Station News

The Connecticut Agricultural Experiment Station
Volume 10 Issue 3 March 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 attended a special meeting of the Experiment Station's Board of Control to address the process for appointment of the next Director (February 4); presented an invited remote talk via Zoom entitled "*Reflections on the Ecology and Epidemiology of Eastern Equine Encephalitis in the Northeastern United States*" to attendees of the 34th Annual Conference of the Michigan Mosquito Control Association (200 attendees) (February 5); and presented a seminar entitled "*Reflections on the Ecology and Epidemiology of Eastern Equine Encephalitis in the Northeastern United States*" to students and faculty of the Department of Pathobiology at UCONN (30 attendees) (February 6).

ANALYTICAL CHEMISTRY

DR. JASON C. WHITE attended the monthly CT Laboratory Preparedness meeting at the DPH Laboratory in Rocky Hill (February 3); hosted a ZOOM call with Dr. Hongda Chen of USDA NIFA and Prof. Phil Demokritou of the Harvard University School of Public Health regarding an upcoming grant submission (February 4); participated in a ZOOM All Faculty call for the Center for Sustainable Nanotechnology (February 6, 7, 13); participated in a ZOOM call with **DR. WADE ELMER** and collaborators at Johns Hopkins University to discuss a collaborative grant proposal (February 7); participated in a ZOOM meeting with collaborators at the Harvard University School of Public Health and Nanyang Technological University (NTU) to discuss progress on our collaborative grant (February 10); along with **MS. TERRI ARSENAULT** and **MS. KITTY PRAPAYOTIN-RIVEROS** attended the FDA Manufactured Foods Regulatory Program Alliance meeting in Spokane, WA (February 11-14); attended the practice session for the Reverse Site Visit for the Center for Sustainable Nanotechnology at NSF (February 18-20); participated in a ZOOM meeting with Prof. Phil Demokritou of the Harvard University School of Public Health and Dr. Christian Dimkpa of the IFDC to discuss nano-enabled fertilizer use (February 21); and participated in the weekly CSN All Center ZOOM call (February 26).

DR. CHRISTINA ROBB attended a long-term program planning and board meeting for the Eastern Analytical Symposium (EAS) for which she is the 2020 short course committee chair (February 6-7); and participated in the FDA FERN monthly FDA FERN CCAP call (February 20).

DR. WALTER KROL and MS. TERRI ARSENAULT presented a talk entitled "Findings from 2019 hemp field trial in Connecticut" at The Connecticut 2020 Hemp Conference and Trade Show held at Maneeley's Conference Center in South Windsor (200 attendees) (February 26).

DR. BRIAN EITZER was a participant in the conference call of the North American Chemical Residue Workshop's organizing committee (February 13); and presented results of research at the Principal Investigator and Stakeholder meeting of the "Protecting Pollinators with Economically Feasible & Environmentally Sound Ornamental Horticulture" Specialty Crops Initiative Grant in San Diego, CA (30 attendees) (February 25).

ENTOMOLOGY

DR. KIRBY C. STAFFORD III presented a CAES Seminar entitled "Maggots and murder: An introduction to forensic science" in Jones auditorium (approx. 60 attendees) (February 5); was interviewed about the effects of the mild winter on tick activity by Robert Miller of the Danbury News-Times (February 5); spoke on invasive ticks and tick-borne diseases at the Yale Forestry Forum in New Haven (20 attendees) (February 6); was interviewed about the rodent Lyme disease vaccine bait and general tick control by Mike Wollschlager, CT Magazine (February 18); was interviewed about the active tick surveillance program by Ed Stannard, New Haven Register (February 20); and presented a poster and participated in the conference "Vector Week" sponsored by the Centers for Disease Control and Prevention in Fort Collins, CO (February 25-28).

MS. JAMIE CANTONI staffed the CAES booth at the Connecticut Tree Protective Association meeting at The Aqua Turf Club in Plantsville (January 16); and staffed the CAES table at the STEMagination event, sponsored by the Girl Scouts of Connecticut, and held at Naugatuck Valley Community College in Waterbury (February 21).

MR. MARK H. CREIGHTON spoke about honey bee health at the Bee School hosted by the CT Beekeepers Association in Falls Village, and provided Varroa Mite Test Kits to all the attendees, which were funded by the Specialty Crop Block Grant Program of the Agricultural Marketing Service of the US Department of Agriculture, and administered by the CT Department of Agriculture (119 attendees) (February 8); spoke at the CT Beekeepers Association Bee Talks in Middletown about honey bee health and provided Varroa Mite Test Kits as above (90 attendees) (February 13); spoke about the importance of screening for Varroa mites at the winter meeting of the CT Beekeepers Association held in Jones Auditorium and provided Varroa Mite Test Kits (110 attendees) (February 15); and presented "An introduction to beekeeping" at the Northern CT Agricultural Summit held at Asnuntuck Community College in Enfield (30 attendees) (February 29).

MS. KATHERINE DUGAS staffed the CAES table at the STEMagination event sponsored by the Girl Scouts of Connecticut, and held at Naugatuck Valley Community College in Waterbury (February 21); and staffed a booth at the 39th annual CT Flower and Garden Show at the Hartford Convention Center (February 22).

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); was interviewed on the effects of the warm winter weather on insects in Connecticut by Channel 3 (February 3); presented a talk about bed bugs at the Manchester town board meeting as they dealt with a long-term bed bug infestation in a town apartment building (February 4); was interviewed about the effects of the warm winter on insects and ticks by Robert Miller from the Danbury News-Times (February 11); was interviewed about a warmer winter and its effects on insects by Kaitlyn McGrath from NBC Connecticut (February 18); was broadcast on Channel 3 TV about insects and the warm winter weather (February 19); was interviewed about bed bugs in ride shares by Channel 3 TV (February 25); and was interviewed about the warm winter and insects by WICC Radio (February 26).

Dr. Ridge received confirmation from the National Systematics Entomology Laboratory in Washington on January 23 of the identification of Allium leafminer *Phytomyza gymnostoma* Loew. The flies were found on a farm in Bridgewater, CT. This is a first state record.

DR. CLAIRE E. RUTLEDGE presented "Biological control of emerald ash borer in Connecticut" at the Yale Forest Forum, New Haven (40 attendees) (February 13); presented "Biological control of emerald ash borer in Connecticut" at Western Connecticut State University's Biological Sciences seminar in Danbury (45 attendees) (February 20); and presented "The emerald ash borer in New London" at the New London Public Library in New London (18 attendees) (February 25).

DR. VICTORIA L. SMITH participated in a meeting of the Yale Biosafety Committee in

New Haven (20 participants) (February 20); and consulted with Prides Corner Farms, a 600-acre nursery in Lebanon, on regulations for selling nursery stock on the Internet, including Amazon.com (February 21).

DR. KIMBERLY A. STONER presented "Planting for the bees' needs" at the Leetes Island Garden Club in Guilford (25 attendees) (February 11); presented current research on pollen trapped at ornamental plant nurseries via webinar as part of a meeting of the Specialty Crops Research Initiative annual meeting in San Diego, CA (24 attendees) (February 25); spoke on "Pollinators and planting for the bees' needs" at the Northern CT Agricultural Summit held at Asnuntuck Community College in Enfield (30 attendees) (February 29).

MS. TRACY ZARRILLO traveled to the Patuxent Wildlife Research Center in Laurel, MD to meet with Sam Droege at his Native Bee and Monitoring Laboratory. While there, she studied expertly identified bee species that are not in the CAES reference collection to further her understanding of the New England wild bee fauna. She also had difficult species determinations confirmed by Sam Droege, including two female *Andrena rehni* (an uncommon specialist of chestnut pollen) that were collected in 2019 in our very own CAES chestnut plantation at Lockwood Farm (February 11-14).

ENVIRONMENTAL SCIENCES

DR. JOSEPH PIGNATELLO participated in multiple conference calls with colleagues at the University of Maryland and GeoSyntec on a research topic for a grant application (February 7, 12, 21).

DR. PHILIP ARMSTRONG gave a talk entitled "EEE outbreak in Connecticut: Risk assessment and response to a rapidly evolving crisis" at the Vector Week Conference held in Ft. Collins, CO (150 attendees) (February 27).

MR. GREGORY BUGBEE was interviewed about hydrilla in the Connecticut River and the threat to nearby lakes by the Connecticut Examiner (February 11).

DR. JOSEPHINE HYDE presented a poster entitled "Investigating the potential for host selection in the establishment of the microbiota among multiple axenic mosquito species" at the American Society for Microbiology (ASM) DC Branch Spring Meeting and attended Early Career Meeting (50-100 attendees) (February 21-22); and was awarded the ASM Peggy Cotter Travel Award worth $1,650 for Early Career Branch Members (DC Branch) to attend the ASM national meeting in June.

DR. JR McMILLAN presented on the CAES's research as a part of UCONN Student One Health research symposium, Storrs (approx. 50 attendees, approx. 35 students) (February 8).

DR. SARA NASON gave a seminar entitled "Plant uptake of organic contaminants: Mechanisms and impacts" to the Plant Science and Landscape Architecture Department and Environmental Engineering Department at the University Connecticut, Storrs, and met with faculty and students (approx. 40 attendees including approx. 30 students) (February 7); met with Profs. Krystal Pollitt and Vasilis Vasiliou at the Yale School of Public Health (February 4 and 14, respectively); and coached science fair students at the Sound School in New Haven (February 6, 13, and 27).

MR. JOHN SHEPARD gave an invited seminar entitled "Connecticut mosquitoes and the viruses they may transmit" at a meeting of the Potapaug Audubon Society in Old Lyme (25 attendees) (February 6); and attended an Executive Board meeting of the Northeastern Mosquito Control Association held at the Hilton Mystic (February 28).

MS. SUMMER STEBBINS attended a conference call on Hydrilla in the Connecticut River (February 21); and participated in a conference call on Connecticut's Boat Launch Steward program (February 25).

FORESTRY AND HORTICULTURE

DR. JEFFREY S. WARD participated in an NESAF 2020 planning committee conference call (February 4); was interviewed about barberry characteristics and control by Will Rowlands, Connecticut Gardener (February 4); participated in the initial Technical Advisory Committee meeting for New England Forestry Foundation's North Central & Transition Hardwoods Exemplary Forestry standards in Littleton, MA (February 6); spoke on "Spring planting and tree selection" for the Cherry Hill Garden Club in Canton (41 attendees) (February 11); co-hosted an Oak Resiliency in Southern New England workshop in Tolland (82 attendees) (February 13); as Chair, presided over the Yankee Division, Society of American Foresters annual meeting in Tolland (February 13); participated in an NESAF 2020 planning committee conference call (February 18); was interviewed about barberry characteristics and control by Will Rowland, Connecticut Gardener (February 25); participated in the initial meeting of the Yankee SAF, Forest Management and Carbon Task Force (February 28); and participated in a conference call for the Increasing Resiliency in Southern New England Oak Forests project (February 28).

DR. ABIGAIL A. MAYNARD participated in a conference call of the New England Vegetable and Fruit Conference Steering Committee (February 3); assisted with a seed germination unit at Hamden Hall Country Day School (12 students, 1 teacher) (February 3,11); discussed the use of compost in cut flower operation in Westport (February 5); visited an old pawpaw plantation in Wallingford (February 7); participated in a meeting of the Agriculture/Soils Sub-Working Group of the Working and Natural Lands Working Group in support of Governor Lamont's Council on Climate Change in Hartford (February 13); inspected the food waste composting site at Wesleyan University in Middletown (4 students, 1 teacher) (February 14, 25); and visited Rose's Berry Farm in South Glastonbury (February 27).

DR. SCOTT C. WILLIAMS participated in a conference call with US Biologic about ongoing collaborative research (February 7); gave an invited talk titled "Deer and tick-borne disease: Concerns for forest and public health alike" at the Great Mountain Forest/Acklerly Brown lecture series, Norfolk (February 8); attended the Yankee Division of The Society of American Foresters Oak Collaborative Meeting, Vernon (February 13); was interviewed by Ayah Galal WFSB Channel 3 Eyewitness News about results from the statewide active tick surveillance effort. https://www.wfsb.com/news/video-new-tick-threats-emerging-in-connecticut-new-report-says/video_6859f280-b213-5a03-92f9-6c5d0620e874.html (February 21); interviewed about the results from the active tick surveillance effort by Lissette Nunez of Fox 61 News: https://www.fox61.com/article/news/local/new-data-released-by-connecticut-researchers-giving-a-closer-look-at-the-tick-population/520-c5f60071-613e-448b-9c01-6ca942f7c1cf?fbclid=IwAR2jZavLCvKk88XkQJ6UB3_IT6hUlEa9cvh8tGdSJ3rOrh1-6P5-hfNVADs (February 21); was interviewed about the mild winter and tick activity by Ray and Joe D from WTIC 1080 Newstalk: https://wtic.radio.com/media/audio-channel/ray-and-joe-d-tick-talk (February 27); and was interviewed about tick surveillance efforts throughout Connecticut by Brian Smith of WSHU Public Radio (February 28).

MR. JOSEPH P. BARSKY hosted Lorenzo Pepe, a student at Cheshire High School, for a job shadow experience (February 4); attended the Yankee Division of The Society of American Foresters Oak Collaborative Meeting in Vernon (February 13); participated in an NESAF 2020 planning committee conference call (February 18); participated in the five year review of the Agriscience Program held at Westhill High School in Stamford (February 25).

PLANT PATHOLOGY AND ECOLOGY

DR. WADE ELMER was invited to speak to the sugarcane growers in San Martin, Guatemala, on the "Use of nano-fertilizers to suppress plant diseases" (6 attendees) (February 25-27) and to begin collaborative research on nanoparticles.

DR. YONGHAO LI presented "Recap 2019 Bedding Crop Diseases to Prepare for 2020" at the UConn Spring Bedding Plant Meeting held in Torrington (35 attendees) (February 11); was interviewed about "Maple Syrup Watchers Need Right Conditions for Production" by Ms. Olivia Hickey of Connecticut Public Radio (February 14); presented "Pruning 101" to Bristol Garden Club members in Bristol (38 attendees) (February 20); presented "Gardening with Native Plants" to Tolland/Vernon Garden Club members in Vernon (22 attendees) (February 22); presented "Principles of Organic Gardening" for the education program at the Cheshire Public Library (27 attendees) (February 24); and staffed the Station booth at the Connecticut Grounds Keeper Association Winter Meeting held in Plantsville (February 26).

DR. ROBERT E. MARRA presented a Sigma Xi seminar at Quinnipiac University entitled "Accurately accounting for decay and carbon loss in trees: A novel nondestructive approach using tomography" (45 attendees) (February 27).

DR. NEIL SCHULTES attended the yearly CAES BSL3 training hosted by **MS. ANGELA BRANSFIELD** (February 23).

DR. LINDSAY TRIPLETT, along with **DR. GOUDARZ MOLAEI**, participated in a job recruitment fair at Central Connecticut State University (40 attendees) (February 3).

VALLEY LABORATORY

DR. JAMES LAMONDIA spoke about "Boxwood cultivar susceptibility and fungicide management of boxwood blight" at the AmericanHort Boxwood Blight Workshop held in Willamette, OR (70 attendees) (February 4); and spoke about fungicide residue management in wrapper tobaccos and Low Converter varieties of Connecticut broadleaf and a plant breeding progress update (95 attendees) (February 25).

DEPARTMENTAL RESEARCH UPDATES FEBRUARY 2020

Cao, Y.; **Ma, C.**; Chen, H.; Zhang, J.; **White, J.C.**; Chen, G.; Xing, B. 2020. Xylem-based long-distance transport and phloem remobilization of copper in *Salix integra* Thunb. *J. Haz. Mat*. In press.

Abstract- Due to high biomass and an ability to accumulate metals, fast-growing tree species are good candidates for phytoremediation. However, little is known about the long-distance transport of heavy metals in woody plants. The present work focused on the xylem transport and phloem remobilization of copper (Cu) in Salix (S.) integra, a shrub willow which shows significant potential for Cu phytoremediation. Micro X-ray fluorescence (μ-XRF) imaging suggests that more Cu accumulated in vascular bundles of mature petiole than in the younger tissues, and that subsequent distribution from the vascular regions to the mesophyll occurred. High Cu intensity was observed in xylem tissues of both stem and root cross sections, confirming that the xylem played a vital role in Cu transport from roots to shoots. Cu was presented in both xylem sap and phloem exudate, which demonstrates the long-distance transport of Cu via both vascular tissues. Additionally, the stable isotope 65Cu was used to trace Cu remobilization from mature leaves to other tissues. The pre-stored 65Cu could be detected in young leaves and roots, confirming the bidirectional transport of Cu via

phloem. Last, a re-rooting experiment further demonstrated that leaf senescence could accelerate the Cu remobilization. Overall, the pattern of Cu distribution in S. integra is through xylem transport and phloem remobilization. To our knowledge, this is the first report to characterize Cu vascular transport and remobilization in fast-growing woody plants, and the findings provide valuable mechanistic understanding for the phytoremediation of Cu-contaminated soils.

Centrella, M.; Russo, L.; Ramirez, N. M.; **Eitzer, B.**; Van Dyke, M.; Danforth, B.; Poveda, K. 2020. Diet diversity and pesticide risk mediate the negative effects of land use change on solitary bee offspring production. *Journal of Applied Ecology*, https://doi.org/10.1111/1365-2664.13600.

Abstract-1. Threats to bee pollinators such as land use change, high pesticide risk, and reduced floral diet diversity are usually assessed independently, even though they often co-occur to impact bees in agroecosystems.
2. We established populations of the non-native mason bee *O. cornifrons* at 17 NY apple orchards varying in proportion of surrounding agriculture and measured floral diet diversity and pesticide risk levels in the pollen provisions they produced. We used path analysis to test the direct and indirect effects of different habitats, diet diversity, and pesticide risk on emergent female offspring number and weight.
3. High proportions of agricultural habitat surrounding bee nests indirectly reduced the number of female offspring produced, by reducing floral diet diversity in pollen.
4. When the proportion of agriculture surrounding bee nests was high, bees collected increased proportions of Rosaceae in their pollen provisions, which marginally ($0.05<p<0.1$) increased fungicide risk levels in pollen. This, in turn, marginally reduced female offspring weight. In contrast, female offspring weight increased as proportions surrounding open habitat (wildflowers, grassland, pasture) increased, but this effect was not influenced by proportion Rosaceae or fungicide risk levels in pollen.
5. *Synthesis and applications*. Threats to bee health such as land use change, pesticide exposure, and changes in pollen diet composition are often studied in isolation. However, our results suggest that these threats can simultaneously influence one another to impact bee populations in the agroecosystems where we rely on them for pollination. By replacing surrounding agricultural habitats with more natural habitats, such as grasslands and pastures, we can increase floral diet diversity and reduce pesticide exposure in bee-collected pollen, resulting in healthier mason bee populations in apple orchards.

Kache, P. A., **Eastwood, G.**, Collins-Palmer, K., Katz, M., Falco, R. C., Bajwa, W. I., **Armstrong, P. M., Andreadis, T.** G., and Diuk-Wasser, M. A. 2020. Environmental determinants of *Aedes albopictus* abundance at a northern limit of its range in the United States. *Am. J. Trop. Med. Hyg.* 102:436-447.

Abstract- *Aedes albopictus* is a vector of arboviruses with high rates of morbidity and mortality. The northern limit of *Ae. albopictus* in the northeastern United States runs through New York state (NYS) and Connecticut. We present a landscape-level analysis of mosquito abundance measured by daily counts of *Ae. albopictus* from 338 trap sites in 12 counties during May–September 2017. During the study period, the mean number of *Ae. albopictus* caught per day of trapping across all sites was 3.21. We constructed four sets of negative binomial generalized linear models to evaluate how trapping methodology, land cover, as well as temperature and precipitation at multiple time intervals influenced *Ae. albopictus* abundance. Biogents-Sentinel (BGS) traps were 2.78 times as efficient as gravid traps and 1.49 times as efficient as CO2-baited CDC light traps. Greater proportions of low- and medium-intensity development and low proportions of deciduous cover around the trap site were positively associated with increased abundance, as were minimum winter temperature and March precipitation. The cumulative precipitation within a 28-day time window before the date of collection had a nonlinear relationship with abundance, such that greater cumulative precipitation was associated with increased abundance until approximately 70 mm, above which there was a decrease in abundance. We concluded that populations are established in Nassau, Suffolk, and New York City counties in NYS; north of these counties, the species is undergoing population invasion and establishment. We recommend that mosquito surveillance programs monitoring the northward invasion of *Ae. albopictus* place BGS traps at sites chosen with respect to land cover.

Krol, W. J., Ph.D., Eitzer, B. D., Ph.D., Robb, C. S., Ph.D., Ammirata, M., Arsenault, T., Musante, C., Prapayotin-Riveros, K., and White, J. C., Ph.D., "Pesticide Residues and Arsenic Found in Produce Sold in Connecticut in 2018-2019: MFRPS ISO 17025:2017 Food Testing" The Connecticut Agricultural Experiment Station Technical Bulletin 21,

February, 2020.

Abstract- The Department of Analytical Chemistry (DAC) at the Connecticut Agricultural Experiment Station (CAES) provides regulatory enforcement analysis of pesticide residues found on domestic and imported food sold within the state to the Connecticut Department of Consumer Protection (DCP). This pesticide residue program ensures: 1) that pesticides on food products are used in accordance with their label and 2) that the public is protected from the deliberate or accidental misuse of pesticides. The DAC also began testing for arsenic in select food samples for the DCP in 2016.

Marmiroli, M.; Orazio Lepore, G.; Pagano, L.; d'Acapito, F.; Gianoncelli, A.; Villani, M.; **White, J.C.**; Marmiroli, N. 2019. The fate of CdS quantum dots in plants as revealed by Extended X-ray Absorption Fine Structure (EXAFS) analysis. *Environ. Sci.: Nano* In press.

Abstract- Use of Quantum Dots (QDs) is widespread and as such, the potential risk associated with their dispersion in the environment has stimulated research on interaction with potential sensitive receptors. To this end, the model plant Arabidopsis thaliana wild type (wt) and two mutant lines known to be tolerant to cadmium-based CdS QDs but not CdSO4 were exposed to CdS QDs or CdSO4 at sub-inhibitory concentrations for 20 days. X-ray Absorption Spectroscopy (XAS) was employed to investigate cadmium speciation in the cellular environment of the plants after treatment. After exposure to CdS QDs and CdSO4, differences in biomass were observed between wt and mutants, but the form of Cd in the treatment had a marked influence on cadmium atomic environment. The spectra of whole plant samples were found compatible with a mixed O/S coordination: while Cd-S distances did not show ample variations, Cd-O distances varied from ≈2.16 Å in samples grown with QDs to ≈2.22 Å in those grown on CdSO4. In addition, the amount of Cd-S bonds in plants grown with QDs was higher than Cd-O bonds. XAS data showed that CdS QDs were bio-transformed after their uptake; the particle original structure was modified but not totally eliminated, Cd atoms were not released as Cd(II) ions. These findings show the nanoscale specific response of plants to QDs, provide important insight to understanding nanoparticle fate in plants and in the environment, and have implications not only for the for both assessing risk and for designing appropriate remediation strategies.

McMillan, J. R., Armstrong, P. M., and **Andreadis, T. G.** 2020. Patterns of mosquito and arbovirus community composition and ecological indexes of arboviral risk in the northeast United States. *PLOS Neglected Trop. Dis.* 14(2) e0008066. https://doi.org/10.1371/journal.pntd.0008066.

Abstract: In the northeast United States, mosquitoes transmit a number of arboviruses, including eastern equine encephalitis, Jamestown Canyon, and West Nile that pose an annual threat to human and animal health. Local transmission of each arbovirus may be driven by the involvement of multiple mosquito species; however, the specificity of these vector-virus associations has not been fully quantified. We used long-term surveillance data consistently collected over 18 years to evaluate mosquito and arbovirus community composition in the State of Connecticut based on land cover classifications and mosquito species-specific natural histories using community ecology approaches available in the R package VEGAN. We then used binomial-error generalized linear mixed effects models to quantify species-specific trends in arbovirus detections. The composition of mosquito communities throughout CT varied more among sites than among years, with variation in mosquito community composition among sites explained mostly by a forested-to-developed-land-cover gradient. Arboviral communities varied equally among sites and years, and only developed and forested wetland land cover classifications were associated with the composition of arbovirus detections among sites. Overall, the avian host arboviruses, mainly West Nile and eastern equine encephalitis, displayed the most specific associations among mosquito species and sites, while in contrast, the mammalian host arboviruses (including Cache Valley, Jamestown Canyon, and Potosi) associated with a more diverse mix of mosquito species and were widely distributed throughout CT. We find that avian arboviruses act as vector specialists infecting a few key mosquito species that associate with discrete habitats, while mammalian arboviruses are largely vector generalists infecting a wide diversity of mosquito species and habitats in the region. These distinctions have important implications for the design and implementation of mosquito and arbovirus surveillance programs as well as mosquito control efforts.

Nguyen, J. N., Schein, J. R., Hunt, K. A., Tippmann-Feightner, J. A., Rapp, M., Stoffer-Bittner, A. J., Nalam, V. J., Funk, A. M., **Schultes N. P.,** Mourad, G. S. (2020) Functional characterization of the sole nucleobase cation symporter 1 of *Nicotiana sylvestris* reveals a broad solute specificity profile**. Plant Gene** https://doi.org/10.1016/

j.plgene.2020.100226

Abstract- Nucleobase Cation Symporter 1 proteins are present in bacteria, fungi and among plants. Microbes often contain numerous NCS1 proteins that have evolved specific solute specificity profiles (solute transport and binding). Conversely, most members of Viridiplantae have a unique NCS1 that shows a broad, yet species –specific, solute specificity profile. Properties of the NCS1 from *Nicotiana sylvestris* Speg. & Comes (NsNCS1) have been determined as part of an ongoing evolution-function analysis through heterologous expression studies in *ncs1*-deficient *Saccharomyces cerevisiae* Meyen *ex* E.C. Hansen as well as functional assays and subcellular localization studies *in planta*. NsNCS1 transports the purine adenine with high affinity and moves guanine, uracil, cytosine and hypoxanthine. Xanthine, uric acid and 5-flourocytosine act as competitive inhibitors for NsNCS1. When expressed in Arabidopsis, NsNCS1 locates to the chloroplast and facilitates the transport of guanine and 8-azaguanine. The NsNCS1 solute specificity profile is very similar, yet distinct, from AtNCS1 (*A. thaliana* (L.) Heynh. NCS1) and indicates that despite evolutionary divergence in the Eudicots - Nicotiana, an Astrid, and Arabidopsis, a Rosid, - little functional difference evolved. The alignment of select plant NCS1 amino acid sequences coupled with a detailed knowledge of each solute specificity profile facilitates identifying residues that may contribute to subtle solute discrimination. Such an evolution-function analysis will complement recent molecular model based site-directed mutagenesis analysis of select microbial and plant NCS1.

Paesano, L.; Marmiroli, M.; Bianchi, M. G.; **White, J. C.**; Bussolati, O.; Zappettini, A.; Villani, M;. Marmiroli, N. 2020. Differences in toxicity, mitochondrial function and miRNome in human cells exposed in vitro to Cd as CdS quantum dots or ionic Cd. *J. Haz. Mat*. In press.

Abstract- Cadmium (Cd) ions are known to be toxic to human cells grown in vitro. Here, the consequences of exposing both hepatocellular carcinoma cells (HepG2) and macrophages (THP-1) to Cd-containing quantum dots (QDs) were compared to those induced by exposure to CdSO4. For both cell types, the Cd2+ ion alone was more cytotoxic than the CdS QDs. Cellular integrity was compromised by a 24 h exposure to CdSO4, whereas the presence of the CdS QDs had only limited impact. While mitochondrial functionality was reduced by the presence of the CdS QDs, exposure to CdSO4 was more damaging. In HepG2 cells, the presence of CdS QDs increased the abundance of 34 microRNAs (miRNAs) and reduced that of 32, whereas the stress resulting from the presence of CdSO4 increased the abundance of 29 miRNAs and reduced that of 102. Among the inducible miRNAs, only 11 responded positively to both types of Cd and only 13 responded negatively. The THP-1 cells responded similarly to the HepG2 cells at the lower concentration of Cd, provided either as CdS QDs or as CdSO4, but at the higher dose of CdS QDs, most of the modulated miRNAs were reduced in abundance. The cells' distinctive miRNAs responses could potentially be used as a biomarker for Cd exposure.

Pokutnaya, D., Molaei, G.*, Weinberger, D. M., **Vossbrinck, C. R., Diaz, A. J.,** "Prevalence of infection and co-infection and presence of rickettsial endosymbionts in *Ixodes scapularis* (Acari: Ixodidae) in Connecticut, USA" *Journal of Parasitology* 2020; 106(1): 30-37. February 2020. DOI: 10.1645/19-116.

Abstract- *Ixodes scapularis* is currently known to transmit 7 pathogens responsible for Lyme disease, anaplasmosis, babesiosis, tick-borne relapsing fever, ehrlichiosis, and Powassan encephalitis. *Ixodes scapularis* can also be colonized by endosymbiotic bacteria including those in the genus of *Rickettsia*. We screened 459 *I. scapularis* ticks submitted to the Connecticut Agricultural Experiment Station Tick Testing Laboratory with the objectives to 1) examine differences in infection prevalence of *Borrelia burgdorferi*, *Anaplasma phagocytophilum, Babesia microti,* and *Borrelia miyamotoi,* 2) evaluate whether prevalence of co-infections occur at the same frequency that would be expected based on single infection, and 3) determine the presence of rickettsial endosymbionts in *I. scapularis*. The prevalence of infection in *I. scapularis* was highest with *Bo. burgdorferi* sensu lato (nymph = 45.8%; female = 47.0%), followed by *A. phagocytophilum* (nymph = 4.0%; female = 6.9%), *Ba. microti* (nymph = 5.7%; female = 4.7%), and *Bo. miyamotoi* (nymph = 0%; female = 7.3%). We also identified rickettsial endosymbionts in 93.3% of *I. scapularis*. Nymphs were significantly more likely to be infected with *Bo. burgdorferi* if they were infected with *Ba. microti*, whereas adult females were significantly more likely to be infected with *Bo. burgdorferi* if they were infected with *A. phagocytophilum*. Our study suggests that the infection prevalence of Bo. burgdorferi is not independent of other co-circulating pathogens and that there is a substantially higher infection of *Bo. miyamotoi* in *I. scapularis* females compared to nymphs in this study. High prevalence of infection and co-infection with multiple pathogens in *I. scap-*

ularis highlights the public health consequences in Connecticut, a state endemic for Lyme and other tick-borne diseases.

Read, A. C., Moscou, M. J., Zimin, A. V., Pertea, G., Meyer, R. S., Purugganan, M. D., Leach, J. E., **Triplett**, **L. R.,** Salzberg, S. L. and Bogdanove, A. J. Genome assembly and characterization of a complex zfBED-NLR gene-containing disease resistance locus in Carolina Gold Select rice with Nanopore sequencing. *PLoS Genetics* 16:e1008571.

Abstract- Long-read sequencing facilitates assembly of complex genomic regions. In plants, loci containing nucleotide-binding, leucine-rich repeat (NLR) disease resistance genes are an important example of such regions. NLR genes constitute one of the largest gene families in plants and are often clustered, evolving via duplication, contraction, and transposition. We recently mapped the *Xo1* locus for resistance to bacterial blight and bacterial leaf streak, found in the American heirloom rice variety Carolina Gold Select, to a region that in the Nipponbare reference genome is NLR gene-rich. Here, toward identification of the *Xo1* gene, we combined Nanopore and Illumina reads and generated a high-quality Carolina Gold Select genome assembly. We identified 529 complete or partial NLR genes and discovered, relative to Nipponbare, an expansion of NLR genes at the *Xo1* locus. One of these has high sequence similarity to the cloned, functionally similar *Xa1* gene. Both harbor an integrated zfBED domain, and the repeats within each protein are nearly perfect. Across diverse Oryzeae, we identified two subclades of NLR genes with these features, varying in the presence of the zfBED domain and the number of repeats. The Carolina Gold Select genome assembly also uncovered at the *Xo1* locus a rice blast resistance gene and a gene encoding a polyphenol oxidase (PPO). PPO activity has been used as a marker for blast resistance at the locus in some varieties; however, the Carolina Gold Select sequence revealed a loss-of-function mutation in the PPO gene that breaks this association. Our results demonstrate that whole genome sequencing combining Nanopore and Illumina reads effectively resolves NLR gene loci. Our identification of an *Xo1* candidate is an important step toward mechanistic characterization, including the role(s) of the zfBED domain. Finally, the Carolina Gold Select genome assembly will facilitate identification of other useful traits in this historically important variety. Author summary: Plants lack adaptive immunity, and instead contain repeat-rich, disease resistance genes that evolve rapidly through duplication, recombination, and transposition. The number, variation, and often clustered arrangement of these genes make them challenging to sequence and catalog. The US heirloom rice variety Carolina Gold Select has resistance to two important bacterial diseases. Toward identifying the responsible gene(s), we combined long- and short-read sequencing technologies to assemble the whole genome and identify the resistance gene repertoire. We previously narrowed the location of the gene(s) to a region on chromosome four. The region in Carolina Gold Select is larger than in the rice reference genome (Nipponbare) and contains twice as many resistance genes. One shares unusual features with a known bacterial disease resistance gene, suggesting that it confers the resistance. Across diverse varieties and related species, we identified two widely-distributed groups of such genes. The results are an important step toward mechanistic characterization and deployment of the bacterial disease resistance. The genome assembly also identified a resistance gene for a fungal disease and predicted a marker phenotype used in breeding for resistance. Thus, the Carolina Gold Select genome assembly can be expected to aid in the identification and deployment of other valuable traits.

Zhang, H.; Huang, M.; Zhang, W.; Gardea-Torresdey, J. L.; **White, J. C.**; Ji, R.; Zhao, L. 2020. Silver nanoparticles alter soil microbial community compositions and metabolite profiles in unplanted and cucumber-planted soil. *Environ. Sci. Technol*. In press.

Abstract- The rapid development of nanotechnology makes environmental impact assessment a neccesity to ensure the sustainable use of engineered nanomaterials. Here, silver nanoparticles (AgNPs) were added to soils in the absence or presence of cucumber (Cucumis sativa) plants for 60 days. The response of the soil microbial community and associated soil metabolites were investigated by 16S rRNA gene sequencing and gas chromatography-mass spectrometry (GC-MS) based metabolomics, respectively. The results show that AgNPs exposure significantly increased soil pH in both unplanted and cucumber-planted soils. The soil bacterial community structure was altered upon Ag exposure in both soils. Several functionally significant bacterial groups, including carbon - (Latescibacteria, Armatimonadetes, etc), nitrogen- (Frankiales, Bradyrhizobium), and phosphorus (Solibacterales, Gemmatimonas) cycling groups, were disturbed by AgNPs in both unplanted and cucumber-planted soils. Generally, plants played a limited role on mediating the impacts of AgNPs on the bacterial community. Soil metabolomic analysis showed that AgNPs altered the metabolite profile in both unplanted and cucumber-planted soils. The significantly changed metabolites are involved in sugar and amino ac-

id related metabolic pathways, indicating the perturbation of C and N metabolism, which is consistant with the bacterial community structure results. In addition, several fatty acids were significantly decreased upon exposure to AgNPs in both unplated and cucumber-planted soils, suggesting the possible oxidative stress imposed on microbial cell membranes. These results provide valuable information for understanding the biological and biochemical impacts of AgNPs exposure on both plant species and on soil microbial communities; such understanding is needed to understand the risk posed by these materials in the environment.

Zhang, Z.; Xia, M.; **Ma, C.**; Guo, H.; Wu, W.; **White, J. C.**; Xing, B.; He, L. 2020. Rapid organic solvent extraction coupled with Surface Enhanced Raman Spectroscopic mapping for ultrasensitive quantification of foliarly applied silver nanoparticles in plant leaves. *Environ. Sci.: Nano* In press.

Abstract- A rapid (2h) organic solvent-based approach was developed to extract silver nanoparticles (AgNPs) from spinach leaves. The extracted AgNPs were enriched on a filter membrane and quantified by a surface enhanced Raman spectroscopic (SERS) mapping technique. The lowest detectable concentration of AgNPs was 1 ng/mL and the accuracy was 74-113%.

Zhao, L.; Wang, A.; Jin, Q.; Miao, A.; White, J. C.; Gardea-Torresey, J. L.; Ji, R. 2019. High-throughput screening for engineered nanoparticles that enhance photosynthesis using mesophyll protoplasts. *J. Agric. Food Chem*. In press.

Abstract- Certain engineered nanoparticles (NPs) have unique properties that have exhibited significant potential for promoting photosynthesis and enhancing crop productivity. Understanding the fundamental interactions between NPs and plants is crucial for the sustainable development of nano-enabled agriculture. Leaf mesophyll protoplasts, which maintain similar physiological response and cellular activity as intact plants, were selected as model system to study the impact of NPs on photosynthesis. The mesophyll protoplasts isolated from spinach were cultivated with different NMs (Fe, Mn3O4, SiO2, Ag, and MoS2) dosing at 50 mg/L for 2 hours under illumination. The potential maximum quantum yield and adenosine triphosphate (ATP) production of mesophyll protoplasts were significantly increased by Mn3O4 and Fe NPs (23% and 43%, respectively), and were decreased by Ag and MoS2 NPs. The mechanism for the photosynthetic enhancement by Mn3O4 and Fe is to increase the photocurrent and electron transfer rate, as revealed by photoelectrochemical measurement. GC-MS based single cell type metabolomics reveal that NPs (Fe and MoS2) altered that metabolic profiles of mesophyll cells during 2 hours illumination period. Separately, the effect of NPs exposure on photosynthesis and biomass were also conducted at the whole plant level. A strong correlation was observed with protoplast data; plant biomass was significantly increased by Mn3O4 exposure (57%). but was decreased (24%) by treatment Ag NPs. The use of mesophyll protoplasts can be a fast and reliable tool for screening NPs to enhance photosynthesis for potential nanofertilizer use. Importantly, inclusion of a metabolic analysis can provide mechanistic toxicity data to ensure the development “safer-by-design” nano-enabled platforms.

Zhu, Li-Hua, Guan-Qun Jin, Dong-Liang Sun, Yu Wan, and **De-Wei Li***. 2020. First report of *Colletotrichum gloeosporioides* sensu stricto causing leaf blotch on *Acer coriaceifolium* in China. Plant Disease 104 (3): 983-984. https://doi.org/10.1094/PDIS-08-19-1716-PDN

Abstract— *Acer coriaceifolium* H. Léveillé is an excellent landscaping tree species native to China. In May 2018, a leaf disease occurred on the foliage of *A. coriaceifolium* at the campus of Nanjing Forestry University, Nanjing, China. The lesions mostly appeared along the leaf edges. Some small round to irregular lesions also developed in other parts of the leaves. The lesions were grayish brown. Pink conidial masses appeared on the lesions in wet weather. Small pieces (3 to 4 mm^2) from the margins of fresh lesions were surface sterilized for 30 s in 75% ethanol follow by 1% NaOCl for 90 s, washed three times with sterile water, and placed on potato dextrose agar (PDA) with 0.1 mg/ml of ampicillin and incubated at 25°C. Pure cultures were obtained by monosporic isolation, and a representative isolate (QS2-1-1) was obtained and deposited in China’s Forestry Culture Collection Center (cfcc53785). When cultured on PDA, the colony of QS2-1-1 was grayish-white, cottony from top view, and pale orange near the center on the reverse side. The growth rate was 11.8 mm/day at 25°C under dark conditions. The conidia were one-celled, straight, colorless, smooth, subcylindrical with rounded ends, and 15.3 ± 1.1 × 6.3 ± 0.3 µm. Appressoria were one-celled, brown, thick-walled, ellipsoidal, and 8.4 ± 1.1 × 6.4 ± 0.7 µm. The morphological characteristics of conidia and other structures of QS2-1-1 matched those of the *Colletotrichum gloeosporioides* species 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 amplified with primers ITS1/ITS4, GDF/GDR, CHS-79F/CHS-345R, and ACT-512F/ACT-783R, respectively. The sequences were deposited in GenBank (accession nos. MN148528 and MN161578 to MN161580). A BLAST search of GenBank showed that ITS, ACT, CHS, and GAPDH sequences of QS2-1-1 were closest to *C. gloeosporioides* KC341948 (identity = 514/514 [100%]), *C. gloeosporioides* MH321218 (identity = 230/230 [100%]), *C. gloeosporioides* KP145381 (identity = 251/251 [100%]), and *C. gloeosporioides* MG561691 (identity = 230/230 [100%]), respectively. Phylogenetic analysis using neighbor joining and concatenated sequences (ITS, GAPDH, CHS, and ACT) with MEGA 7 placed QS2-1-1 in the clade of *C. gloeosporioides* s.s. including ex-type ICMP 17821. Based on the morphological characteristics and phylogenetic analysis, QS2-1-1 was identified as *C. gloeosporioides* s.s. Pathogenicity of QS2-1-1 was verified on detached and attached leaves inoculated with 10 µl of conidial suspension (10^6 conidia/ml) or mycelial plugs (5 mm in diameter) from the edge of a 5-day-old culture, and each treatment had five replicates. Controls were treated with sterile dH_2O or PDA plugs. All detached leaves were placed in 20-cm dishes on wet filter paper at 25°C. Each attached leaf was covered with a plastic bag, in which a wet cotton ball was placed to maintain the moisture condition for 24 h. Leaves inoculated with conidial suspension and mycelial plugs developed lesions, which were the same as those in the field 5 days after inoculation. *C. gloeosporioides* s.s. was reisolated from the inoculated leaves, and recovery rates of were 100%. Control leaves were symptomless. *C. gloeosporioides* s.s. is a common pathogen causing many plant diseases. For example, it was previously reported infecting *Liriodendron tulipifera* (Choi et al. 2012) and *L. chinense* × *tulipifera* (Zhu et al. 2019), but this is the first report of *C. gloeosporioides* s.s. causing leaf blotch on *A. coriaceifolium*. This finding provided crucial information for management of this disease.

JOURNAL ARTICLES APPROVED FEBRUARY 2020

Donato, M., O. Johnson, **Blaire T. Steven**, and B. A. Lawrence. Nitrogen enrichment stimulates wetland plant responses whereas salt amendments alter sediment microbial communities and biogeochemical responses. *PLoS One*

Eisen, L. and **Kirby C. Stafford III**. Barriers to effective tick management and tick-bite prevention in the United States. *Journal of Medical Entomology*

Iman, A. A., **Regan B. Huntley**, G. S. Mourad, and **Neil P. Schultes**. Apple Nucleobase Cation Symporter 1 transports guanine and the *Erwinia amylovora* produced toxic analog 6-thioguanine. *Physiological and Molecular Plant Pathology*

Molaei, Goudarz and **Eliza Little**. First report of morphological anomalies in *Amblyomma americanum* (Acari: Ixodidae). *Experimental and Applied Acarology*

Mukome, F. N. D., M. C. Buelow, J. S. Shang, J. S. Peng, M. Rodriguez, D. M. Mackay, **Joseph J. Pignatello**, N. Sihota, T. Hoelen, and S. J. Parikh. Biochar amendment as a remediation strategy for surface soils impacted by crude oil. *Environmental Pollution*

Steven, Blaire. Phototrophic mats of the desert: The biological soil crust community. In: *Microbiology of Hot Deserts*; Springer Book Chapter

Wang, Zhengyang, S. Bakshi, C. Li, S. Parikh, H. S. Hsieh, and **Joseph J. Pignatello**. Modification of pyrogenic carbonaceous materials for phosphate sorption through binding of a cationic polymer. *Water Research*

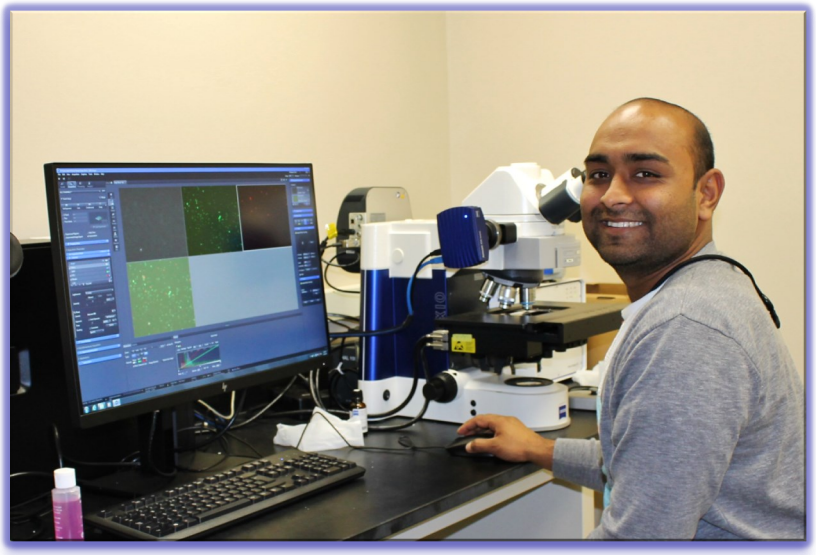
Zhang, C., B. Wu, B. Pan, S. Zhang, and **Joseph J. Pignatello**. Deep removal of arsenite for production of safe water without need for pre-oxidation or in-line oxidation. *Environmental Science & Technology*

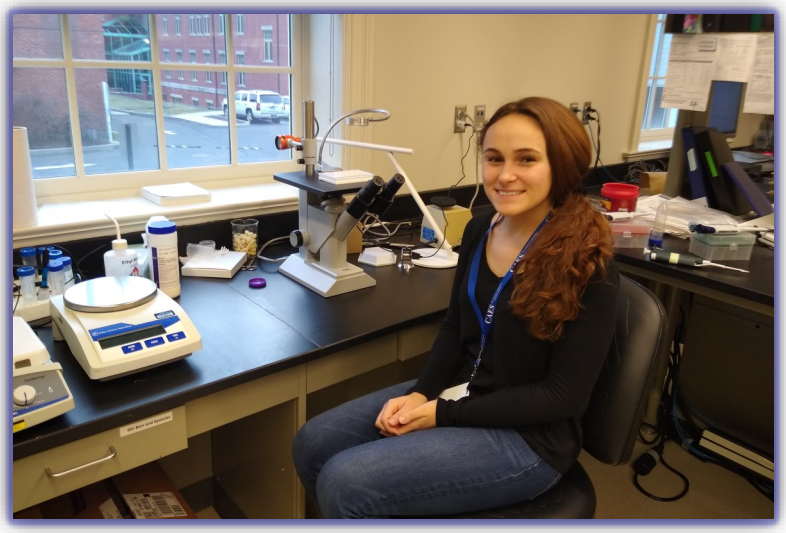
ARTICLES OF INTEREST FEBRUARY 2020

Ninety-five people attended the Connecticut Agricultural Experiment Station's annual Tobacco Research Meeting held at the East Windsor Scout Hall on February 25, 2020. Dr. Jim LaMondia welcomed growers and spoke about recent developments at the Experiment Station. The meeting addressed a wide variety of issues of concern to growers. Jon Anderson from the Kentucky Fish and Wildlife Resources Department introduced growers to No-till or strip till tobacco production and examples from Kentucky. Thomas Rathier spoke about carbon and nitrogen in well drained tobacco soils. Christina Berger of the DEEP spoke about Worker Protection Standard updates. Jim LaMondia spoke about fungicide residue management in wrapper tobaccos and Low Converter varieties of Connecticut broadleaf and a plant breeding progress update. Joe Bonelli (UConn Cooperative Extension) and Colleen Kisselburgh (Arthur Carroll Insurance) discussed risk management in tobacco and the tobacco insurance program. Martha Dorsey of the Farm Services Administration provided updates on FSA services to growers. Andrew Urbanowicz, Dave Arnold and Paul Polek presented an update on the Connecticut-Massachusetts Tobacco Growers Association. Brianna Dunlap and members of the Tobacco Museum Board had information available about the museum and the need for grower input and support. Jane Canepa-Morrison, Jim Preste and Michelle Salvas assisted with much of the behind the scenes work for the meeting. The meeting qualified for pesticide applicator re-certification credit in Connecticut and Massachusetts and 62 persons received credit.

NEW STAFF, STUDENTS, AND VOLUNTEERS FEBRUARY 2020

Dr. Ravikumar (Ravi) Patel started as a postdoc in the laboratory of Dr. Lindsay Triplett on January 3rd. He is working on projects on bacterial stress persistence and on understanding the effects of protists on plant hormones.





Brianna Hammond is a sophomore at Central Connecticut State University who is doing a research for credit internship in the laboratory of Dr. Lindsay Triplett. She is doing research on protist feeding patterns and effects on plants.

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