Station News

The Connecticut Agricultural Experiment Station
Volume 9 Issue 6 June 2019

Rubicon strawberry, developed with resistance to root rot by Drs. Richard Cowles and James LaMondia (Photo credit R. Cowles)

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

GRANTS RECEIVED MAY 2019

Dr. Blaire Steven, co-PI along with others at Los Alamos National Laboratory, New Mexico: "Microbial Carbon Cycling in Terrestrial Environments" Department of Energy, Science Focus Area Grant; $40,000; September 1, 2019 – August 31, 2020.

Executive summary: The LANL SFA in Terrestrial Microbial Carbon Cycling aims to inform climate modeling and enable carbon management in terrestrial ecosystems by discovering widespread biological processes that control carbon storage and release in temperate biome soils (primarily arid grass/shrub lands and forests). Until recently the SFA strategy focused on cataloguing microbial (fungal and bacterial) activity in response to perturbations—physico-chemical drivers of ecosystem change—in field studies led by external collaborators. Perturbations were levels of atmospheric CO_2, ozone, nitrogen deposition, temperature, precipitation, and/or physical disturbance. "Activity" has been assessed as significant differences between communities, taxa, or functional genes in comparison samples. Lists of active taxa/genes can be referenced against a suite of supporting databases to infer microbial processes that are affected by ecosystem change, but supporting databases are not yet mature enough to effectively achieve this goal. To address this gap, the SFA performed auxiliary studies to acquire reference data describing activities or the functional potential of specific organisms. Studies included use of ^{13}C-stable isotope probing to identify cellulose-consuming organisms in different soils; biochemical assays of hundreds of Actinobacterial and fungal isolates cultivated from field site samples; genome sequencing of select isolates, protein secretome profiles of a handful of fungi (EMSL user project), and analyses of the phylogenetic distribution of key biogeochemical pathways. The SFA has applied targeted metagenomics to 13 ecosystem studies and shotgun metagenomics techniques to 6 studies to assess the degree of community activity in response to different perturbations, and to identify the taxa and potential functions most affected. Targeted metatranscriptomics (e.g., ribosomal RNA and cellobiohydrolase RNA) was used in a similar way with 5 field studies, but also improved the identification of physiologically active taxa/genes at the time of sampling. To expand this approach, a shotgun metatranscriptomic technique was developed and applied to broadly examine actively expressed genes in soils. The SFA also leveraged a form of targeted proteomics (eco-enzyme assays) to quantify the activity level of a few specific microbial functions.The suite of techniques provides hierarchical data, ranging from organism-specific potential activity for all metabolic functions (metagenomics) to community-level realized activity for a few key functions (Eco-Enzyme Assays). These techniques were generally consistent in showing activity patterns that varied in complex ways with soil depth and ecosystem. Building on prior experience, the SFA now has a revised strategy to improve discovery of microbial processes that can drive variation in ecosystem function. Metagenomic and metatranscriptomic techniques remain central to monitoring microbial activity. However, the SFA is now integrating these techniques tightly with additional measurements (C flux, stable isotope tracing, metabolomics) and computation techniques to accelerate understanding of community composition, microbial "activity", and ecosystem function.

Dr. Carole Cheah received a 2019 grant ($22,792) on June 6 from USDA APHIS PPQ for "Biological control of Mile-a-minute weed in CT" and received a grant ($1,000) from the Connecticut Christmas Tree Growers Association in June 2019 for a project entitled "Developing a mass rearing system for *Chilocorus stigma*, native predator of armored scales in Christmas tree plantations."

ADMINISTRATION

DR. THEODORE ANDREADIS participated in a "boot camp" workshop on mosquitoes, ticks and associated vector-borne diseases sponsored by the Northeast Regional Center for Excellence in Vector-Borne Diseases held at Fordham University's Louis Calder Center in Armonk, NY (20 student attendees) (May 14-15); was interviewed about the current climate and outlook for ticks, mosquitoes and associated vector-borne diseases this season by Amanda Cuda, Connecticut Post (May 15); was interviewed about the impact of climate change on the establishment of native

and exotic tick species and emergence of tick-borne diseases by Danielle Abreu, NBC Bay Area (May 16); participated in a press event held at Jones Family Farm in Shelton to announce the start of the seasonal "wine trail passport" program with Lieutenant Governor, Susan Bysiewicz, Commissioner of Agriculture, Bryan Hurlburt, Associate Dean and Associate Director for UConn Extension in the College of Agriculture, Health and Natural Resources Michael O'Neil and CAES Board of Control Vice President, Terry Jones (May 17); and was interviewed about the statewide prevalence and distribution of the causal agent of Lyme disease, *Borrelia burgdorferi* in the tick, *Ixodes scapularis* and the risk of acquiring Lyme disease in different regions of the state by Amanda Cuda, Connecticut Post (May 28).

ANALYTICAL CHEMISTRY

DR. JASON C. WHITE participated in the weekly all-hands ZOOM call for the Center for Sustainable Nanotechnology (May 1, 15, 22); held a ZOOM call with Prof. Greg Lowry and other collaborators regarding an upcoming NSF ERC grant submission (May 3, 17); attended the Center for Sustainability Nanotechnology NSF Annual Site Visit and Review at the University of Wisconsin Madison (May 4-8); participated in an FDA webinar on data package assembly and submission for state Rapid Response Teams (RRTs) and Food Emergency Response Network (FERN) Cooperative Agreement Program Laboratories (May 8); along with **DR. BRIAN EITZER, DR. WALTER KROL, MS. TERRI ARSENAULT, MR. CRAIG MUSANTE, MR. JOHN RANCIATO, AND MS. KITTY PRAPAYOTIN-RIVEROS,** participated in the monthly FDA FERN cCAP WebEx call (May 9); participated in a conference call with collaborators at Louisiana State University regarding a newly funded USDA NIFA research grant on nano-enabled agriculture (May 9); participated in a teleconference call with collaborators at the Harvard University TH Chan School of Public Health to discuss collaborative experiments (May 14); along with Department staff, hosted in a ZOOM call with Becky Curtis of the University of Wisconsin Milwaukee regarding collaborative research and her upcoming stay at CAES (May 15); attended the USDA NIFA Nanotechnology Annual Program Review at Vanderbilt University in Nashville, TN and gave a presentation entitled "Nanoscale Elements Suppress Plant Disease, Enhance Micronutrient Use Efficiency, and Increase Crop Yield" (40 attendees) (May 19-21); participated by ZOOM in the thesis proposal defense of Ms. Jaya Borgatta, who is a PhD student at the University of Wisconsin Madison and I am serving on her committee (May 24); and presented an invited lecture at the Nanjing University School of the Environment entitled "Nanotechnology in Agriculture: Assessing the Balance Between Applications and Implications" and met with students and faculty to discuss ongoing and future collaborative research (May 27-30).

DR. BRIAN EITZER presented a keynote address entitled "Challenges in Determining the Exposure of Pollinators to Pesticides" at the Latin American Pesticide Residue Workshop held in Foz do Iguaçu, Brazil (140 attendees) (May 6-8).

MS. KITTY PRAPAYOTIN-RIVEROS participated in the US FDA Sample Analysis Data Exchange - IT Implementation Phase work group WebEx call (May 7, 21).

DR. CHRISTINA ROBB attended a board meeting and a long-term program planning meeting for the Eastern Analytical Symposium (EAS) in Plainsboro, NJ (May 17).

Dr. Jason C. White presented an invited lecture at the Nanjing University School of the Environment entitled "Nanotechnology in agriculture: Assessing the balance between applications and implications" (left); pictured with host Prof. Lijuan Zhao and Prof. Yuxiong Huang (Tsinghua-

Berkeley Shenzhen Institute) (center); and on the Nanjing City Wall with his son Donovan White (right).

ENTOMOLOGY

DR. KIRBY C. STAFFORD III was interviewed about gypsy moth defoliation and impact on trees in eastern Connecticut by Gregg Monte, NBC Connecticut (May 3); participated in the NEVBD Center of Excellence "Boot Camp" for public health personnel and provided training on tick identification and tick management at the Louis Calder Center, Fordham University, Armonk, NY (May 13-16).

MS. TIA M. BLEVINS participated in the 45th annual Horticultural Inspection Society - Eastern Chapter's meeting in Portland, Maine. As Archivist, Tia presented the archival report to the members, worked on the Planning Committee, Audit Committee and moderated a roundtable discussion about eCommerce Nurseries (16 participants) (April 8-11).

MR. MARK H. CREIGHTON spoke about basic beekeeping to visitors at the Canterbury Public Library (20 attendees) (May 13) and spoke about beekeeping and pollination at Joshua Center in Dayville (20 high school students) (May 28).

DR. MEGAN LINSKE participated in a collaborative meeting with Dr. Mark Coffelt and Dr. Nicola Gallagher from Syngenta Crop Protection, LLC, to discuss present and future research opportunities (May 8); participated in a conference call as Executive Secretary for the Northeast Section of the Wildlife Society (May 8); participated in a planning call for the National Wildlife Society Annual Conference's Network and Engagement Committee as a new member and Northeast Representative (May 28); became a Wildlife Society Leadership Institute Mentor for Justin Shew, LI Class of 2019 (May 28).

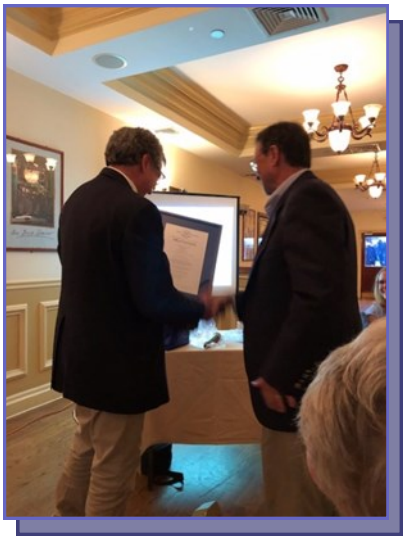
DR. GALE E. RIDGE identified the Horn moth, *Ceratophaga vastella* (Zeller) found in imported lamb's horns from Iceland, which was confirmed by the national Systematics Entomology Laboratory (SEL) (May 8); delivered an environmental speech as part of the Sustainable CT lecture series entitled "Turning Eden into Dust," which addressed the changing environment and its impact on native species in Connecticut with 800 threatened or endangered species of plants, arthropods, mammals, birds, and reptiles (40 attendees) (May 9); and was interviewed about delusions of parasitosis by Lou Carter at WIHS for broadcast (May 23).

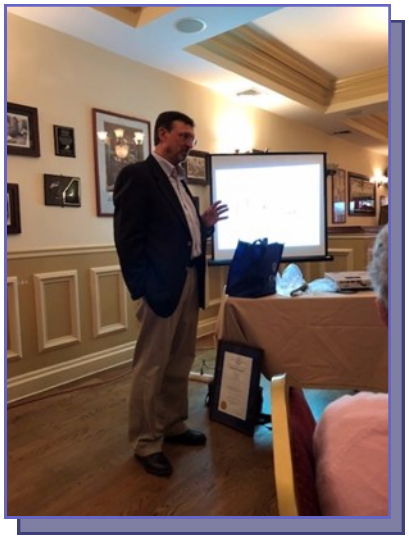
DR. VICTORIA L. SMITH was interviewed about Gypsy moths by Channel 3 WFSB News (May 9) and participated in a meeting of the Yale Biosafety Committee, held at 135 College Street, New Haven (20 participants) (May 16).

DR. KIMBERLY A. STONER was interviewed about Pollinator Pathways by Theresa Barger Sullivan of Connecticut Magazine (May 8); was interviewed about Pollinator Pathways by Bob Miller of the Danbury News-Times (May 21); was interviewed about CT Department of Transportation efforts to create pollinator habitat along state highways by Greg Hladky of the Hartford Courant (May 22); participated as a member of Benjamin Gluck's graduate school committee at his seminar and thesis defense (May 29); and gave bee pictures to Edible Nutmeg magazine for an article on Pollinator Pathways (May 29).

RETIREMENT OF DR. CHRIS T. MAIER

After 42 years of service to Connecticut, Dr. Chris Maier retired June 1, 2019. A retirement dinner was held May 30, 2019 at the Playwright Restaurant, well attended by friends and family. Dr. Kirby Stafford, head of Entomology, provided a humorous review of his career at the Experiment Station with early career pictures and insect comics, followed by presentation of the Governor's Proclamation by Director Dr. Theodore Andreadis, and comments by Chris himself. Dr. Chris Maier began his Station career on June 20, 1977 and began conducting research on economically important insects attacking fruit and nursery stock. He was promoted from Assistant Scientist to Associate Scientist in May, 1982. Starting with his first Hatch project on three weevils and the "appointment" of liaison with the Connecticut Pomological Society in 1983, Chris's work has supported our growers and citizens virtually his entire career. He soon was conducting research on the parasitoid behavioral ecology and mortality of apple leafminers. He was promoted from Associate Agricultural Scientist to Agricultural Scientist in October, 1995. He served on numerous environmental and other committees. With an impressive publication record, Dr. Maier's research on weevils, apple and cranberry leaf miners and their natural enemies, other pests impacting fruit growers, pests of conifers, wood-boring beetles, non-native invasive insects, not to mention periodical cicadas has benefited science and the citizens of Connecticut. However, Dr. Maier hasn't finished his work and will continue his research as an emeritus scientist.





ENVIRONMENTAL SCIENCES

DR. JOSEPH PIGNATELLO attended the business meeting and annual dinner of the Connecticut Academy of Science and Engineering (May 28).

DR. PHILIP ARMSTRONG was interviewed about the spring weather conditions that favor high mosquito populations by NBC Connecticut (May 8) and News Channel 8 (May 15) ; and gave a

lecture entitled "Arthropod Biology and Behavior" for the Vector Biology Boot Camp Course held at the Louis Calder Center in Armonk, NY (40 attendees) (May 14).

MS. ANGELA BRANSFIELD participated in the Federal Select Agent Program webinar *eFSAP System Update* (May 30).

MR. GREGORY BUGBEE served as judge at the Future Farmers of America Science Fair held in Jones Auditorium (May 2); and gave a talk entitled "CAES Invasive Aquatic Plant Program" to the Bantam Lake Protective Association Board of Directors at the White Memorial Conservation Center in Litchfield (approx. 12 attendees) (May 16).

DR. JOSEPH R. McMILLAN gave a talk entitled "The things they carry: the biology and control of mosquito-borne diseases in Connecticut", as a part of the Town of Darien Health Department's Fight The Bite: The Challenge of Tick- and Mosquito-borne Diseases, at the Darien Public Library (approx. 20 attendees) (May 21).

DR. GOUDARZ MOLAEI was interviewed by the Republican American, *https://www.rep-am.com/local/news-local/2019/05/05/right-to-be-ticked-off-tiny-creepy-bugs-post-dangerous-threat/* (May 5); was interviewed by WFSB-TV-DT Chanel 3, https://www.wfsb.com/news/tips-to-stay-tick-free-as-weather-warms/article_f64d1bf4-730c-11e9-bae6-cf1f544286a1.html (May 10); was interviewed by the Connecticut Post, https://www.sfchronicle.com/local/article/Time-for-ticks-almost-time-for-mosquitoes-13848279.php (May 15); was interviewed by WPLR, on tick activity, Lyme disease, areas with higher tick abundance and activity, and the risk of infection with tick-borne diseases (May 16); organized a public information event as a part of the Town of Darien Health Department's Fight The Bite: The Challenge of Tick- and Mosquito-borne Diseases, and presented the talk, *"Passive Tick Surveillance and Testing Program: Tracking Ticks and Associated Pathogens in Connecticut"* (approx. 20 attendees) (May 21); was interviewed by the Connecticut Post, https://www.ctpost.com/local/article/Study-reveals-more-information-about-Lyme-13900908.php (May 28); was interviewed by News 8 WTNH, https://www.wtnh.com/news/health/lyme-disease-hot-zones-based-on-tick-population-in-ct-released/2034253454 (May 28); was interviewed by News 3 WFSB Eyewitness, https://www.wfsb.com/news/study-maps-out-spots-in-ct-with-greater-risk-of/article_c3c5a2de-8151-11e9-bbc9-a7cebe11911a.html (May 28); was interviewed by 1080 WTIC NEWSTALK - WTIC Radio on Lyme disease across the state, https://omny.fm/shows/mornings-with-ray-dunaway/morning-show-w-dr-goudarz-molaei-5-30-19 (May 30); and was interviewed by the Day, New London, on the passive tick surveillance program at the CAES (May 30).

DR. SARA NASON participated in a conference call for the Benchmarks and Publications for Non-Targeted Analysis working group (May 15).

MR. JOHN SHEPARD spoke to two groups of high school students about the State Mosquito Trapping and Arbovirus Surveillance Program at the 2019 State Agriscience Fair (46 students) (May 2); and gave a seminar entitled "Taxonomic Identification of Adult Female Mosquitoes" as part of a Vector Biology Boot Camp sponsored by the Northeast Regional Center for Excellence in Vector-Borne Diseases held at the Louis Calder Center in Armonk, NY (20 students) (May 16).

DR. BLAIRE STEVEN gave a talk entitled "Biological Soil Crusts as a Model for Soil Carbon Cycling" at the 10th annual Gobabeb/Namib Desert Symposium and Field Expedition held in Gobabeb, Namibia (approx. 60 attendees; 30 students) (April 22).

FORESTRY AND HORTICULTURE

DR. JEFFREY S. WARD participated in an Audubon Connecticut Science Committee conference call (May 21); was visited by John Truong, Forest Ecosystem Monitoring Cooperative, to discuss urban forestry inventories (May 23); with **MR. JOSEPH P. BARSKY**, visited Dr. Chad Jones (Connecticut College) and students to discuss collaborative research and forest dynamics (3 students, 1 professor) (May 29).

DR. ABIGAIL A. MAYNARD judged entries for the CAES prize at the New Haven Science Fair at Hillhouse High School (580 students, 205 teachers) (May 13, 14); advised students with their composting operation at Wesleyan University (6 students, 1 teacher) (May 10); and assisted students working in the Learning Garden at Hamden Hall Country Day School in Hamden (33 students, 3 teachers) (May 13, 17, 20).

DR. SCOTT C. WILLIAMS participated in a conference call about membership issues in the Northeast Section of the Wildlife Society (May 8); met with representatives of Syngenta, Inc., about past and future collaborative research efforts (May 8); with **MR. MICHAEL SHORT**, field visit with MDC foresters and DEEP wildlife biologist in Burlington to discuss proper data collection and analysis for a large-scale deer exclosure for oak regeneration (3 attendees) (May 22).

MR. JOSEPH P. BARSKY co-organized the 2019 Agriscience Fair and hosted tours for students (45 students) (May 2); participating in the Connecticut State Consulting Committee for Agricultural Science and Technical Education (May 3); and served as a judge for the New Haven Science Fair (6 students) (May 13).

PLANT PATHOLOGY AND ECOLOGY

DR. WADE ELMER attended the All hands meeting for Center for Sustainable Nanotechnology review in Madison, WI (May 5-7), met with Dr. Dan Cooley from UMass Amherst (May 22), attended the CAES-SCSU mentor training for 2019 interns in Jones Auditorium (12 attendees) (May 23).

DR. YONGHAO LI presented “Organic Gardening” in the Canterbury Public Library in Canterbury (15 adults) (May 6); presented “Backyard Composting” in the Showroom event at the Torrison Stone & Garden in Durham (9 adults) (May 18); and presented “Invasive Species” to the Hooker School Science Club members in New Haven (15 youths and 1 adult) (May 21).

DR. ROBERT MARRA was interviewed at Lockwood Farm by Jan Ellen Spiegel about his work quantifying carbon loss due to internal decay in trees, for the MIT publication, "Undark" (May 31).

DR. LINDSAY TRIPLET organized and conducted a meeting of Plant Health Fellows mentors to discuss the upcoming summer internship program (12 attendees) (May 23), visited the University of Connecticut to meet with collaborators (5 attendees) (May 9), and met with Dr. Dan Cooley from UMass Amherst (May 22).

DR. QUAN ZENG visited University of Massachusetts Cold Spring Orchard and visited with Jon Clements to discuss mutual research interests (May 9), hosted Dr. Dan Cooley from UMass who delivered a lunch seminar at Jones Auditorium (May 22), and taught "Apple Stories" to a preschool class at the Cheshire Nursery School in Cheshire (16 children, 5 adults) (May 24).

VALLEY LABORATORY

DR. CAROLE CHEAH gave a presentation on climate impacts on eastern hemlocks for the Weantinoge Land Trust at the Gunn Memorial Library in Washington (25 attednees) (May 14); gave a talk on trees under siege to the Breakfast Club at the McAuley Retirement Community in West Hartford (35 attendees) (May 29).

DR. RICHARD COWLES was interviewed by Greg Hladky of the Hartford Courant on the subject of pollinator plantings and bee health (May 29), for which an article was published on May 30 (https://www.courant.com/news/connecticut/hc-news-dot-flowers-20190530-xhs2ew7blvdrfp3pcumx36gmoa-story.html).

DR. JAMES LAMONDIA was interviewed about farmer interest in hemp production in CT by Davis Dunavin of WSHU (May 14).

DEPARTMENTAL RESEARCH UPDATES MAY 2019

Adisa, I.; Pullagurala, V.L.R.; Peralta-Videa, J.R.; Dimkpa, C.O.; **Ma, C.**; **Elmer, W.H.**; Gardea-Torresdey J.L.; **White, J.C.** 2019. Engineered nanomaterials as plant fertilizers and pesticides: Emerging opportunities with lower environmental impacts. *Environ. Sci.: Nano*. DOI: 10.1039/C9EN00265K.

Abstract- The use of nanomaterials in agriculture as nanofertilizers, nanopesticides, or nano-enabled sensors to increase crop yield is gaining increasing interest. Engineered nanomaterials (ENMs) can improve crop productivity by influencing fertilizer nutrient availability in soil and uptake by plants. These materials can suppress crop diseases by directly acting on pathogens through a variety of mechanisms, including the generation of reactive oxygen species (ROS). ENMs may also suppress disease indirectly by improving crop nutrition and enhancing plant defense pathways. Efficient use of ENMs may complement or replace conventional fertilizers and pesticides, subsequently reducing the environmental impact of agricultural practices. This review evaluates the current literature on ENMs used as pesticides and fertilizers, and highlights critical knowledge gaps that must be addressed to ensure sustainable application of nanotechnology in agriculture so as to achieve global food security.

Allan-Perkins, E., Li, D. W., Schultes, N. P., Yavuz, S., and **LaMondia, J. A.** First Report of the Resurgence of Hop Powdery Mildew (*Podosphaera macularis*) in a New England Commercial Hop Yard. Plant Disease https://doi.org/10.1094/PDIS-12-18-2259-PDN

Abstract - Powdery mildew, caused by *Podosphaera macularis* (Wallr.) U. Braun & S. Takam., is one of the major diseases of hop (*Humulus lupulus*) in North America. Historically, pow-

dery mildew has been present in commercial hop yards throughout the Northeastern United States but has not been detected in New England since the reintroduction of hop to the growing region about 10 years ago. In June 2018, a hop grower in Colchester, Connecticut, contacted The Connecticut Agricultural Experiment Station in Windsor with suspected powdery mildew on hop. A visit to the farm confirmed the presence of white powdery circular fungal colonies that were amphigenous on leaves and a diffuse white powdery mycelia covering stems. No chasmothecia were observed. Fungus was present on nearly 100% of bines for the cultivar Zeus and about 20% of bines for the cultivar Cascade and had covered nearly 100% of lower leaves and stems of the affected bines. Infected leaves and stems from Zeus were collected for further identification. Mycelia were hyaline and septate. Conidia were hyaline, barrel-shaped, and approximately 28.17 ± 2.49 × 15.58 ± 1.82 µm, with fibrosin bodies in chains. Conidiophores were erect with cylindrical foot cells. The morphological characters matched the description of *P. macularis* (Braun 1987; Mahaffee et al. 2009). The partial ITS and 28S regions of ribosomal DNA were amplified from isolate-derived genomic DNA using primers V9G and LR1 and sequenced (GenBank accession no. MH687414) (Gerrits van den Ende and de Hoog 1999; White et al. 1990). A nucleotide BLAST search confirmed 99% identity to *P. macularis* GenBank accession number KX842348.1. Maximum likelihood phylogenetic analysis of 28S rDNA using GenBank accession numbers KX842348, KX858801, and MG076960 for *P. macularis* and numbers AB022384, MG183669, MG76955, MF919434, AB022410, AB022423, AB022393, AB022347, and AB022353 of closely related species supported the identification of our sequence as *P. macularis* with 90% bootstrap support. Only the mating type idiomorph MAT1-1 was found from our isolate as determined by polymerase chain reaction using primers modified from Wolfenbarger et al. (2015), specifically forward MAT1-1A 5′-GCCGATCGTTACATTTCTTGA-3′ and reverse MAT1-1B 5′-CGTCCAAACCGTAGTCGTAAA-3′ for MAT1-1 and forward MAT1-2A 5′-GCAACCCTGGTCTTAGCAATA-3′ and reverse MAT1-2C 5′-GTGGCCCACATTGAAGAGTA-3′ for MAT1-2. Pathogenicity testing was conducted by brushing conidia from the diseased Zeus leaves onto leaves of a Cascade strap cutting. After 14 days, white mycelia were visible on the adaxial leaf surfaces of the inoculated plant but not on the negative control plant. Microscopic observation confirmed the presence of hyaline, barrel-shaped conidia matching the description of *P. macularis*. The reemergence of powdery mildew in Connecticut is a new challenge to hop growers in the region. Management practices to prevent the overwintering of this pathogen in buds may help to reduce disease in subsequent years because only one mating type was found, suggesting chasmothecia were not produced. The race of *P. macularis* present on hops in Connecticut should be determined (as in **Gent et al. 2017**), and an evaluation of disease susceptibilities of cultivars to the Connecticut isolate is important to provide recommendations for disease-tolerant plants to growers. Commercial hop yards throughout the Northeastern United States should actively scout for this disease, because its spread into surrounding areas is likely.

Dandurand. L. M., Zasada, I. A., and **LaMondia, J.A**. Effect of the trap crop, *Solanum sisymbriifolium,* on *Globodera pallida, Globodera tabacum,* and *Globodera ellingtonae*. Journal of Nematology Vol. 51 , ISSN (Online) 2640-396X, DOI: 10.21307/jofnem-2019-030, Mar 2019.

Abstract-The effect of the nematode trap crop ***Solanum sisymbriifolium*** was assessed against three ***Globodera*** spp., the potato cyst nematode ***Globodera pallida*** (in Idaho), the recently described ***Globodera ellingtonae*** (in Oregon), and the tobacco cyst nematode ***Globodera tabacum*** (in Connecticut) in field trials. At all locations the ability of ***S. sisymbriifolium*** to reduce ***Globodera*** encysted second-stage juveniles (J2) in egg densities compared to fallow was considered. For ***G. ellingtonae***, the impact of planting and termination dates of ***S. sisymbriifolium*** on final egg densities was also evaluated; and for G. pallida, the ability of the nematode to reproduce on potato (***Solanum tuberosum***) after exposure to ***S. sisymbriifolium*** was determined. Encysted J2 in egg densities of all three ***Globodera*** spp. declined from 25 to 68% after trap cropping with ***S. sisymbriifolium***. For G. pallida, ***S. sisymbriifolium*** reduced final encysted J2 in egg density by 23 to 50% compared to the fallow treatment, and significantly decreased ***G. pallida*** reproduction on potato after exposure to ***S. sisymbriifolium*** by 99 to 100% compared to the fallow treatment ($P < 0.0001$). For ***G. ellingtonae***, the planting date of ***S. sisymbriifolium*** in May or June did not impact final egg densities ($P = 0.32$). Rather, percentage reduction in ***G. ellingtonae*** encysted J2 in egg density was most influenced by the length of time to which nematodes were exposed to ***S. sisymbriifolium***, with 30 and 81% reduction after 6 vs 12 wk of exposure, respectively ($P < 0.0001$). Similar levels of nematode reduction after ***S. sisymbriifolium*** were observed for ***G. tabacum*** after 12 to 14 wk of exposure to the trap crop; ***G. tabacum*** density changes consisted of a 114% increase after susceptible tobacco, a 65% decrease after resistant tobacco, and an 88% decrease after S. sisymbriifolium compared to bare soil. In conclusion, this research demonstrates

the widespread applicability of S. sisymbriifolium in reducing a diversity of *Globodera* spp. present in the USA.

da Silva, L., Yang, K., Pettis, G., Soares, N. R., Giorno, R., and Clark, C. Flooding-associated soft rot of sweetpotato storage roots caused by distinct Clostridium isolates. Plant Disease https://doi.org/10.1094/PDIS-03-19-0548-RE

Abstract-Flooding of sweetpotatoes in the field leads to development of soft rot on the storage roots while they remain submerged or upon subsequent harvest and storage. Incidences of flooding following periods of intense rainy weather are on the rise in the southeastern United States, which is home to the majority of sweetpotato production in the nation. In an effort to characterize the causative agent(s) of this devastating disease, here we describe two distinct bacterial strains isolated from soft-rotted sweetpotato storage roots retrieved from an intentionally flooded field. Both of these anaerobic spore-forming isolates were identified as members of the genus Clostridium based on sequence similarity of multiple housekeeping genes, and both were confirmed to cause soft rot disease on sweetpotato and other vegetable crops. Despite these common features, the isolates were distinguishable by several phenotypic and biochemical properties and phylogenetic analysis placed them in separate well-supported clades within the genus. Overall, our results demonstrate that multiple plant-pathogenic Clostridium species can cause soft rot disease on sweetpotato and suggest that a variety of other plant hosts may also be susceptible.

Kah, M.; Tufenkji, N.; **White, J.C.** 2019. Nano-enabled strategies to enhance crop nutrition and protection. *Nature Nano*. 14:532-540.

Abstract- A variety of nano-enabled strategies are proposed to improve crop production and meet the growing global food, feed and fuel demands while practicing sustainable agriculture. After providing a brief overview of the challenges faced in the sector of crop nutrition and protection, we analyse the various strategies by which nanotechnology can significantly improve current practices. In addition to being an industry with a narrow profit margin, agricultural businesses have a number of inherent constraints that must be carefully considered. For instance, many suggested strategies involve the intentional application of relatively large quantities of nanomaterials on food crops, which may conflict with existing (or future) regulations, as well as with public perception and acceptance. Critical assessment of the performance of novel nano-enabled solutions, as well as their long-term ecological and social implications, are needed to achieve successful, responsible and sustainable application of nanotechnology in the agricultural sector. In this review, the possible applications of nanotechnology for crop nutrition and protection are investigated from different perspectives while also considering performance data from patents and unpublished sources, so as to accurately define the scope of what can be realistically achieved in this area. A number of directions are also identified to guide future research and establish objectives that promote the responsible development of nanotechnology in the agribusiness sector. We also offer perspective on how nanotechnology can address one of the most pressing challenges that humanity will face in the near future: Achieving global and sustainable food security.

Keyel A. C., Timm O., Backenson, P. B., Prussing, C., Quinones, S., McDonough, K. A. Vuille, K. M., Conn, J. E., **Armstrong, P. M., Andreadis, T. G.**, and Kramer, L. 2019. Seasonal temperatures and hydrological conditions improve the prediction of West Nile virus infection rates in *Culex* mosquitoes and human case counts in New York and Connecticut. PLOS One 14(6): e0217854. https://doi.org/10.1371/journal.pone.0217854

Abstract- West Nile virus (WNV; Flaviviridae: Flavivirus) is a widely distributed arthropod -borne virus that has negatively affected human health and animal populations. WNV infection rates of mosquitoes and human cases have been shown to be correlated with climate. However, previous studies have been conducted at a variety of spatial and temporal scales, and the scale-dependence of these relationships has been understudied. We tested the hypothesis that climate variables are important to understand these relationships at all spatial scales. We analyzed the influence of climate on WNV infection rate of mosquitoes and number of human cases in New York and Connecticut using Random Forests, a machine learning technique. During model development, 66 climate-related variables based on temperature, precipitation and soil moisture

were tested for predictive skill. We also included 20 – 21 non-climatic variables to account for known environmental effects (e.g., land cover and human population), surveillance related information (e.g., relative mosquito abundance), and to assess the potential explanatory power of other relevant factors (e.g., presence of wastewater treatment plants). Random forest models were used to identify the most important climate variables for explaining spatial-temporal variation in mosquito infection rates (abbreviated as MLE). The results of the cross-validation support our hypothesis that climate variables improve the predictive skill for MLE at county- and trap-scales and for human cases at the county-scale. Of the climate-related variables selected, mean minimum temperature from July – September was selected in all analyses, and soil moisture was selected for all county-scale analyses. Models demonstrated predictive skill, but still over- and under-estimated WNV MLE and numbers of human cases. Models at fine spatial scales had lower absolute errors but had greater errors relative to the mean infection rates.

Little, E.A.H., Anderson, J.F., Stafford III, K.C., Eisen, L., Eisen, R.J., **Molaei, G.*** "Predicting spatiotemporal patterns of Lyme disease incidence from passively collected surveillance data for *Borrelia burgdorferi* sensu lato-infected *Ixodes scapularis* ticks," *Ticks and Tick-borne Diseases*, https://doi.org/10.1016/j.ttbdis.2019.04.010; Published: 15 May 2019.

Abstract- Lyme disease is the most prevalent vector-borne disease in the United States. *Ixodes scapularis*, commonly referred to as the blacklegged tick, is the primary vector of Lyme disease spirochetes, *Borrelia burgdorferi* sensu lato (s.l.), in the eastern United States. Connecticut has pervasive populations of *I. scapularis* and remains a hotspot for Lyme disease. A primary aim of this study was to determine if passively collected data on human-biting *I. scapularis* ticks in Connecticut could serve as a useful proxy for Lyme disease incidence based on the cases reported by the Connecticut Department of Public Health (CDPH). Data for human-biting *I. scapularis* ticks submitted to the Tick Testing Laboratory at the Connecticut Agricultural Experiment Station (CAES-TTL), and tested for infection with *B. burgdorferi* s.l., were used to estimate the rate of submitted nymphs, nymphal infection prevalence, and the rate of submitted infected nymphs. We assessed spatiotemporal patterns in tick-based measures and Lyme disease incidence with generalized linear and spatial models. In conjunction with land cover and household income data, we used generalized linear mixed effects models to examine the association between tick-based risk estimates and Lyme disease incidence. Between 2007 and 2017, the CAES-TTL received 26,116 *I. scapularis* tick submissions and the CDPH reported 23,423 Lyme disease cases. The rate of submitted nymphs, nymphal infection prevalence, the rate of submitted infected nymphs, and Lyme disease incidence all decreased over time during this eleven-year period. The rate of submitted nymphs, the rate of submitted infected nymphs, and Lyme disease incidence were spatially correlated, but nymphal infection prevalence was not. Using a mixed modeling approach to predict Lyme disease incidence and account for spatiotemporal structuring of the data, we found the best fitting tested model included a strong, positive association with the rate of submitted infected nymphs and a negative association with the percent of developed land for each county. We show that within counties, submissions of *B. burgdorferi* s.l. infected nymphs were strongly and positively associated with inter- annual variation in reported Lyme disease cases. Tick-based passive surveillance programs may be useful in providing independent measures of entomological risk, particularly in settings where Lyme disease case re- porting practices change substantially over time.

Ma, C.; Borgatta, J.; **De La Torre Roche, R.**; **Zuverza-Mena, N.**; **White, J.C.**; Hamers, R.J.; **Elmer, W.E.** 2019. Time-dependent transcriptional response of tomato (Solanum lycopersicum L.) to Cu nanoparticle exposure upon infection with Fusarium oxysporum f. sp. Lycopersici. *ACS Sus. Chem. Eng*. 10.1021/acssuschemeng.9b01433.

Abstract- Achieving and sustaining global food security will become increasingly difficult as a changing climate increases crop loss due to greater pest and pathogen activity. Nano-enabled agrichemical delivery platforms offer a unique potential to manage pathogens and increase productivity with reduced negative environmental consequences. Two greenhouse experiments were conducted to assess the potential of in-house synthesized Cu3(PO4)2•3H2O nanosheets and commercial CuO nanoparticles (NP) to increase plant growth of tomato (Solanum lycopersicum) and suppress Fusarium oxysporum f. sp. lycopersici infection. The particles were foliarly applied once (500 mg/L; 1-2 mL dose) to seedlings prior to 30 days of growth. In control plants not treated by nanomaterials, Fusarium infection reduced plant growth by 62% across both experiments. Amendment with Cu3(PO4)2•3H2O nanosheets or CuO nanoparticles significantly reduced disease presence by

an average of 31%, resulting in greater plant biomass. The time-dependent expression of three genes integral to plant defense (pathogenesis-related genes transcriptional activator [PTI5], polyphenol oxidase [PPO], and plant resistance protein 1A1 [PRP1A1]) was shown to be uniquely modulated by nanoscale Cu amendment. Specifically, Cu3(PO4)2•3H2O nanosheets increased the expression of all 3 genes in both experiments within the first 7 days of pathogen exposure, which was prior to any phenotypic evidence of disease. CuO NP showed slower increases in the genes in the plants harvested after 21 days. Importantly, these nanoscale Cu-induced changes in expression correlated well with positive changes in disease suppression and plant growth. These results highlight the importance of adequate nutrition in crop disease response and demonstrate the potential of nanoscale platforms to more effectively deliver critical micronutrients at early stages of plant development. The transcriptomic results provide important mechanistic insight into NP Cu-based disease suppression and can be used to further optimize this important approach in nano-enabled precision agriculture.

VanAcker, M.C., Little, E.A.H, **Molaei, G.**, Bajwa, W.I., and Diuk-Wasser, M.A. Enhancement of Risk for Lyme Disease by Landscape Connectivity, New York, New York, USA, *Emerging Infectious Diseases,* https://wwwnc.cdc.gov/eid/article/25/6/18-1741_article ; Volume 25, Number 6, June 2019.

Abstract- Most tickborne disease studies in the United States are conducted in low-intensity residential development and forested areas, leaving much unknown about urban infection risks. To understand Lyme disease risk in New York, New York, USA, we conducted tick surveys in 24 parks throughout all 5 boroughs and assessed how park connectivity and landscape composition contribute to *Ixodes scapularis* tick nymphal densities and *Borrelia burgdorferi* infection. We used circuit theory models to determine how parks differentially maintain landscape connectivity for white-tailed deer, the reproductive host for *I. scapularis* ticks. We found forested parks with vegetated buffers and increased connectivity had higher nymph densities, and the degree of park connectivity strongly determined *B. burgdorferi* nymphal infection prevalence. Our study challenges the perspective that tickborne disease risk is restricted to suburban and natural settings and emphasizes the need to understand how green space design affects vector and host communities in areas of emerging urban tickborne disease.

VanAcker M, Little EAH, **Molaei G**, Bajwa W, Diuk-Wasser M. 2019. Enhancement of risk for Lyme disease by landscape connectivity, New York, New York, USA. *Emerging Infectious Diseases*. 25 (6): 1136-1143.

Abstract- Most tickborne disease studies in the United States are conducted in low-intensity residential development and forested areas, leaving much unknown about urban infection risks. To understand Lyme disease risk in New York, New York, USA, we conducted tick surveys in 24 parks through- out all 5 boroughs and assessed how park connectivity and landscape composition contribute to *Ixodes scapularis* tick nymphal densities and *Borrelia burgdorferi* infection. We used circuit theory models to determine how parks differentially maintain landscape connectivity for white-tailed deer, the reproductive host for *I. scapularis* ticks. We found forested parks with vegetated buffers and increased connectivity had higher nymph densities, and the degree of park connectivity strongly determined *B. burgdorferi* nymphal infection prevalence. Our study challenges the perspective that tickborne disease risk is restricted to suburban and natural settings and emphasizes the need to understand how green space design affects vector and host communities in areas of emerging urban tickborne disease.

Ward, J.S., and J. Wikle. 2019. Increased individual tree growth maintains stand volume growth after b-level thinning and crop-tree management in mature oak stands. Forest Science. doi: 10.1093/forsci/fxz042

Abstract- Six study areas were established in 80–125-year-old upland oak stands on average sites to compare stand and individual tree growth response following two active treatments (B-level thinning, crop tree) with an unmanaged control. Initial stocking of 104 percent was reduced to 62 percent and 60 percent on the B-level and crop-tree-management plots, respectively. Approximately 7,200 board feet per acre (International ¼) were harvested on the actively managed plots with upland oaks accounting for 81 percent of pre- and 86 percent residual stand. Eleven-year diameter and volume growth of oak sawtimber trees was greater on actively managed plots. Growth response increased with degree of release and was maintained for the length

of the study. Because of the increased individual tree growth of oaks in response to release, stand volume growth of oak sawtimber did not differ between treatments. In contrast to an 11-year decline of poletimber stocking on unmanaged plots, poletimber stocking increased on managed plots as diameter growth increased in response to partial release. This may increase difficulty of regenerating oak in the future. For those mature red oak stands where traditional regeneration prescriptions will not be implemented or will be delayed, commercial harvests can be conducted without compromising stand volume growth of oak.

Venice Juanillas, Alexis Dereeper, Nicolas Beaume, Gaetan Droc, Joshua Dizon, John Robert Mendoza, Jon Peter Perdon, Locedie Mansueto, **Lindsay Triplett**, Jillian Lang, Gabriel Zhou, Kunalan Ratharanjan, Beth Plale, Jason Haga, Jan E Leach, Manuel Ruiz, Michael Thomson, Nickolai Alexandrov, Pierre Larmande, Tobias Kretzschmar, Ramil P Mauleon. 2019. Rice Galaxy: an open resource for plant science. *GigaScience* **8**(5):giz028.

Abstract- Rice molecular genetics, breeding, genetic diversity, and allied research (such as rice-pathogen interactions) have adopted sequencing technologies and high-density genotyping platforms for genome variation analysis and gene discovery. Germplasm collections representing rice diversity, improved varieties, and elite breeding materials are accessible through rice gene banks for use in research and breeding, with many having genome sequences and high-density genotype data available. Combining phenotypic and genotypic information on these accessions enables genome-wide association analysis, which is driving quantitative trait loci discovery and molecular marker development. Comparative sequence analyses across quantitative trait loci regions facilitate the discovery of novel alleles. Analyses involving DNA sequences and large genotyping matrices for thousands of samples, however, pose a challenge to non–computer savvy rice researchers. The Rice Galaxy resource has shared datasets that include high-density genotypes from the 3,000 Rice Genomes project and sequences with corresponding annotations from 9 published rice genomes. The Rice Galaxy web server and deployment installer includes tools for designing single-nucleotide polymorphism assays, analyzing genome-wide association studies, population diversity, rice–bacterial pathogen diagnostics, and a suite of published genomic prediction methods. A prototype Rice Galaxy compliant to Open Access, Open Data, and Findable, Accessible, Interoperable, and Reproducible principles is also presented. Rice Galaxy is a freely available resource that empowers the plant research community to perform state-of-the-art analyses and utilize publicly available big datasets for both fundamental and applied science.

Zheng, Xiangrong, Pinyi Yin, Ming Chen, **De-Wei Li**, Ting-ting Dai. 2019. First report of stem canker caused by *Botryosphaeria dothidea* on *Aucuba japonica* in China. Plant Disease 103(5): 1020. https://doi.org/10.1094/PDIS-06-18-1081-PDN

Abstract - *Aucuba japonica* 'Variegata' is an important evergreen shrub for public landscapes and private gardens in the middle and lower reaches of the Yangtze River in China. In the summer of 2017, severe stem canker was observed on approximately 25% of *A. japonica* 'Variegata' plants in many surveyed parks and garden such as Xuanwu Lake Park and Lovers Garden in Nanjing, Jiangsu Province, China. Initial symptoms included elliptical lesions on the bark at points of infection. Lesions eventually enlarged and coalesced to form elongated, brown to black, sunken cankers. Tissues at the margin of cankers from 30 plants were cut into 50 × 50-mm square pieces, surface disinfected in 75% ethanol for 30 s, washed three times with sterile distilled water (ddH_2O), and plated onto potato dextrose agar (PDA). After 7 days, a total of eight isolates with identical morphological features were recovered. A representative isolate SJ1 was used for morphological and molecular characterization. Pycnidia were produced by incubating PDA cultures of SJ1 at room temperature (approximately 25°C) under near-ultraviolet light for 45 days. Hyaline, thin-walled, aseptate, fusiform conidia (n = 80) were 19.42 to 24.67 µm (average 22.05 ± 2.62 µm) in length and 5.74 to 7.60 µm (average 6.67 ± 0.93 µm) in width. The morphological features were consistent with those of *Botryosphaeria* spp. (Slippers et al. 2004). The internal transcribed spacer (ITS) region and ß-tubulin (*ß-tub*) gene of the representative isolate were amplified with primer pairs ITS1/ITS4 (White et al. 1990) and ßt2a/ßt2b (Glass and Donaldson 1995), respectively. The ITS sequence of isolate SJ1 (GenBank accession no. MH393518) was 99% identical to that of *B. dothidea* epitype CBS 115476 (KF766151). The *ß-tub* sequence of isolate SJ1 (MH483927) was 100% identical to that of *B. dothidea* isolate SCDY7-1 (KP183129). Based on its morphological and molecular features, the fungus represented by isolate SJ1 was identified as *B. dothidea*. The representa-

tive isolate was tested for pathogenicity on *A. japonica* 'Variegata'. Ten replicates of detached stems (11 to 13 cm) of 1-year-old plants were surface disinfested with 75% ethanol for 30 s, rinsed with ddH_2O three times, and wounded by cutting into the bark using a sterile scalpel. A mycelial plug (5-mm diameter) from the margin of a 7-day-old SJ1 PDA culture was placed on the wound of each stem and covered with a sterile, wet cotton ball. A sterile PDA plug was used instead of mycelial plugs on a stem as the negative control. This pathogenicity test was repeated three times. All inoculated and control stems were placed in a growth chamber set at 27°C with 90% relative humidity and a 12-h/12-h light/dark cycle. The symptoms described above were observed on all inoculated stems within 2 weeks, whereas the control stems remained asymptomatic. The causal pathogen with identical morphological features to those of the representative isolate was recovered from all inoculated stems. To our knowledge, this is the first report of stem canker caused by *B. dothidea* on *A. japonica* in China. Considering the popularity of *A. japonica* in landscaping and gardening in Jiangsu Province, China, this study is important to lay the foundation for rapid detection of this disease and to facilitate the development of management measures. This disease has already reoccurred at the same locations in the summer of 2018.

Zhu, Li-Hua, Wu Xu, Ji-Yun Yang, **De-Wei Li***, Jian-Ming Ge, Jian-Ren Ye. 2018 [2019]. First report of *Septotinia populiperda* causing leaf blotch of *Salix babylonica* in China. Plant Disease 103(4): 768-769. https://doi.org/10.1094/PDIS-05-18-0827-PDN

Abstract - *Salix babylonica* L. is an important landscape tree in China. In November 2016, *S. babylonica* with leaf blotch was collected from Shanghai, China. Symptoms began as small tan to brown lesions near the tip of leaves and later expanded proximally and stopped at the middle part of the leaves. The lesions enlarged rapidly and further developed into dry lesions with sporodochia. Symptomatic leaf tissues (3 to 4 mm^2) were surface sterilized in 75% ethanol for 30 s and then 1% NaOCl for 90 s, rinsed with sterile distilled H_2O, and placed on potato dextrose agar and incubated at 25°C for 7 days. Pure cultures were obtained by monosporic isolation. Three isolates were obtained and deposited at CCTCC (LS01, AF2018006; LS1-5-4, AF2018007; and LS03, AF2018008). The isolates developed white-gray, scalloped margin, zonate colonies with radiating mycelia. The advancing edge of the colony soon showed a fanlike growth of mycelia. The morphological characters differed greatly among the strains. LS01 and LS03 formed abundant black sclerotia in approximately 10 days but no sporulation. LS1-5-4 sporulated after 10 to 14 days, but sclerotia were rare. The fungus was asexual, dimorphic, amphigenous. Sporodochia are salmon in color, 98 to 388 µm in diameter; conidiophores densely compact, hyaline. Conidiogenous cells were holoblastic, cylindrical, attenuated toward the apex, 9.3 ± 1.1 × 3.9 ± 0.5 µm. Conidia (CA) are hyaline, smooth, zero to three septate, with truncate apex and base. Most CA on leaves were 1 to 2 celled, oblong or artillery shell shaped; some were 3 to 4 celled, oblong and straight or slightly curved. One-celled CA are 13.6 ± 1.8 × 6.5 ± 0.8 µm; 2-celled CA are 19.3 ± 2.9 × 6.5 ± 0.6 µm; 3- to 4-celled CA are 28.8 ± 3.2 × 6.8 ± 0.8 µm. Synanamorph: CA are 1-celled, global, hyaline, smooth, 2.9 ± 0.3 µm, developed on phialides, which are 6.8 ± 1 × 2.7 ± 0.4 µm. Its morphology fit *Septotinia populiperda* (Sutton 1980; Waterman and Cash 1950). The internal transcribed spacer (ITS) region and large subunit (LSU) gene were amplified with primers ITS1/ITS4 (White et al. 1990) and LR0R/LR05 (Schoch et al. 2009). Both ITS and LSU sequences were 100% identical to the ones of the two cultures of *S. populiperda* bought from CBS (Utrecht, the Netherlands) (CBS 339.53 and CBS 374.64) by multiple sequence alignment with BioEditor (Yang et al. 2003). The sequences of CBS 318.37, CBS 339.53, CBS 374.64, LS01, LS03, and LS1-5-4 were submitted to GenBank (ITS, MH101502 to MH101504, MG786831, MG786832, and MG572458, respectively; LSU, MH101505 to MH101507, MG786833, MG786834, and MG572459, respectively). Based on the morphological and molecular data, all the isolates were identified as *S. populiperda* Waterman & E.K. Cash ex B. Sutton. To complete Koch's postulates, 20 detached and 20 intact healthy 12-week-old leaves from 2-year-old potted *S. babylonica* were inoculated with 10 µl of CA suspension (10^5 CA/ml) by a point inoculation on upper leaf surface and plugs of mycelia of LS1-5-4, and control leaves were treated with sterilized H_2O and agar plugs. All detached inoculated leaves were placed in plates on wet filter paper at 25°C. The seedlings were placed in a greenhouse at 25°C and 16-h photoperiod. The experiment was repeated three times. All detached and 70% intact leaves inoculated developed symptoms and sporodochia in 3 to 5 days. The symptoms of developing leaf necrosis were the same as those in the field, whereas the controls were symptomless. The same fungus was reisolated. This is the first report of *S. populiperda* on *S. babylonica* in China and in the world and a severe disease in Shanghai.

Zhu, Li-Hua, Yu Wan, Ya-Nan Zhu, Cheng-Long Liu, and **De-Wei Li***. 2019. First report of species of

Colletotrichum causing leaf blotch of *Liriodendron chinense* × *tulipifera* in China. Plant Disease 103 (6): 1431. https://doi.org/10.1094/PDIS-12-18-2265-PDN

Abstract - Hybrid tulip tree (*Liriodendron chinense* [Hemsl.] Sarg. × *tulipifera* L.) is an important landscaping tree widely planted in China. Leaf spot symptoms on hybrid tulip trees were observed on the campus of Nanjing Forestry University (NJFU), China, from May to November 2017. The spots were initially 1 to 2 mm diameter with yellow edges, and then they enlarged and turned brown or black. The lesions coalesced and became elongated or irregularly shaped, and rarely acervuli and pink conidial masses developed. Later, the lesions became necrotic and shriveled. Small pieces (3 to 4 mm^2) from the margin of an infected lesion were surface sterilized in 75% ethanol for 30 s followed by 1% NaOCl for 90 s and were placed on potato dextrose agar (PDA) and incubated at 25°C. Pure cultures were obtained by monosporic isolation, and two isolates (G2 and R3) were obtained and deposited in China's Forestry Culture Collection Center (G2, cfcc53053; R3, cfcc53054). When isolate G2 was cultured on PDA, the colony was grayish-white and was pale orange toward the center on the reverse side. The conidia were one-celled, straight, hyaline, subcylindrical with rounded ends, and 15.3 ± 1.1 × 6.3 ± 0.3 µm in size. Appressoria were one-celled, pale brown, thick-walled, ellipsoidal, and measured 8.4 ± 1.1 × 6.4 ± 0.7 µm. When isolate R3 was cultured on PDA, the colony was white and then turned gray and light gray on the reverse side, producing dark-green pigmentation near the center. The conidia and appressoria were almost identical with G2, with sizes of 15.0 ± 0.9 × 4.8 ± 0.1 µm and 7.7 ± 1.1 × 6.5 ± 0.6 µm, respectively. The characteristics of the conidia and other structures of G2 and R3 matched the morphological characteristics of the *Colletotrichum gloeosporioides* complex (Weir et al. 2012). For accurate identification, the internal transcribed spacer (ITS) and the genes encoding glyceraldehyde-3-phosphate dehydrogenase (GAPDH), chitin synthase (CHS), and actin (ACT) were respectively amplified with primers ITS1/ITS4, GDF/GDR, CHS-79F/CHS-345R, and ACT-512F/ACT-783R. The sequences were deposited in GenBank (accession nos. MK268673 to MK268676 for G2, MK268677 to MK268680 for R3). A BLAST search of GenBank showed that ITS, ACT, CHS, and GAPDH sequences of G2 were identical to *C. gloeosporioides* at a high level (>99%). For R3, the ITS was 100% identical to *C. gloeosporioides* CBS 125969 or *C. siamense* ICK-3, and the GAPDH and ACT were 99% identical to *C. siamense* ICK-23 and COUFAL0199, respectively, whereas the CHS was 98% identical to *C. fructicola* ICKA 15. Phylogenetic analysis using neighbor joining and concatenated sequences (ITS, GAPDH, CHS, and ACT) with MEGA 7 placed G2 in the clade of *C. gloeosporioides* sensu stricto (s.s.) with ex-type ICMP 17821 and R3 in the clade of *C. siamense* with ex-type ICMP 18578. Based on these morphological and phylogenetic studies, G2 and R3 were *C. gloeosporioides* s.s. and *C. siamense*, respectively. Pathogenicity of the two species was verified on detached and attached leaves inoculated with 10 µl of conidial suspension (10^6 conidia/ml) and 5-mm plugs cut from the edge of 5-day-old colonies, each with five replicates. Controls were treated with sterile dH_2O and agar plugs. All detached leaves were placed in 20-cm dishes on wet filter paper at 25°C. Each attached leaf and a wet cotton ball were covered with a plastic bag on the trees for 24 h. Spots appeared in 2 days and reached 2 cm diameter in 5 to 8 days. The symptoms were the same as those in the field, but with no yellow edges. Recovery rates of G2 and R3 were 90 and 80%, respectively. No lesions were observed on control plants. *C. gloeosporioides* and *C. acutatum* were previously reported infecting *L. tulipifera* (Choi et al. 2012; Lori et al. 2004), but this is the first report of *C. gloeosporioides* s.s. causing tulip tree leaf spot in China and the first report of tulip tree as a host of *C. siamense*. All tulip trees at NJFU showed infection, and the level of disease was severe throughout Nanjing. Determination of the pathogens, *C. gloeosporioides* s.s. and *C. siamense*, laid the groundwork for future studies of this disease.

JOURNAL ARTICLES APPROVED MAY 2019

Aulakh, Jatinder S. Weed and Sucker Management in Hops. *CAES Fact Sheet*

Bravo, Joan L. Vineyard Establishment for the Connecticut Homeowner. *CAES Bulletin*

Cao, X., F. Xiao, P. Duan, **Joseph J. Pignatello**, J. Mao, and K. Schmidt-Rohr. Effects of Post-Pyrolysis Air Oxidation on the Chemical Composition of Biomass Chars Investigated by Solid-State Nuclear Magnetic Resonance Spectroscopy. *Carbon*

Cheah, C. 2019. Climate Impacts on Eastern Hemlock. In: The Habitat 31(1):6-7, 13-14.
(a newsletter for the Connecticut Association of Conservation and Inland Wetlands Commissions,

Inc.)

Dimkpa, C. O., U. Singh, P. S. Bindraban, **Wade H. Elmer**, J. L. Gardea-Torresdey, and **Jason C. White**. Zinc Oxide Nanoparticles Alleviate Drought-Induced Alterations in Sorghum Performance and Nutrient Acquisition in Soil. *Agronomy for Sustainable Development*

Elmer, Wade H., **Roberto De La Torre-Roche**, **Nubia Zuverza-Mena**, C. Dimkpa, J. Gardea-Torresdey, and **Jason C. White**. Influence of Foliar Application of Nanoparticle Suspensions of CuO, MnO, and/or ZnO on Eggplant Growth, Yield, and Verticillium Wilt Severity. *Plant Disease*

Little, Eliza and **Goudarz Molaei**. Passive Tick Surveillance: Exploring Spatiotemporal Associations of *Borrelia burgdorferi* (Spirochaetales: Spirochaetaceae), *Babesia microti* (Piroplasmida: Babesiidae), and *Anaplasma phagocytophilum* (Rickettsiales: Anaplasmataceae) Infection in *Ixodes scapularis* (Acari: Ixodidae). *Vector-Borne and Zoonotic Diseases*

Majumdar, S., L. Pagano, J. A. Wohlschlegel, M. Villani, W. Li, O. Parkash Dhankher, A. Zappettini, N. Marmiroli, **Jason C. White**, and A. Keller. Proteomic, Gene and Metabolite Characterization Reveal Uptake and Toxicity Mechanism of Cadmium Sulfide Quantum Dots in Soybean Plants. *New Phytologist*

Stafford, Kirby C. III, **Scott C. Williams**, J. van Oosterwijk, **Megan A. Linske**, S. Zatechka, L. M. Richer, **Goudarz Molaei**, C. Przybyszewski, and S. K. Wikel. Field Evaluation of a Novel Oral Reservoir-Targeted Vaccine Against *Borrelia burgdorferi* Utilizing an Inactivated Whole-Cell Bacterial Antigen Expression Vehicle. *PLOS ONE*

Williams, Scott C., Michael A. Gregonis, and **Megan A. Linske**. How Could Oak Trees Possibly Drive Bird of Prey Populations? *Connecticut Wildlife*

ARTICLES OF INTEREST MAY 2019

2019 Connecticut State AgriScience Fair

On Thursday, May 2, 2019, The Connecticut State AgriScience Fair was held at The Connecticut Agricultural Experiment Station. This annual event is sponsored by the 20 regional high schools that offer Agricultural Science and Technology Education (ASTE) Programs in Connecticut. The event this year drew 46 exhibits prepared by 60 students. Students may work either as a team or design their own project. The projects can cover many topics, including: animal science, environmental services/ natural resource systems, food products and processing systems, plant systems, social systems, and power, structural and technology systems. The winning projects in each category are eligible to participate in the Northeast Regional AgriScience Fair, held at The Eastern States Exposition in September and the National FFA AgriScience Fair held in Indianapolis, IN, October 30-November 2, 2019.

Tours of the Experiment Station were offered to the participants, advisors and chaperones attending the AgriScience Fair. Dr. Gale Ridge, Ms. Summer Stebbins, and Mr. John Shepard offered presentations about ongoing research programs to the group. The participating ASTE high schools included: Bloomfield, Bridgeport, Middletown, Northwestern, Southington, Rockville, and Wamogo. The event was organized by Harold Mackin of the Connecticut State Department of Education, and Mr. Joseph P. Barsky of The Connecticut Agricultural Experiment Station.

The agricultural science and technology education program serves secondary students in full and shared time programs. Each program, located at a comprehensive high school, includes instruction in agricultural science and technology education. The purpose is to prepare individuals for entry-level employment or higher education and to develop leadership skills in the field of agriculture. Programs include instruction in plant and animal science, agricultural mechanics, food science, biotechnology, aquaculture, agribusiness, natural resources and the environment. The agricultural science and technology education program includes interrelated components such as classroom instruction, laboratory experience, leadership training and supervised agricultural work experience.

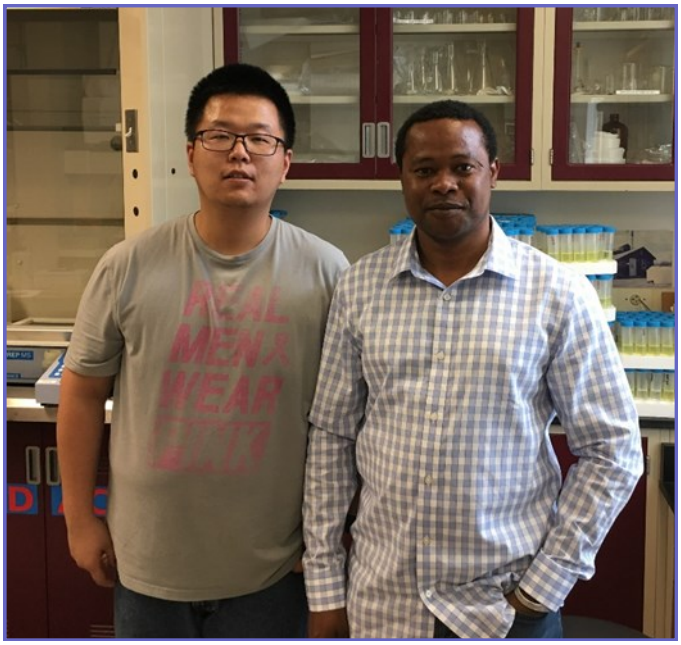
Mr. John Shepard describing and demonstrating the mosquito trapping equipment

Ms. Summer Stebbins gave an overview of the aquatic invasive plant program

Dr. Gale Ridge offered an tour of the Insect Inquiry Office

NEW STAFF, STUDENTS, AND VOLUNTEERS MAY 2019

Dr. Yu Shen (left) has joined the Department of Analytical Chemistry as a post-doctoral associate working on nano-enabled agricultural projects as part of the NSF CCI Center for Sustainable Nano-technology. **Dr. Ishaq Adisa** (right) has joined the Department of Analytical Chemistry as a post-doctoral associate working on FDA and CT food safety projects.



Ten seasonal research assistants have joined the Department of Entomology to assist with insect pest surveys and various research projects on pollinators, ticks, and forest insects under Dr. Victoria Smith and State Survey Coordinator Ms. Katherine Dugas, Dr. Kimberly Stoner, Dr. Kirby Stafford, and Dr. Claire Rutledge. Mr. Benjamin Gluck and Mr. James Durrell have worked for Dr. Stoner in previous summers.

MS. HEATHER HUMINSKI graduated this May with a degree in Ecology and Evolutionary Biology with an emphasis on plant evolution from Brown University. She loves insect-mediated pollination syndromes and general plant-insect interactions and wants to gain more specific knowledge of plant-pollinator interactions. She is working with **Dr. Kimberly Stoner** on her pollinator protection grant.

MR. JEREMY DAY is a 2017 graduate of the University of Massachusetts in Amherst. He has worked with bumblebees and has worked previously on a pollinator survey with Dr. David Wagner at the University of Connecticut. He is working with **Dr. Kimberly Stoner** on bee exposure to neonicotinoids project.

MR. JAMES DURRELL is a part-time lecturer and adjunct faculty at the University of Bridgeport where he teaches a course on the diversity of native bees among other courses. He is working with **Dr. Kimberly Stoner** on her pollinator habitat project. He is interested in continuing to learn more about pollinators and the many factors which effect pollinator composition and habitat.

MR. BENJAMIN GLUCK recently defended his master's thesis in Entomology at the University of Connecticut, studying plant species that could be useful to attract pollinators and other beneficial insects on farms, and also studying how well some of the plants continued to attract beneficial insects under drought conditions. He has a bachelor's degree from UConn and has previously worked for The Connecticut Agricultural Experiment Station during the field seasons in 2012 and 2014 – 2016. He is working with **Dr. Kimberly Stoner** on her pollinator protection grant.

MS. ANAIS (ANNIE) BOLDUC is currently majoring in environmental engineering at Three Rivers Community College. She has worked as a barn manager and is a reserve champion for the Mystic Valley Hunt Club Equestrian Event and a cross country equestrian. She is working with **Dr. Kimberly Stoner** on her pollinator protection grant.

MS. BAILEY WILLETT is a junior at Cornell University double majoring in Microbiology and Entomology minoring in Infectious Disease Biology. She has extensive experience working with ticks on Long Island with Suffolk County Vector Control and with mosquitoes and immunology in laboratories at Cornell. She is working with **Dr. Kirby Stafford** and technician **Ms. Heidi Stuber** on the tick IPM project in Guilford, CT.

MS. MEAGEN DENICOLO is majoring in Natural Resources at the University of Connecticut. She has interned with the Connecticut DEEP's wildlife division in North Franklin, Connecticut helping with the New England Cottontail project and spent a summer on the African Field Ecology course in Limpopo, South Africa.

MS. ASHLEY MARTONE is a graduate of Gateway Community College and student at the University of Maine working on a Bachelor of Science degree in Forestry. She received the Oscar P. Stone arborist scholarship from the Connecticut Tree Protective Association. Her long term goal is a career in conservation, particularly in New England.

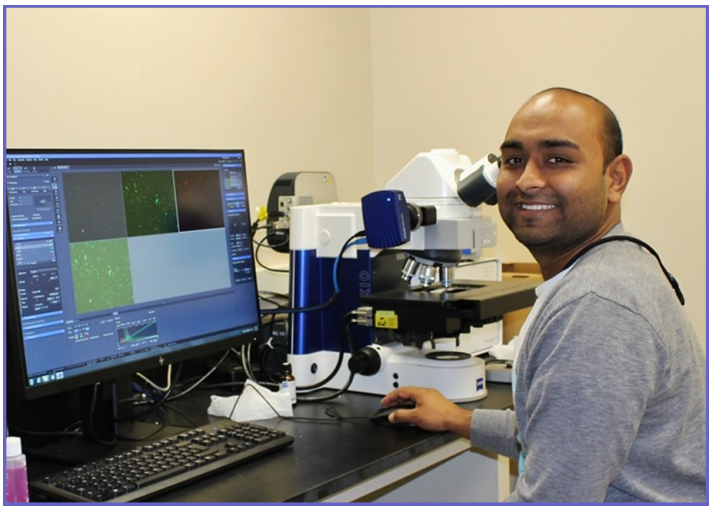
MS. SARA CARSON graduated this May with a Bachelor of Science, Natural Resources with a concentration in Environmental Sustainability and Conservation from the University of Connecticut. She did a South Africa field ecology course and was a member of the UConn Wildlife Society. She is working with Katherine Dugas on the Cooperative Agricultural Pest Survey.

MR. JACOB GROSS worked as an intern at the Massaro Community Farm in Woodbridge, CT. During this time, he learned about basic agricultural techniques and the experience sparked his interest in the relationship between insects and the environment. He is currently a student at Tufts University. He is working with Katherine Dugas on the Cooperative Agricultural Pest Survey.

MS. Jamie Cantoni previously began work at CAES in summer 2014 as a mosquito trapper for the Center for Vector Biology and Zoonotic Diseases. She then transferred to Forestry and Horticulture to quantify forest habitats and growth through spring 2016. She left to pursue her passion for marine science, working for several zoos and aquariums in both Connecticut and Australia. Eventually, Jamie realized how much she missed The Station, and rejoined the Department of Forestry and Horticulture in the summer of 2018 to sample ticks across the state. Jamie is a volunteer Rescue Responder and in-house rescue clinic volunteer for Mystic Aquarium's Animal Rescue Program. She hopes to progress further in the field of animal rescue and rehabilitation.

MS. Sarah Hemstock has been a seasonal since 2017 working with **Dr. Kirby Stafford** and **Dr. Scott Williams** on the USA-ARS supported tick management study. This summer she is working in the Department of Forestry and Horticulture as part of the Active Tick Surveillance study. Sarah is a student at the University of Massachusetts-Amherst studying Veterinary Technology.

MS. Sarah Sullivan is a seasonal in the Department of Forestry and Horticulture working on studies of forest regeneration and the impact of gypsy moth infestation on tree growth and mortality. In 2007, she completed her Capstone project at North Branford High School working as a student volunteer assisting with our Old-Series study of forest dynamics. She is a student at SUNY – Environmental Science and Forestry studying forest resource management.



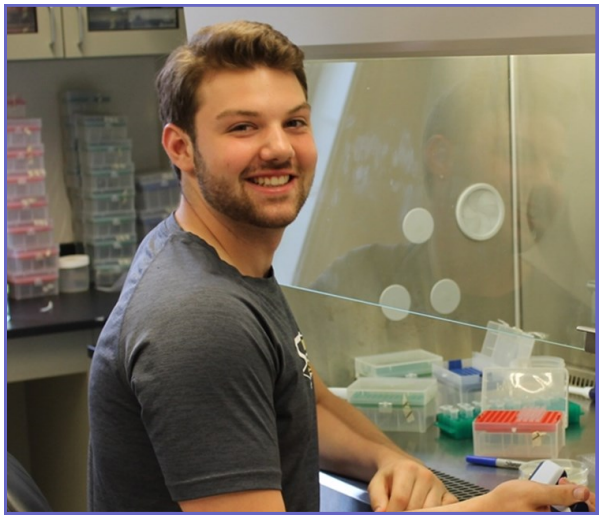
DR. RAVI PATEL is back at CAES after being away three years, working in **Dr. Lindsay Triplett**'s Laboratory to characterize the physiology of stress tolerance in the plant pathogen *Pseudomonas syringae*. He is also an excellent cook and avid fan of tennis.

MR. RAYMOND STEVE GERARD ANDRIATAHINJANAHARY, first began working with the Station as summer staff at Lockwood Farm in 2016. He now works at the Plant Disease Information Office under **Yonghao Li Ph.D.** as a Seasonal Research assistant and Seeds Analyst since December 2017. Steve has an undergraduate degree in Ecology from Madagascar and will begin his Master's in Environmental Science at the University of New Haven this fall. In his free time he enjoys playing guitar or practicing his Krav Maga skills.

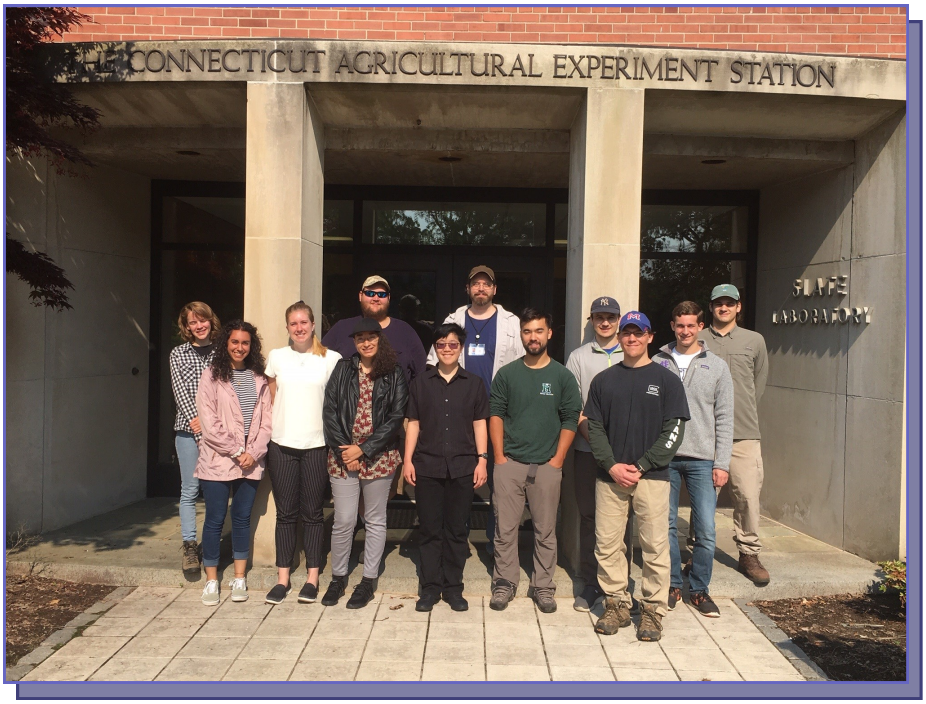
MS. ALEXANDRA FARAH (**ALEX**) is working with **Dr. Robert Marra** as a seasonal employee this summer to help with oak wilt diagnostics, as well as other projects in the lab, in particular the population genetics of *Fusarium palustre*, the fungal pathogen of saltmarsh cordgrass associated with Sudden Vegetation Dieback. Alex will be entering her senior year at the University of New Haven in the Forensic Sciences program.

MS. BRITNEY CASO, a senior Forensic Biology and Biochemistry double major at the University of New Haven joined the laboratory of Dr. Yonghao Li in Plant Pathology and Ecology on May 24th 2019 as a Seasonal Resource Assistant. She previously worked at the station earlier this year as an Intern within the departments of Analytical Chemistry and of Plant Pathology and Ecology. She is a car, music, and dance enthusiast; and loves to talk about all three. She recently was elected treasurer of her University's car club, the Import and Domestic's club, which was created in honor of Connor Bradshaw.

MR. ROBERT TORRENS (**ARTHUR**) is doing a research-experience internship with **Dr. Robert Marra,** and will be assisting on various projects in the laboratory, including population genetics of *F. palustre*, and the mating system of the perennial canker pathogen, *Neonectria ditissima*. Arthur will be entering his senior year at the University of New Haven in the Forensic Sciences program.



MR. EVAN WARNER is a summer intern in the **Dr. Lindsay Triplett**'s Laboratory, where he will be helping finish a project on stress survival in mutants of *Erwinia amylovora*. He recently finished his freshman year at UMass Amherst, where he majors in biochemistry. In his spare time he pitches in a summer baseball league and plays intercollegiate competitive ping pong.



2019 Seasonal Mosquito Research Staff

CAES

The Connecticut Agricultural Experiment Station

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