Station News

The Connecticut Agricultural Experiment Station
Volume 10 Issue 2 February 2020

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

DR. THEODORE ANDREADIS was interviewed about eastern equine encephalitis activity in the northeastern US this year and the impact of global climate change on the mosquito-borne diseases by freelance journalist, Oscar Schwartz (January 9); was interviewed about the plans to expand the Mosquito Trapping and Virus Surveillance Program for 2020 to include sites in new regions of the state where the human and equine cases occurred in 2019 by Julia Werth, CT Examiner (January 14); presided over a quarterly meeting of the Station's Board of Control held in Hartford (January 15); hosted and presented a talk entitled *Reflections on the Ecology and Epidemiology of Eastern Equine Encephalitis in the Northeastern United States* at the *3rd Annual Meeting of the Northeast Regional Center of Excellence in Vector-Borne Diseases* held at the Station (100 attendees) (January 23-24); and presented an update on Experiment Station activities at a meeting of the Experiment Station Associates Board of Directors held at the Station (8 attendees) (January 29).

ANALYTICAL CHEMISTRY

DR. JASON C. WHITE, along with **DR. NUBIA ZUVERZA-MENA**, participated in a ZOOM call with collaborators at Harvard University to discuss research projects on micro-/nanoplastics (January 6); participated in a meeting hosted by DPH at the LOB on State Agency Alignment of Priorities (January 7); attended the annual "all hands" meeting for the Center for Sustainable Nanotechnology (CSN) held in Minneapolis, MN (January 8-10); hosted the monthly "Nanochem-plant" ZOOM call for the CSN (January 14); participated in a Microsoft Teams call with Taylor and Francis to discuss the *International Journal of Phytoremediation* (I am the Managing Editor) (January 17); attended the Proposal A exam of Yuqing Yu at the University of Texas El Paso (January 21-23); participated in a ZOOM call with FDA and other FERN participants to discuss updated reporting requirements (January 28); met with individuals from the CT DEEP Bureau of Water Protection & Land Reuse (January 30); and participated in a 2020 AFRPS Planning Committee call (January 30).

DR. CHRISTINA ROBB attended training at the Center for Biological Mass Spectrometry at the Centers for Disease Control and Prevention (CDC) in Atlanta, GA (January 21-22); and prepared a grant submission for the acquisition of an LC–MS (triple quadrupole) with Zip-Chip interface for the NSF Major Research Instrumentation (MRI) program.

DR. BRIAN EITZER attended the monthly Laboratory Preparedness meeting at the Department of Public Health Laboratory in Rocky Hill (January 6); and attended the American Bee Research Conference and was a participant in the principal investigator meeting of the multi-state Hatch grant on "Sustainable Solutions to Problems Affecting Bee Health" in Schaumberg, IL (January 8-10).

ENTOMOLOGY

DR. KIRBY C. STAFFORD III was interviewed about the published research with a rodent-targeted oral Lyme disease vaccine by Angus Chen, NPR station WBUR (January 6).

MS. KATHERINE DUGAS attended the UConn Extension's CT Vegetable & Small Fruit Growers' Conference held in South Windsor (January 6); gave a forest pest update on spotted lanternfly, emerald ash borer, and gypsy moth at the Valley Green Winter Seminar held in Seymour (January 8); attended and staffed a CAPS and Forest Pest booth at the CT Tree Protective Association Winter Meeting held at the Aqua Turf Club in Plantsville (January 16); and staffed a CAPS and Forest Pest booth at the CT Nursery and Landscape Association Winter Meeting held at the Aqua Turf Club in Plantsville (January 22-23).

MR. MARK H. CREIGHTON gave a presentation on Varroa mites and honey bee health at a meeting of the Eastern Connecticut Beekeepers Association at Woodstock Academy and distributed 74 mite testing kits to those who needed them (110 attendees) (January 12); and spoke at the Connecticut Beekeepers Association Bee School at The Connecticut Agricultural Experiment Station in New Haven, where he distributed mite testing kits to 110 students and staffed a display booth on honey bee health (January 18).

DR. GALE E. RIDGE presented a lecture about bed bugs and Delusions of Infestations at a winter conference sponsored by the University of New Hampshire in Concord, NH (67 attendees) (January 10); and received confirmation from the National Systematics Entomology Laboratory in Washington of the identification of Allium leafminer *Phytomyza gymnostoma* Loew (January 23). The flies were found on a farm in Bridgewater, CT. This is a first state record.

DR. CLAIRE E. RUTLEDGE gave a talk entitled "Little trees get eaten too" to the Greater New Haven Bonsai Club in New Haven (25 adults, 1 youth) (January 14); and helped to organize and run the annual meeting of the Connecticut Tree Protective Association held at the Aqua Turf Club in Plantsville (800 attendees) (January 16).

DR. VICTORIA L. SMITH participated in the CT Tree Protective Association winter meeting, held at the Aqua Turf Club in Plantsville (January 16) and participated in the CT Nursery and Landscape Association Winter Symposium held at the Aqua Turf Club in Plantsville (approximately 200 participants) (January 22, 23). In January, we issued 76 federal certificates and 8 state certificates, for export of CT agricultural commodities out of country and out of state, respectively, for products ranging from tobacco to houseplants, for a total of 84 certificates.

DR. KIMBERLY A. STONER was interviewed live on the bilingual radio program Juntos Podemos by Caprice Taylor Mendez about planting for pollinators on La Voz Hispana Radio, 103.5 FM and archived on their Facebook page (January 6); interviewed by Mark Zaretsky of the New Haven Register about bee health, including both honey bees and native bees (January 10); organized and led a meeting of the Connecticut Native Plants for Pollinators and Wildlife Working Group at CAES in New Haven (24 attendees) (January 14); interviewed by Jennifer Sass, Senior Scientist, Natural Resources Defense Council, about pesticides, particularly neonicotinoids, and bees (January 24); spoke to the Branford Land Trust on "Planting for the Bees' Needs – Pollinator Habitat" at the Wallace Willoughby Library in Branford (55 attendees) (January 28); interviewed about the recent published paper about plant sources of pollen collected by honey bees by Greg Hladky of the Hartford Courant (January 29); and interviewed about the recent published paper about plant sources of pollen collected by honey bees and about utilization of native and non-native plants by Jeannette Ross of the Wilton Bulletin (January 30).

ENVIRONMENTAL SCIENCES

DR. JOSEPH PIGNATELLO met with candidates for open Assistant Scientist II position in Forestry and Horticulture (January 7, 14, and 22); participated in a conference call with collaborators on a grant (January 27); met with Professor John Fortner, Yale University, on mutual research interests (January 29); and attended a Council meeting of the Connecticut Academy of Science and Engineering held in Rocky Hill (January 29).

DR. PHILIP ARMSTRONG gave a talk entitled "Transmission of arboviruses by mosquito vectors to live vertebrate hosts is underestimated by in vitro assays" (100 attendees), and led a discussion panel on eastern equine encephalitis at the Annual Meeting of the Northeast Regional Center for Excellence in Vector-Borne Diseases held at CAES (60 attendees) (January 23-24).

MS. ANGELA BRANSFIELD attended the Annual Meeting of the Northeast Regional Center for Excellence in Vector-Borne Diseases held in Jones Auditorium (January 23).

MR. GREGORY BUGBEE, with **MS. SUMMER STEBBINS** gave a talk entitled "Hydrilla in the Connecticut River – What's going on anyway?" (approx. 100 attendees), proctored the aquatic herbicide supervisory license recertification program, and participated in the Board of Directors meeting held at the Northeast Aquatic Plant Management Society held in Lake Placid, NY (January 14-16); with **MS. SUMMER STEBBINS**, spoke on "Hydrilla in the Connecticut River" at the Hartford Boat Show (10 attendees) (January 17); with **MS. SUMMER STEBBINS** gave two Invasive Aquatic Plant Workshops as part of the 2020 Envirothon held at the Connecticut River Academy in East Hartford (approx. 60 attendees) (January 18); and with Summer Stebbins, gave a tour of the Invasive Aquatic Plant Program facilities to officials from CT DEEP (approx. 10 attendees) (January 30).

DR. ANDREA GLORIA-SORIA gave a talk entitled "Population genetics of invasive mosquitoes; the rise of *Aedes aegypti* and *Ae. albopictus*" at the Medical, Urban, and Veterinary Entomology Section Symposia on Urban Pests and Vectors: Emerging Impacts, Sustainable Management, and Future Research at the Entomological Society of America Annual Meeting held in St. Louis, MO (70 attendees) (November 17–20); and gave a CAES Seminar Series talk entitled "Tracking Down Invasions of the Yellow Fever Mosquito, *Aedes aegypti*, at Different Time Scales" in Jones (50 attendees) (December 4).

DR. J.R. McMILLAN gave a poster entitled "Larviciding catch basins and its impact on West Nile virus transmission in two Connecticut, U.S. towns" at the Annual Meeting of the Northeast Regional Center of Excellence in Vector-Borne Diseases held in Jones Auditorium (January 23).

DR. GOUDARZ MOLAEI was interviewed by Bloomberg News on the range expansion of the lone star tick and its implications for altering tick-borne disease dynamics in the Northeast (January 2); was interviewed by Eyewitness News 3 on the implication of the warmer winter for tick activity in 2020 (January 15); gave two talks entitled "Host Association of the Asian Tiger Mosquito, *Aedes albopictus* (Skuse)" and "Passive Tick Surveillance: Tracking Ticks and Tick-borne Pathogens in Connecticut," and co-authored two posters entitled "Passive Tick Surveillance in Connecticut: Spatiotemporal Associations of Infections and Co-Infections in *Ixodes scapularis* (Acari: Ixodidae)" and "Lone Star Rising—Continued Range Expansion of *Amblyomma americanum*, the Lone Star Tick, in Connecticut" at the Annual Meeting of the Northeast Regional Center for Excellence in Vector-borne Diseases held in Jones Auditorium (65 attendees, 15 student attendees) (January 23).

MR. JOHN SHEPARD was interviewed about *Culiseta melanura* habitats and Eastern Equine Encephalitis by freelance journalist, Oscar Schwartz (January10); and spoke about "Mosquito-Borne Viruses in Connecticut" to 5th graders at O'Connell IB World School in East Hartford (18 students) (January 14).

MS. SUMMER STEBBINS attended the Guilford Conservation subcommittee meeting on managing Lake Quonnipaug (January 28); and hosted a table at the Yale Career Fair (January 31).

FORESTRY AND HORTICULTURE

DR. JEFFREY S. WARD gave two webinars on "Rehabilitation of degraded hardwood stands" for the Cornell University ForestConnect series (317 participants who collectively manage 27 million acres in the United States and Canada) (January 15); provided an update on current CAES tree research at the Connecticut Tree Protective Association annual meeting in held Plantsville (400 attendees) (January 16); and participated in a New England planning committee conference call (January 28).

DR. ABIGAIL A. MAYNARD attended the UConn Extension's Vegetable & Small Fruit Growers' Conference held in South Windsor (January 6); inspected the food composting operation at Wesleyan University in Middletown (January 9,24,31); reported on Station activities at a meeting of the State Technical Committee held in Tolland (29 adults) (January 22); and worked with students from Hamden Hall Country Day School on transplanting seedlings (23 students, 3 teachers) (January 24, 28).

DR. SCOTT C. WILLIAMS gave an invited lecture entitled "Use of Repellents for Averting Deer and Rabbit Damage" at the UConn Extension's Vegetable & Small Fruit Growers' Conference held in South Windsor (246 attendees) (January 6); participated in a Leadership Conference Call for the Northeast Regional Center for Excellence in Vector-Borne Diseases (January 7); with **MR. MICHAEL SHORT**, spoke to students in the Wildlife Biology class from Lyman Hall Memorial High School (Wallingford) about career development (12 students, 1 teacher) (January 10); was interviewed by Jillian Mauro of WLAD-AM about efficacy of reservoir targeted vaccination for *Borrelia burgdorferi* in rodent reservoirs (January 10); was interviewed by Greg Hladky of the Hartford Courant about efficacy of reservoir targeted vaccination for Borrelia burgdorferi in rodent reservoirs. (https://www.courant.com/news/connecticut/hc-news-ct-researchers-anti-lymedisease-mouse-vaccine-20200119-x5zuum2xmzfu3ahvv5srgbpxzy-story.html) (January 14); and presented a short talk entitled "Update on an Integrated Tick Management Project with 4-Posters, Bait Boxes, and *Metarhizium anisopliae* in Connecticut" and attended the Annual Meeting of the Northeast Regional Center for Excellence in Vector-Borne Diseases held in Jones Auditorium (80 attendees) (January 23, 24).

MR. JOSEPH P. BARSKY participated in a NESAF 2020 planning committee conference call (January 7); and staffed the CAES booth at the Connecticut Tree Protective Association annual meeting held at the Aqua Turf Club in Plantsville (January 16).

PLANT PATHOLOGY AND ECOLOGY

DR. WADE ELMER, along with **DR. JASON WHITE** and Yu Shen, attended the All Hands meeting of Center for Sustainable Nanotechnology held in Minneapolis, MN (January 11-13).

DR. YONGHAO LI staffed the CAES booth at the UConn Extension's Vegetable & Small Fruit Growers' Conference held in South Windsor (January 6); staffed the CAES booth at the Connecticut Tree Protective Association Annual Meeting held at the Aqua Turf Club in Plantsville (January 16); staffed the CAES booth at a Pre-Season Meeting of the Maple Syrup Producers Association of CT in Lebanon (January 18); attended the Connecticut Nursery and Landscape Association Winter Symposium held in Plantsville (January 22); and participated in the National Plant Diagnostic Network Web Communication Committee Zoom Meeting (7 adults) (January 24).

DR. ROBERT E. MARRA assisted in staffing the CAES booth at the Connecticut Tree Protective Association Annual Meeting held in Plantsville (January 16); along with **DR. YONGHAO LI,** staffed a CAES booth at a Pre-Season Meeting of the Maple Syrup Producers Association of CT in Lebanon (January 18).

DR. LINDSAY TRIPLETT was awarded the Louis A. Magnarelli Postdoctoral Fellowship Award along with **DR. CHRISTINA ROBB** for their proposal entitled "Plant hormones: Linking soil microbes and predators to crop health," which will employ postdoctoral research scientist **DR. RAVI PATEL,** who brings extensive experience in analyzing phytohormone production in beneficial bacteria.

DR. QUAN ZENG, DR. ZHOUQI CUI, and **DR. BLAIRE STEVEN** met with Dr. Alvaro Sanchez from Yale University and discussed mutual research interests and potential collaboration (January 23); and met with Dr. Vijay Choppakatla from Biosafe Inc. and discussed fire blight field trials (January 27).

VALLEY LABORATORY

DR. JATINDER S. AULAKH attended the Northeastern Plant, Pest, and Soils conference in Philadelphia, PA, and presented a poster entitled "Gemini G Herbicide Safety to Sedum album and Sedum rupestre" (approx. 50 visitors) (January 6-9); participated in the annual IR-4 group meeting (January 5); and served as chair and moderator for the Turf and Ornamental session (January 7 and 9).

DR. RICHARD COWLES spoke about "Insect Pest Update" to the Connecticut Nursery and Landscape Association meeting held in Plantsville (30 attendees) (January 23); and presented "Sustainable armored scale management?" to the New Jersey Christmas Tree Growers' Association held in Bordentown, NJ (70 attendees) (January 25).

MS. ROSE HISKES taught the Connecticut Tree Protective Association Arboriculture 101 students about diagnosing insect problems at review night in Wallingford (42 attendees) (December 4); and participated in a Connecticut Invasive Plant Working Group symposium planning committee meeting held in Windsor (January 30).

DR. JAMES LAMONDIA chaired the Connecticut Agricultural Information Council meeting regarding Agriculture Day at the Capitol and the Connecticut Outstanding Young Farmer Award in Windsor (January 13); spoke about "Identification and Management of Boxwood Blight" as a part of the SiteOne Educational Program held in Meriden (70 attendees) (January 14); spoke about "Hops in 2019, new and emerging pests" as a part of the Connecticut Hop Growers Association annual meeting held in Northford (January 18); discussed management of foliar diseases at a meeting of the Tobacco Disease Council (20 attendees) (January 22); presented "The Effect of Disease management Programs on Fungicide Residues in Shade Tobacco" at the Tobacco Workers Conference held in Louisville, KY (100 attendees) (January 22); and participated in a review of boxwood blight management tactics for nursery producers (12 attendees), spoke about prevention and management of boxwood blight (350 attendees) and presented best management practices for dealing with boxwood blight for landscapers (50 attendees) as a part of the Rhode Island Nursery and Landscape Association Winter Conference held in Warwick, RI (January 29).

DEPARTMENTAL RESEARCH UPDATES JANUARY 2020

Adisa, I.; Rawat, S.; Pullagurala, V.L.R.; Dimkpa, C.O.; Elmer, W.H.; White, J.C.; Peralta-Videa, J.R.; Gardea-Torresdey, J.L. 2019. Nutritional status of tomato (Solanum lycopersicum) fruit grown in Fusarium-infested soil: Impact of cerium oxide nanoparticles. *J. Agric. Food Chem.* doi.org/10.1021/acs.jafc.9b06840.

Abstract- In this study, the impact of cerium oxide nanoparticles on the nutritional value of tomato (*Solanum lycopersicum*) fruit grown in soil infested with *Fusarium oxysporum* f. sp. *lycopersici* was investigated in a greenhouse pot study. Three-week old seedlings of Bonny Best tomato plants were exposed by foliar and soil routes to nanoparticle CeO2 (NP CeO2) and cerium acetate (CeAc) at 0, 50, and 250 mg/L and transplanted into pots containing a soil mixture infested with the Fusarium wilt pathogen. Fruit biomass, water content, diameter, and nutritional content (lycopene, reducing and total sugar) along with elemental composition, including Ce, were evaluated. Fruit Ce concentration was below the detection limit in all treatments. Foliar exposure to NP CeO2 at 250 increased the fruit dry weight (67%) and lycopene content (9%) in infested plants compared with the infested untreated control. Foliar exposure to CeAc at 50 mg/L reduced fruit fresh weight (46%) and water content (46%), and increased the fruit lycopene content by 11% via root exposure as compared with untreated infested control. At 250 mg/L, CeAc increased fruit dry weight (94%) compared with infested untreated control. Total sugar content decreased in fruits of infested plants exposed via roots to NP CeO2 at 50 mg/kg (63%) and 250 mg/kg (54%), CeAc at 50 mg/kg (46%), and foliarly at 50 mg/L (50%) and 250 mg/L (50%), all compared with infested untreated control. Plants grown in Fusarium-infested soil had decreased fruitdry weight (42%) and lycopene content (17%), and increased total sugar (60%) and Ca content (140%) when compared

with the non-infested untreated control ($p \leq 0.05$). Overall, the data suggested minimal negative effect of NP CeO2 on the nutritional value of tomato fruit while simultaneously suppressing Fusarium wilt disease.

Brazee, N. J. and **Marra, R. E.** 2020. Incidence of Internal decay in American Elms (*Ulmus americana*) Under Regular Fungicide Injection to Manage Dutch Elm Disease. Arboriculture & Urban Forestry 46(1): 1-11.

Abstract- Fungicide injection is regularly performed to prevent and manage Dutch elm disease (DED) of American elm (Ulmus americana). In an effort to better understand the effects of long-term fungicide injection on tree health, sonic tomography (SoT) and electrical-resistance tomography (ERT) were used to nondestructively determine the incidence and severity of internal decay in the lower trunk of American elms in suburban and urban settings. Overall, 253 sonic and electrical-resistance tomograms were generated from 210 American elms. Sampled trees were partitioned into two fungicide injection groups: (1) regular injection; and (2) irregular injection or no known history of injection. Among all American elms, the incidence of internal decay in the lower trunk was 30% (63/210) with a mean percent decay, as determined by SoT, of 39%. Based on Chi-square analysis, there were no significant differences in the frequency of elms with decay by injection history (P = 0.799). Mean percent decay was significantly different by dbh class (P = 0.005) and while linear regression demonstrated a positive correlation between percent decay and dbh, most of the variability went unexplained (R2 = 0.182). For elms with decay, there was a significantly higher frequency of trees in the lowest decay class (< 25% of the cross section) compared to the highest decay class (> 75% of the cross section). The results suggest that the wounding associated with regular fungicide injection does not increase the likelihood of internal decay and that American elms exhibit a low frequency and severity of internal decay.

Chen, Feifei, Jianren Ye, Ayyappa Kumar Sista Kameshwar, Xuelian Wu, Jiahong Ren, Wensheng Qin, **De-Wei Li**. 2020. A novel cold-adaptive endo-1,4-ß-glucanase from *Burkholderia pyrrocinia* JK-SH007: gene expression and characterization of the enzyme and mode of action. Frontiers in Microbiology. 10 (3137): 1-11. https://doi.org/10.3389/fmicb.2019.03137

Abstract–The efficient industrial conversion of plant-derived cellulose to simple sugars and other value-added chemicals requires various highly stable and reactive enzymes. Industrial processes especially synchronous saccharification and fermentation (SSF)-based production of cellulosic bio-ethanol require enzymes that are active at lower temperatures. In this study, we have identified, characterized, and expressed the cold-adaptive endo-1,4-ß-glucanase (BpEG) isolated from the *Burkholderia pyrrocinia* JK-SH007. The analysis of the predicted amino acid sequence indicated that BpEG belongs to GH family 8. The *BpEG* without the signal peptide was cloned into the expression vector pET32a and significantly expressed in *Escherichia coli* BL21 (DE3) competent cells. The SDS-PAGE and Western blot analysis of BpEG revealed that the recombinant BpEG was approximately 60 kDa. Purified recombinant BpEG exhibited hydrolytic activity against carboxymethyl cellulose (CMC) and phosphoric acid swollen cellulose (PASC), but not crystalline cellulose and xylan substrates. High performance, anion exchange, chromatography-pulsed amperometric detector (HPAEC-PAD) analysis of the enzymatic products obtained from depolymerization of 1,4-ß-linked biopolymers of different lengths revealed an interesting cutting mechanism employed by endoglucanases. The recombinant BpEG exhibited 6.0 of optimum pH and 35°C of optimum temperature, when cultured with CMC substrate. The BpEG enzyme exhibited stable activity between pH 5.0 and 9.0 at 35°C. Interestingly, BpEG retained about 42% of its enzymatic activity at 10°C compared to its optimal temperature. This new cold-adaptive cellulase could potentially achieve synchronous saccharification and fermentation (SSF) making BpEG a promising candidate in the fields of biofuel, biorefining, food and pharmaceutical industries.

Dimkpa, C.O.; Andrews, J.; Fugice, J.; Singh, U.; Bindraban, P.S.; Elmer, W.H.; Gardea-Torresdey, J.L.; White, J.C. 2020. Facile coating of urea with low-dose ZnO nanoparticles promotes wheat performance and enhances Zn uptake under drought stress. *Front. Plant Sci.* In press.

Abstract- Zinc oxide nanoparticles (ZnO-NPs) hold great promise as novel fertilizer-nutrients. However, their ultra-small size could make large-scale field applications difficult. In this study, urea was coated with ZnO-NPs (1%) and evaluated with wheat under drought and non-drought conditions, and in comparison with ZnO-NP-

uncoated urea, as well as bulk-ZnO-coated (2%) and uncoated urea. In all cases, plants were exposed to a lower rate of ZnO-NPs than bulk-ZnO. Coating urea with nanoscale and bulk-ZnO showed similar efficiencies, 74-75%. Under drought stress, ZnO-NPs, but not bulk-ZnO, reduced average time to panicle initiation by 5 days, relative to the control. Compared to the control, the average grain yield increased 51 or 39% with ZnO-NP-coated or uncoated urea; and by 73 or 24% with bulk-ZnO-coated or uncoated urea. Uptake of Zn into above-ground tissues was enhanced 24 or 8% by coating or not coating with ZnO-NPs; and by 78% or 10% by coating or not coating with bulk-ZnO. Under non-drought condition, Zn treatment did not significantly reduce panicle initiation time, except with uncoated bulk-ZnO. Relative to the control, grain yield was significantly enhanced by ZnO-NPs (irrespective of coating), but not by bulk-ZnO; and Zn uptake was enhanced significantly only by coated ZnO-NPs. Collectively, these findings demonstrate that coating of urea with ZnO-NPs can enhance plant performance and Zn accumulation, thus potentiating the feasible deployment of nano-scale nutrients at the field scale. Notably, lower Zn input from ZnO-NPs was sufficient to enhance crop productivity, comparable to a higher input from bulk-ZnO. This highlights one of the intended benefits of nanofertilizers: a reduction of nutrient inputs into agriculture.

Little, E. A. H., Williams, S. C., Stafford, K. C. III, Linske, M. A., Molaei, G.*, Evaluating the effectiveness of an integrated tick management approach on multiple pathogen infection in *Ixodes scapularis* questing nymphs and larvae parasitizing white-footed mice, *Experimental and Applied Acarology*. doi: 10.1007/s10493-019-00452-7.

Abstract- We investigated the effectiveness of integrated tick management (ITM) approaches in reducing the burden of infection with *Borrelia burgdorferi*, *Babesia microti*, and *Anaplasma phagocytophilum* in *Ixodes scapularis*. We found a 52% reduction in encountering a questing nymph in the *Metarhizium anisopliae* (Met52) and fipronil rodent bait box treatment combination as well as a 51% reduction in the combined white-tailed deer (*Odocoileus virginianus*) removal, Met52, and fipronil rodent bait box treatment compared to the control treatment. The Met52 and fipronil rodent bait box treatment combination reduced the encounter potential with a questing nymph infected with any pathogen by 53%. Compared to the control treatment, the odds of collecting a parasitizing *I. scapularis* infected with any pathogen from a white-footed mouse (*Peromyscus leucopus*) was reduced by 90% in the combined deer removal, Met52, and fipronil rodent bait box treatment and by 93% in the Met52 and fipronil rodent bait box treatment combination. Our study highlights the utility of these ITM measures in reducing both the abundance of juvenile *I. scapularis* and infection with the aforementioned pathogens.

Sheele, J. M., Lesser, E., Li, X., Schlatzer, D., Ridge, G. 2020. Ivermectin and Moxidectin Can Incapacitate Different Strains of the Common Bed Bug Cimex lectularius L.: A Study. Cureus. 12(1): e6714. doi:10.7759/cureus.6714.

Abstract- The common bed bug *Cimex lectularius* L. *(C. lectularius)* is a hematophagous ectoparasite that has recently resurged in many western industrialized nations, in part due to pesticide resistance. Using a laboratory feeding system, we found that the antiparasitic drugs ivermectin and moxidectin did not show higher incapacitation rates in pyrethroid-resistant strains of *C. lectularius* compared to a pyrethroid-susceptible strain. Additionally, we developed a high-performance liquid chromatography (HPLC) and mass spectroscopy (MS) assay to measure the concentrations of ivermectin inside *C. lectularius* and found that ivermectin persists in the insects for up to one month. HPLC/MS will be useful in understanding the pathophysiology behind the long-term morbidity observed in *C. lectularius* that consumes a sublethal dose of ivermectin.

Sponsler, D.B., Grozinger, C.M., Richardson, R.T. *et al.* A screening-level assessment of the pollinator-attractiveness of ornamental nursery stock using a honey bee foraging assay. *Sci Rep* **10,** 831 (2020) doi:10.1038/s41598-020-57858-2

Abstract- In urban and suburban landscapes characterized by extensive designed greenspaces, the support of pollinator communities hinges significantly on floral resources provided by ornamental plants. The attractiveness of ornamental plants to pollinators, however, cannot be presumed, and some studies suggest that a majority of ornamental plant varieties receive little or no pollinator visitation. Here, we harness the sampling power of the western honey bee, a generalist pollinator whose diet breadth overlaps substantially with that of other pollinators, to survey the utilization of ornamental plants grown at three commercial nurseries in Connecticut, USA. Using a combi-

nation of DNA metabarcoding and microscopy, we identify, to genus-level, pollen samples from honey bee colonies placed within each nursery, and we compare our results with nursery plant inventories to identify the subset of cultivated genera that were visited during pollen foraging. Samples were collected weekly from May to September, encompassing the majority of the growing season. Our findings show that some plant genera known to be cultivated as ornamentals in our system, particularly ornamental trees and shrubs (e.g. *Hydrangea*, *Rosa*, *Spiraea*, *Syringa*, *Viburnum*), functioned as major pollen sources, but the majority of plants inventoried at our nurseries provided little or no pollen to honey bees. These results are in agreement with a growing body of literature highlighting the special importance of woody plants as resources for flower-visiting insects. We encourage further exploration of the genera highlighted in our data as potential components of pollinator-friendly ornamental greenspace.

Stafford III, K. C., Williams, S. C., Oosterwijk, J. G., Linske, M. A., Zatechka, S., Richer, L. M., Molaei, G., Przybyszewski, C. and Wikel, S. K. 2020. Field evaluation of a novel oral reservoir-targeted vaccine against *Borrelia burgdorferi* utilizing an inactivated whole-cell bacterial antigen expression vehicle. Experimental and Applied Acarology. https://doi.org/10.1007/s10493-019-00458-1

Abstract- Blacklegged ticks (*Ixodes scapularis*) are the principal vector for *Borrelia burgdorferi,* among other infectious agents, in the northeastern, mid-Atlantic, and upper Midwestern USA. White-footed mice (*Peromyscus leucopus*) are the primary and most competent reservoir host of *B. burgdorferi* in the Northeast. Live reservoir-targeted vaccines (RTVs) to limit enzootic transmission of *B. burgdorferi* were previously developed and successfully evaluated in laboratory and controlled field trials. A novel, inactivated RTV was developed to minimize regulatory and market challenges facing previous RTVs based on live bacterial or viral vehicles. Thirty-two residential properties in Redding, Connecticut, participated in a field trial of an orally delivered, inactivated RTV efficacy study (2015–2016). During the two-year vaccination period, a significant decrease in the percentage of *B. burgdorferi*infected *I. scapularis* larvae parasitizing *P. leucopus* was observed, as was a significant reduction in the percentage of infected *P. leucopus* on RTV-treated properties when compared to control properties. This novel inactivated RTV was effective in reducing numbers of *B. burgdorferi* infected *I. scapularis* and *B. burgdorferi*-infected *P. leucopus* on properties where it was distributed.

Tippery, N. P., **Bugbee, G. J., Stebbins, S. E.** Evidence for a genetically distinct strain of introduced *Hydrilla verticillata* (Hydrocharitaceae) in North America, *Journal of Aquatic Plant Management*, 58: 1-6. 2020.

Abstract- The invasive aquatic plant, hydrilla (*Hydrilla verticillata*), exists in North America as two genetically and morphologically distinct strains, with the dioecious strain mostly found in the southern United States and the monoecious strain being more northern, including previously known sites in Connecticut. In 2016, an additional hydrilla population was located in a portion of the Connecticut River near Hartford CT, USA with unusual morphological features relative to other Connecticut populations. Hydrilla plants from this population were subjected to genetic testing and their molecular sequences for one chloroplast (trnL-F) and two nuclear gene regions (ITS and PDS) were compared against published data. The Connecticut River hydrilla plants are distinct from all known North American plants, representing a novel introduction, likely from northern Eurasia. The genetic novelty of this recent introduction may present additional ecological and management challenges beyond what has been encountered for hydrilla to date.

Yang, Z.; Yan, Y.; Yu, A.; Pan, B.*; **Pignatello, J. J.*** Revisiting the phenanthroline and ferrozine colorimetric methods for quantification of Fe(II) in Fenton reactions, *Chemical Engineering Journal*, doi.org/10.1016/j.cej.2019.123592 (online November 22, 2019).

Abstract- Colorimetric methods for Fe(II) determination based on complexation of heterocyclic amines, such as phenanthroline (Phen) and ferrozine (FZ), have been widely used for analysis of iron species in solution, which is critical to discuss the mechanism of Fenton and related reaction systems. However, the reliability of both methods in the background of hydrogen peroxide has never been addressed. In this study, we demonstrate that serious Fe(II) overestimation possibly occurs for both methods in Fenton systems, particularly for the Phen method. A systematic variation of incubation conditions reveals that the available Fe(II) concentration depends greatly on the incubation time

after mixing the colorimetric reagents with the sample. Also, it is highly sensitive to pH and temperature as well as the initial concentrations of Fe(III), H_2O_2, and acetate buffer. The experimental results combined with simulations indicate that Fe(II) overestimation mainly results from the reduction of Fe(III)-Phen or Fe(III)-FZ complexes by residual H_2O_2 during analysis, a reaction that is facilitated by the ligand field effect of the heterocyclic amine. An effective remedy for the instability and inaccuracy of the methods in the presence of H_2O_2 is the addition of NH_4F to the incubation mixture (55 mM for Phen and 35 mM for FZ), which converts residual Fe(III) to a colorless and reduction-insensitive fluoride complex.

Yixun, W., Chen, J., Xu, X., Cheng, J., Zheng, L., Huang, J., and **Li, D**. 2020. Identification and characterization of *Colletotrichum* species associated with anthracnose disease of *Camellia oleifera* in China. Plant Disease 104 (2): 474–482. https://doi.org/10.1094/PDIS-11-18-1955-RE

Abstract-Tea-oil tree (*Camellia oleifera* Abel) is an important edible oil woody plant with a planting area over 3,800,000 hectares in southern China. Anthracnose is a serious disease of tea-oil tree in southern China, causing severe economic losses and posing a huge threat to the *Ca. oleifera* industry. Based on recent developments in the classification of *Colletotrichum* species, the objective of this study was to identify *Colletotrichum* species associated with tea-oil tree and examine their pathogenicity on leaves and fruits of *Ca. oleifera*. In total, 232 isolates were obtained from *Ca. oleifera* leaves and fruits with anthracnose symptoms. These isolates were further characterized based on morphology and multilocus phylogenetic analyses using partial DNA sequences at the ribosomal internal transcribed spacer regions and ß-tubulin, actin, calmodulin, glyceraldehyde-3-phosphate dehydrogenase, and chitin synthase-encoding genes. The fungal isolates belong to five species: *C. camelliae*, *C. fructicola*, *C. siamense*, *C. aenigma*, and *C. gloeosporioides*. *C. camelliae* was the most predominant and widely distributed species on fruits of *Ca. oleifera* (91.4%), followed by *C. fructicola* (6.3%). However, *C. fructicola* was common and widely distributed species on leaves (75.9%), followed by *C. camelliae* (17.2%). There was no evidence of geographical specialization of the different species. Pathogenicity assays showed that all tested isolates, including 20 of *C. camelliae*, 11 of *C. fructicola*, four of *C. siamense*, two of *C. aenigma*, and one of *C. gloeosporioides*, were pathogenic to leaves and fruits of *Ca. oleifera*. Among the five species, *C. camelliae* species showed strong pathogenicity on both leaves and fruits of *Ca. oleifera*, and *C. fructicola*, *C. siamense*, *C. aenigma*, and *C. gloeosporioides* all showed weak pathogenicity on both leaves and fruits. No relationship was found between origin of isolates and their virulence. This is the first description of *C. camelliae*, *C. fructicola*, *C. siamense*, and *C. gloeosporioides* from the fruits of *Ca. oleifera* in China.

Yuan, X., **Zeng, Q.**, Xu, J., Severin, G.B., Zhou, X., Waters, C.M., Sundin, G.W., Ibekwe, A.M., Liu, F., and Yang, C.H.(2019) Tricarboxylic acid (TCA) cycle enzymes and intermediates modulate intracellular cyclic di-GMP levels and the production of plant-cell-wall degrading enzymes in soft rot pathogen *Dickeya dadantii*. **Mol. Plant-Microbe Interact.** https://doi.org/10.1094/MPMI-07-19-0203-R

Abstract- Dickeya dadantii is a plant-pathogenic bacterium that causes soft-rot in a wide range of plants. Although we have previously demonstrated that cyclic bis-(3′-5′)-cyclic dimeric guanosine monophosphate (c-di-GMP), a bacterial secondary messenger, plays a central role in virulence regulation in D. dadantii, the upstream signals that modulate c-di-GMP remain enigmatic. Using a genome-wide transposon mutagenesis approach of a Δhfq mutant strain that has high c-di-GMP and reduced motility, we uncovered transposon mutants that recovered the c-di-GMP-mediated repression on swimming motility. A number of these mutants harbored transposon insertions in genes encoding tricarboxylic acid (TCA) cycle enzymes. Two of these TCA transposon mutants were studied further by generating chromosomal deletions of the fumA gene (encoding fumarase) and the sdhCDAB operon (encoding succinate dehydrogenase). Disruption of the TCA cycle in these deletion mutants resulted in reduced intracellular c-di-GMP and enhanced production of pectate lyases (Pels), a major plant cell wall–degrading enzyme (PCWDE) known to be transcriptionally repressed by c-di-GMP. Consistent with this result, addition of TCA cycle intermediates such as citrate also resulted in increased c-di-GMP levels and decreased production of Pels. Additionally, we found that a diguanylate cyclase GcpA was solely responsible for the observed citrate-mediated modulation of c-di-GMP. Finally, we

demonstrated that addition of citrate induced not only an overproduction of GcpA protein but also a concomitant repression of the c-di-GMP-degrading phosphodiesterase EGcpB which, together, resulted in an increase in the intracellular concentration of c-di-GMP. In summary, our report demonstrates that bacterial respiration and respiration metabolites serve as signals for the regulation of c-di-GMP signaling.

JOURNAL ARTICLES APPROVED JANUARY 2020

Allan-Perkins, E., **De-Wei Li**, **Neil P. Schultes**, and **James A. LaMondia**. New and re-emerging diseases of common hop in Connecticut. *Phytopathology* (abstract)

Aulakh, Jatinder S. Weed management update – Indaziflam safety to Christmas trees in Connecticut. *The Real Tree Line*

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Dimkpa, C. O., J. Andrews, J. Sanabria, U. Singh, **Wade H. Elmer**, J. L. Gardea-Torresdey, and **Jason C. White**. Interactive effects of drought, organic matter, and zinc oxide nanoscale and bulk particles on wheat performance and grain nutrient accumulation. *Biology and Fertility of Soils*

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Station News was prepared and edited by Dr. Theodore G. Andreadis, Ms. Vickie Bomba-Lewandoski, Ms. Sandra Carney, and Ms. Brandi Marks.

Volume 10 Issue 2
February 2020