hydrolysis of insensitive munition compounds by pyrogenic carbonaceous matter (PCM) and functionalized PCM in soils, *J. Hazardous Materials* 494, 138501. DOI: 10.1016/j.jhazmat.2025.138501.

Abstract: Military training with insensitive munitions (IM) deposits a large amount of post-detonation residues on range soils that may contaminate groundwater. This study investigated the effectiveness of pyrogenic carbonaceous matter (PCM) and functionalized PCM as a soil amendment to retain and transform IM compounds (e.g., 5-nitro1,2-dihydro-3H-1,2,4-triazin-3-one (NTO), nitroguanidine (NQ), and 2,4-dinitroanisole (DNAN)). Initial hydrolysis tests showed quaternary ammonium (QA)-modified PCM accelerated NQ hydrolysis, while NTO formed charge-assisted hydrogen bonds with PCM's surface groups instead of hydrolyzing. We amended three soils with a subset of PCM materials and monitored the removal of NTO, NQ, and DNAN under varying pH conditions (i.e., 8.0, 10.0, and 12.0) and amendment dosages (i.e., 0, 2, 3, and 5 % (w)) in batch reactors. We also assessed the reactivity and reusability of the best-performing PCM by consecutive addition of IM post-detonation residues. Our results indicate that PCM can significantly enhance the removal of NTO, NQ, and DNAN in

soils by 50–300- fold compared to soil controls, and QA-modified activated carbon (AC) performed the best. Increasing pH from 8.0 to 10.0 enhanced the DNAN hydrolysis with PCM, whereas NQ hydrolysis only occurred at pH 12.0.

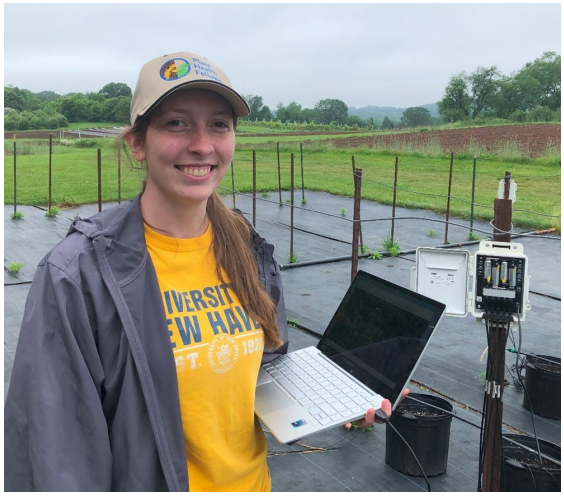
2. Shcherbatyuk, N., Weiss, B., **Yu, Y.**, Gull, N., Williams, A., DeVetter, L. W. Miles, C. (2025). Frequently asked questions about soil-biodegradable plastic mulches. *HortTechnology*, 35(4), 470-480. DOI: 10.21273/HORTTECH05652-25

Abstract: Plastic mulch accounts for approximately 16% of agricultural plastics, with approximately 2.5 million metric tons of plastic mulch films used globally each year. Polyethylene (PE) is the most widely used polymer in mulch manufacturing because of its low cost, excellent mechanical strength, and barrier properties that prevent weed growth, optimize soil temperature, and conserve soil moisture for crop growth. However, PE mulch is a growing source of plastic pollution because it is nonbiodegradable, and there is a lack of sustainable end-of-life disposal options, resulting in nearly all PE mulch being burned, buried, stockpiled, or landfilled. Soil-biodegradable plastic mulch (BDM) is an eco-friendly alternative that is designed to be tilled into soil at the end of the growing season, and soil microorganisms degrade it into carbon dioxide, methane, water, and microbial biomass. Generally, BDM has an agronomic performance similar to that of PE mulch (dependent on thickness and color), is applied with the same equipment, and its in situ disposal saves labor as well as removal and disposal costs. Yet, BDM adoption in the United States has been limited because of questions regarding its ingredients, costs, biodegradability, and impacts on soil ecosystems and overall soil health. This article answers these most frequently asked questions regarding BDM. For example, BDM that meets the EN 17033 standard is biodegradable in soil and has not been found to have negative impacts on soil ecology or health. The BDM purchase cost can be twice the cost of PE mulch, but the overall cost tends to be similar because there is no cost to remove or dispose of BDM. Two to 10 years are required for BDM to biodegrade in soil, depending on environmental conditions, such as climate, soil temperature, and soil moisture. Much of the misinformation regarding BDM comes from a lack of adherence by marketers and the scientific community to the definition of biodegradable plastic, leading to the usage of plastics that are not biodegradable, thus resulting in plastic pollution.

3. Whittinghill, L. J., Goins, M., Lucas, S. (2025). Market yield of relay cropped leafy greens in urban agriculture production systems. *HortScience*. 60(7): 1171-1179. DOI: 10.21273/HORTSCI18586-25

Abstract: Leafy greens are an ideal crop for the urban environment, given their shallow roots, short growing time, and high nutritional value. Yields of greens and their nutritional value can, however, be affected by the production system used and nutrient management practices. The purpose of this study was to explore two different types of urban agriculture production systems (raised beds and container plots) and four nutrient management treatments (conventional fertilizer, organic fertilizer, peat and compost plus organic fertilizer, and peat and compost only) to determine their impact on the yields of relay cropped leafy greens. Lettuce, arugula, mizuna, mustard greens, chard, kale, and spinach were planted in succession through the growing seasons of 2018 and 2019 and the amount of time it took to harvest, total yield, and marketable yield were measured. Significant differences between growing systems and among nutrient management strategies were few and inconsistent across measured harvest metrics and the crops observed. Results suggest that small plastic pool containers are a suitable container for urban production of greens. This study also tentatively supports the use of organic fertilizers and compost as a nutrient source in urban agriculture, as some greens responded favorably to organic fertilizers and the use of compost. The effects of nutrient management treatments may have been obscured by high insect pressure and the unusual weather patterns that took place during the study, which affected some crops more than others. Further research should refine the use of small plastic pools for relay cropping greens and optimize the order in which greens are grown in succession.

NEW SEASONAL STAFF:



RILEY EAGLESON is a graduate student studying green and analytical chemistry at the University of New Haven. She joined the Station this summer as a part of the Plant Health Fellowship program working with **Leigh Whittinghill, Ph.D.** In her free time, Riley enjoys painting, hiking, and listening to music.

KATIE BRUNO is a rising senior at Middlebury College studying conservation biology. This summer, she joined the Station as a seasonal research assistant working with **Leigh Whittinghill, Ph.D.**to study urban agriculture. In her free time, Katie likes to run, spend time outdoors, and read!

LAUREN CRAWFORD is a student studying botany and horticulture at the University of New Haven. This summer, she joined the Station as a research intern with **Leigh Whittinghill, Ph.D.** to gain hands on plant research experience. Lauren hopes to continue her own research projects at the UConn plant science graduate program, where she may learn to breed and hybridize horticultural plants. In her free time, Lauren loves to forage, read, and play with her cat, Figment.

Postdoctoral Scientist **Jing Yuan, Ph.D.** presents lecture titled “Nanopore Adaptive Sequencing Recovers Full Bacterial Genomes from the Mosquito Microbiome” with **Blaire Steven, Ph.D.** and **Jacquelyn Lareau** as co-authors at the American Society for Microbiology Microbe meeting in Los Angeles on June 20.

PLANT PATHOLOGY AND ECOLOGY

LINDSAY TRIPLETT, PH.D. lead orientation, fieldwork, career panel, and industry field trip activities for the eighth Plant Health Fellows cohort (June 9, 16, and 27, 8 students); gave a talk on CAES History for the Arts and Ideas Festival (June 26, 23 adults and 4 children), and represented CAES at the New Haven Garden Club's 100th anniversary celebration (June 3, 60 adults).

WASHINGTON DA SILVA, PH.D. served as co-advisor for Ms. Maria Helena Diogenes da Costa's doctoral dissertation defense (June 27th, 18 adults, via Google Meetings). Dr. da Costa presented her Ph.D. thesis research on the use of nanotechnology and RNAi for controlling plant viruses; another student that Dr. da Silva co-advisor, Tatianne Alves, passed her qualification exam to pursue her Ph.D. (June 25th, 22 adults, via Google Meetings). Dr. da Silva visited three vineyards in Connecticut (Nancy's Vineyard on June 17th, Casabianca Vineyard on June 26th, and Jones Farm Vineyard on June 30th) to provide on site expertise on management of grapevine diseases.

YONGHAO LI, PH.D. Participated in the National Plant Diagnostic Network Online Communication & Web Portal Committee meeting via Zoom (June 11, 6 adults); Participated in the Northeast Plant Diagnostic Network monthly meeting via Zoom (June 12, 12 adults); interviewed by Dr. Yu Lei at UConn about applications of sensors to detect soilborne and airborne plant pathogens (June 27).

ROBERT MARRA, PH.D. co-led a field seminar on forest health, pests, and pathogens, at Naugatuck State Forest, in Naugatuck, for the Connecticut Forest & Parks Association's Master Woodland Managers certification program (22 adults) (June 21); administered the arborist certification oral exam ("TPX") (12 adults) (June 11); participated in the monthly meeting of Divisional Forum Representatives of the American Phytopathological Society, via Zoom (9 adults)(June 24); fielded four phone calls from citizens regarding beech leaf disease and treatment options.

FELICIA MILLETT participated in the NEPDN monthly meeting (June 12) (16 adults); was interviewed by Lilli Iannella of CT Insider about mountain laurels and where to see them in peak bloom in Connecticut (June 11); spoke with Plant Health Fellows during a Career Panel (June 16) (12 students); hosted the NPDN Proficiency Committee monthly meeting (June 17, 5 adults); and led the PDIO stop on the Arts and Ideas Festival tour of CAES (June 26) (3 children, 23 adults).

RAQUEL ROCHA, PH.D. served as a committee member for Ms. Monique Rodrigues e Silva's doctoral dissertation defense, which took place via Google Meetings (June 16th, 20 adults). Monique, also a member of the Rocha Lab, presented her research on the use of nanotechnology for controlling plant parasitic nematodes. Congratulations to Dr. Rodrigues e Silva!

NEIL SCHULTES, PH.D. gave an oral presentation "Epiphytic growth of *Erwinia amylovora* amino acid auxotroph strains on the apple stigma surface" at the 5th International Fire Blight Symposium in Richland, WA (June 26, 90 adults).

QUAN ZENG, PH.D. gave a keynote lecture "Identifying a fire blight-resistant apple cultivar and investigating the mechanism mediating its disease resistance" at the 5th International Fire Blight Symposium in Richland, WA (June 24, 90 adults). **James Standish** gave two oral presentations "Resistance and susceptibility: The divergent roles of *eop1* in apple cultivar responses to fire blight" and "Identifying biocontrol yeasts that trigger systemic acquired re-

sistance in Arabidopsis to inhibit *Pseudomonas syringae* infection" at the same conference (June 24, 90 adults).

OTHER DEPARTMENTAL NEWS:

The participants of the 2025 Plant Health Fellows USDA-REEU program visited Enko Chem in Mystic, CT on June 26th. They were hosted for a tour by the Chief Scientific Officer Michael Luethy, and had lunch with staff plant pathologists, chemists, and entomologists who are discovering and testing new pest control products. L-R: Dr. Michael Luethy, Riley Eagleson (Whittinghill Lab, U. New Haven), Annette Flotten (Shabtai Lab, U. Maine), Hannah Flis (Rutledge Lab, Trinity College), Sarah Gray (da Silva lab, SCSU), Remy McIntyre (Kerio lab, U. New Hampshire), Erik Galvin (Marra lab, SCSU), Mikayla Spero (Zeng lab, NYU), and Hamid Shahbaz (Fisher Lab, Wesleyan U).

Doctoral dissertation defense of Ms. Monique Rodrigues e Silva, member of the Rocha Lab.

VALLEY LABORATORY

JATINDER S AULAKH, PH.D. attended the twilight meeting of the Connecticut Christmas tree growers' association and talked about summer weed management options (June 18, 2025); and attended the Connecticut Invasive plants council meeting (June 18, 2025).

CAROLE CHEAH, PH.D. implemented Partnership Wild and Scenic River releases of the HWA biocontrol agent Sasajiscymnus tsugae, funded by the Farmington River Coordinating Committee for the Upper Farmington and by the Lower Farmington and Salmon Brook Wild and Scenic Committee at Penwood State Park, Bloomfield, June 2; Talcott Mountain State Park, Simsbury, June 3; Aqueduct Canal and Clatter Valley Preserves, Farmington Land Trust with a land trust steward, June 3; together with land trust staff (2), released at the Northwoods Land Conservancy properties, Mill District Preserve, June 4 and Mill District Sanctuary, in Hartland, on June 11; at Peoples State Forest, Barkhamsted with CT DEEP staff (3) June 4 and 11; at Enders State Forest in Granby, June 5; at Tunxis State Forest in Hartland, June 6 with a member of the public (1); at the Burlington Fish Hatchery, Nassahegon State Forest June 8; at Traprock Ridge Land Conservancy properties with a land trust member at River Bend and Ian Clarke Preserves, East Granby, on June 9; at Algonquin State Forest, Colebrook, June 11; at New Hartford Land Trust properties with volunteers (5) at South Nepaug, Wernick and Oliva preserves June 12; at Metropolitan District Commission riparian property in Hartland, June 12; at the American Legion State Forest, Barkhamsted, June 12; at Farmington River Park, Bloomfield and Windsor Wildlife Management Area, June 16; at the Pratt Preserve, Canton Land Conservancy with a land trust member, June 17 and 18; at Werner Woods, Nepaug State Forest and the Roaring Brook Nature Center, Canton June 18; at McLean Game Refuge, Granby and Simsbury with volunteers and staff (6), June 23; and at the historic Mine Hill Preserve, Roxbury Land Trust with the property manager on June 25; gave an overview of the Connecticut program of HWA biological control to staff and volunteers at the McLean Game Refuge, June 23 (5).

RICHARD COWLES, PH.D. presented "Insects and diseases affecting Christmas trees," at the CCTGA twilight meeting, North Branford, June 18 (45 participants).

ROSE HISKES lent her insect collection to the Windsor Garden Club for use in the Junior Gardener program that they conduct for second graders in the Windsor school system, gave a talk on invasive plants at a "Walk and Talk" event at the David Hayes Sculpture Fields in Coventry (June 7)(10 adult attendees), and participated via email in the CAPS meeting at the Connecticut Agricultural Experiment Station in New Haven (June 23).

NATE WESTRICK, PH.D. was interviewed by News 12 Connecticut about dropping strawberry yields due to disease and extreme weather– "Connecticut's famed strawberry crops threatened by extreme weather, state scientists say" (June 3); was interviewed by Connecticut Public Radio about Strawberry Diseases – "Floods and fungus take a bite out of CT strawberry crop" (June 6); presented a poster entitled "Characterizing the Endophyte -To-Pathogen Transition in Colletotrichum siamense" at the Mycological Society of America meeting in Madison, WI (June 29-July 2) (400 Participants).

PUBLICATIONS:

1. Cui, Y-J, Wang, C-G, Dai, Y-C, Liu, S., Ren, Y-H, **Schultes, N. P.**, Kaishian, P. O., **Paine. E.**, Yuan, Y.*, **Li, D-W***, Zhao, H.* (2025). Phylogeny, divergence times, and biogeography of the phytopathogenic fungal genus *Phaeolus* (Basidiomycota, Polyporales). *Journal of Systematics and Evolution* in press. DOI: 10.1111/jse.13187

Abstract: The genus *Phaeolus* holds significant economic and ecological value as an important pathogen of coniferous trees. Although species diversity within this genus has been described in recent years, there were limited studies of its origin, evolution, and biogeography. In this study, we collected new specimens from China and the United States, and reconstructed the phylogeny, divergence times, and biogeography of *Phaeolus* based on internal transcribed spacers (ITS) and nuclear large ribosomal subunit (nLSU) sequences. Phylogenetic analyses identified two new species, *Phaeolus himalayanus* and *Phaeolus occidentiamericanus*, one new combination, *Phaeolus hispidoides*, one synonym, *Phaeolus fragilis* (treated as *Phaeolus schweinitzii*), and one new record from China, *Phaeolus sharmae*. *Phaeolus himalayanus* is characterized by pileate, imbricate basidiomata, round to irregular pores of two to three per millimeter, abundant gloeoplerous hyphae, mango-shaped to ellipsoid basidiospores (5.5–7 × 4–4.5 µm), and distribution in Xizang of China. *Phaeolus occidentiamericanus* is characterized by pileate, imbricate basidiomata, round to irregular pores of two to three per millimeter, mango-shaped to ellipsoid basidiospores (6.5 –7.8 × 4–5 µm), and distribution in the western United States. Molecular clock analyses indicated that the genus *Phaeolus* likely originated in the Late Cretaceous, with species divergence occurring between 9–71 Ma. Ancestral state reconstruction suggested that the genus originated in the Himalaya–Hengduan Mountains region and subsequently dispersed to Europe and North America. The earliest host trees of *Phaeolus* were probably *Abies* and *Pinus*, with all known species capable of growing on *Pinus*, demonstrating a strong host trees preference. Additionally, a key of the genus *Phaeolus* is added. This study provides a crucial foundation in pathogen control and ecological conservation of this genus in the future.

2. Garofalo E.W., Rowland D, and **Westrick N. M.** (2025). First report of Colletotrichum fioriniae causing bitter rot of apple in Massachusetts. DOI: 10.1094/PDIS-03-25-0597-PDN

Abstract: In the summer of 2024, the UMass Extension Fruit Team was contacted due to reports of apple (*Malus domestica*) plants showing fruit rot symptoms. Infested fruits were found on ~70% of orchard trees and developed brown water-soaked lesions exhibiting sporulating concentric rings as are typical with bitter rot of apple. Symptomatic apples, cv. Cortland, were collected from a commercial orchard in Hampshire County. Diseased tissue was sterilized in 10% bleach for 1 min, rinsed with sterile water, and plated on potato dextrose agar amended with 100 µg/ml chloramphenicol. Hyphal tips of fungi were transferred to fresh plates which formed fluffy, dark gray mycelial mats with prominent pink undersides from all symptomatic apples. Orange spore masses formed near the center of the colonies, each of which contained numerous fusiform and cylindrical straight conidia, matching spores of the genus *Colletotrichum* (de Silva et al. 2019). Average conidia (n=169) length was 11.4 ± 1.9 µm and width was 4.9 ± 0.5 µm. Areal hyphae were collected from two isolates, CFF1-1 and APO1-1, and DNA was extracted for further molecular

characterization. PCR was performed using primers targeting actin (*ACT*), calmodulin (*CAL*), GAPDH (*gpdA*), and ITS, followed by Oxford Nanopore sequencing (CFF1-1 Accessions numbers: PV288758, PV288759, PV288760; APO1-1 Accessions numbers: PV641589, PV641590, PV641591) (Carbone and Kohn 1999; Hassan et al. 2018; Templeton et al. 1992). Sequences were queried through NCBI's RefSeq Genome Database with BLASTN. Orthologous sequences from ten *Colletotrichum* genomes which appeared in all BLASTN queries were aligned, trimmed, and concatenated into super-genes using Mega11 (Tamura et al. 2021). Model selection was conducted using IQ-TREE and selected parameters were used to generate a maximum-likelihood tree from the concatenated sequence, placing the isolates in a high confidence cluster with *Colletotrichum fioriniae* (Nguyen et al. 2015). To confirm the virulence of the pathogen, apples (cv. Fuji) (n=8) were inoculated with spores, with or without injury to the cuticle. The inoculum consisted of 15 µL of spores at a concentration of 107 spores per mL. Injured apples (n=4) were penetrated 5 mm deep with a sterile 20 µL pipette tip before inoculation on the wound site while control plants (n=4) were inoculated with 10 µL of sterile water. Fruits were maintained under fluorescent lights for 18 hours/day (30°C) and in the dark for 6 hours/day (20°C) in a growth chamber and assessed after 9 days. All inoculated apples had sunken lesions consistent with field samples and bisected apples revealed the brown lesions penetrating 3-5 centimeters into the apple. Control plants had no clear lesions and bisected apples were visibly healthy. *C. fioriniae* re-isolated from infected tissue presented with identical hyphal /spore morphology. Fruit inoculations were repeated, yielding identical lesions. Bitter rot of apple has been inferred to several species in the *C. acutatum* species complex (including *C. fioriniae*) and is a prominent disease of apples in other apple growing regions. This disease has been sporadically reported throughout New England, though with the increasing frequency of warm and wet spells, occurrences are becoming more common. Future work should continue to evaluate *Colletotrichum* species present for disease management efficacy.

NEW SEASONAL STAFF:

Audrey Dunlap, Lee Braun, Emma Carey, Jameson Flynn, Jason Flynn, Rebacca Syme, Melissa Trudeau, and David Yih.

DEWEI LI, PH.D. and VL staff hosted a visit of eight biology professors/instructors of CT State Community College Manchester on May 28. Scientist: Drs. Rich Cowles, Carole Cheah, Jatinder Aulakh, Nate Westrick, Farm Manager, Jim Preste, inquiry office staff, Ross Hiskes and soil technician, Diane Riddle gave a short presentation/talk to the visitors.

JOURNAL ARTICLES APPROVED JUNE 2025

Buurma, E. E., Vaidya, S. R., Pilotto, L., **Dimkpa, C. O., White, J. C.**, Fellet, G., Howard, D., Fairbrother, H.D. Differential effects of biodegradable polymers and polymer-phosphorus composites on tomato performance and phosphorus uptake. *ACS Agricultural Science and Technology*.

Data, S., Basharat, S., Barker, D., **Pignatello, J. J.**, Kah, M.,* Leitao, E. M.,* and Padhye, L. P.* Quaternary-Ammonium-Grafted Flax Fibres Enable Capture and Regeneration of Short-Chain PFAS from Water. *Environmental Science & Technology*.

Davidson, E., **Aikpokpodion, P.**, Pestereva, A., Pereira J., Diracca, Giullo, L., Allison, Tetard, L., **Dimkpa, C.**, Santra, S. Development of a nano sulfur-biopolymeric coating composite for rock phosphate: transforming a mineral into a fertilizer. *ACS Agricultural Science and Technology*.

Fisher, K. E., Coates, B., Dopman, E. B., Rowland, D., Abel, C. A., Smith, J. L., and Dively, G. Evidence of field-evolved resistance in Ostrinia nubilalis to Bacillus thuringiensis Cry1Ab and Cry1A.105 + Cry2Ab2 sweet corn in Connecticut, USA. *Journal of Economic Entomology*.

Goheen, M. M., Orfanó, A., S. Rodrigue Dah3, Foy, B. D., **Brackney, D. E.**, Ouédraogo, J-B, Da, D. F., Dabiré, R. K., Somé, A. F., Bei, A. K., Parikh, S. Anopheles mosquitoes exposed to long-acting antimalarials via drug-spiked bloodmeal absorb drug but do not suffer fitness costs. *PLoS Pathogens*.

Lyu, Y., Guo, Z., Li. Z., Li, F.-G., Lynch, I., **White, J. C.**, Zhang, P. Prediction of metal nanoparticle interactions with soil properties: Machine learning insights into soil health dynamics. *ACS Nano*.

Poh, K. C., **Brown, J. E.**, Esoldo, M., and Machtinger, E. T. Differences in movement and feeding behaviors of blacklegged ticks (Ixodes scapularis) from northern and southern lineages in the United States. *Journal of Medical Entomology*.

Riner, A. E., **Watts, M.**, **Foley, J. R.**, Sperry, B. Effect of Chilling Duration on Sprouting of Hydrilla verticillata subsp. lithuanica Axillary Turions. *Aquatic Plant Management*.

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. *Nano*.

Xu, X., Cai, Z., Jia, W., Cao, Y., Zhou, X., Liang, A., Lin, Z., Zhuang, S., Zhang, Z., Han, L., Yao, X., Shen, Y., Hu, P., Stitgen, A., Kesner, L., Sigmon, L.R., Deng, C., Deng, C., Jilani, S.Z., Zhao, J., **White, J. C.**, Ma, C., Xing, B. Multi-omics insights into nano-boron nitride-mediated antioxidant defense and metabolic reprogramming in Cucumis sativus L. in response to Fusarium oxysporum f. sp. Infection. Adv. Sci. Submitted. *Advanced Science*.

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