Station News

The Connecticut Agricultural Experiment Station
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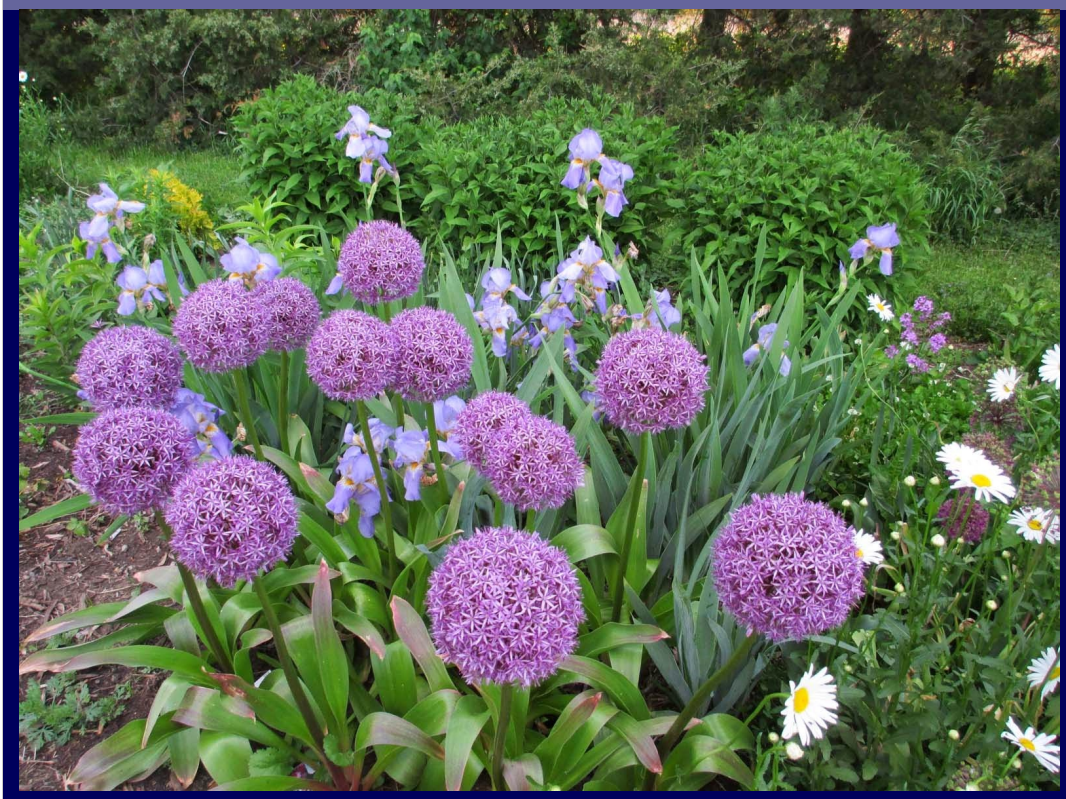


The mission of The Connecticut Agricultural Experiment Station is to develop, advance, and disseminate scientific knowledge, improve agricultural productivity and environmental quality, protect plants, and enhance human health and well-being through research for the benefit of Connecticut residents and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

CAES

The Connecticut Agricultural Experiment Station

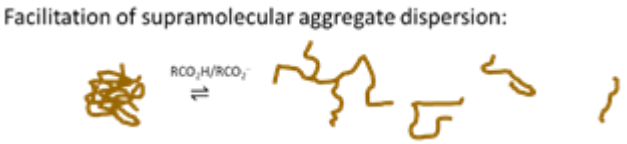
Putting Science to Work for Society since 1875

This Issue

GRANTS RECEIVED APRIL 2020

J.J. Pignatello and B. Xing, "Involvement of Very Strong Hydrogen Bonds in Soil Organic Matter Aggregation, Adhesion and Interaction with Pollutants," U.S.D.A. NIFA AFRI Program, 05/01/2020 through 04/30/2023; $499,998 (awarded May 1).

Abstract—Non-technical Summary: Natural organic matter (OM) is the decayed and decaying remains of plant and microbial biomass. It is ever-present in soil and water. Dissolved and solid forms of OM play crucial roles in the biogeochemistry of the earth and the fate of chemical contaminants and agrichemicals in soil. A key to characterizing these roles is a molecular-level understanding of the forces governing the binding of OM molecules with each other, to natural particles including soil particles, and to natural and synthetic chemical compounds. We postulate a strong and special force exists between acidic groups on OM and other molecules known as "charge-assisted hydrogen bonds (CAHB)." The objectives of the project are to test certain hypotheses that CAHB contributes to OM cohesive forces, adhesive forces with particle surfaces, and binding of certain types of chemical contaminants. The test materials include OM reference materials, OM-rich soils, and lab-prepared woody chars, and the project will target weak acids phosphate, pyrophosphate, phenolic acid root exudates, the antibiotic sulfamethoxazole, the fungicide p-aminobenzonic acid, and the analgesic paracetamol. Objective 1 will investigate binding forces between molecules dissolved in water. Objective 2 will investigate binding of dissolved OM with carbonaceous surfaces of particles. Objective 3 will examine the binding between OM and chemical contaminants both dissolved in water. This hypothesis-driven project addresses goals of the Soil Health Priority of the AFRI Program of NIFA. The postulated CAHB potentially impacts OM aggregation in water, soil OM solubility in water, transport of OM through the soil, the stability of soil carbon, pH buffering in soil, the interaction between soil particles and root exudate compounds, adsorption of dissolved OM on particles, and the binding of contaminants and nutrients to solid and dissolved forms of OM. The knowledge gained may lead to strategies that reduce crop uptake of chemical contaminants, thereby protecting food quality and safety.



G. Molaei and others at Virginia Mosquito Control Agency, City of Suffolk, VA: "Vector-Host Interactions of *Culex pipiens* Mosquitoes and their Contribution to Transmission of Arboviruses in Virginia"; $10,000; (awarded April 23).

Abstract—In recent years, we have witnessed introduction and/or range expansion and changes in the frequency of mosquito-borne arboviruses in the Western Hemisphere. West Nile virus (WNV) has now become firmly established in the continental United States since its discovery in the New York City area in 1999, and EEEV has made a comeback in 2019 in the Northeast. Both WNV and EEEV are maintained in enzootic cycles that involve wild birds and ornithophilic mosquitoes. Although numerous mosquito species have been found to be infected with WNV and EEEV in North America, *Culex pipiens* mosquitoes have been implicated as primary and auxiliary vectors, because they are physiologically competent, frequently infected with the viruses in nature, and closely associated with transmission foci. Nevertheless, the precise role that *Cx. pipiens* plays in enzootic transmission and epidemic transmission to humans in different regions requires additional investigations. Entomologic measures of risk may be estimated for different mosquito species by considering their abundance, biting behavior, prevalence of virus infection, and vector competence. We have proposed to investigate eco-epidemiology of these arboviruses by characterizing the host-feeding patterns of *Cx. pipiens* mosquitoes and evaluating their contribution to enzootic maintenance of arboviruses in wild bird populations and epidemic transmission to humans in Virginia.

DR. ROBERT E. MARRA received a U.S. Forest Service "Emerging Pest" grant of $31,870 for research on "Expansion of Beech Leaf Disease."

ADMINISTRATION

DR. JASON C. WHITE participated in the weekly Center for Sustainable Nanotechnology (CSN) center-wide Zoom call (April 1, 8, 15, 22, 29); participated in a Zoom call with collaborators at the University of Wisconsin regarding a collaborative manuscript on plant-derived corona formation on nanoparticles (April 1, 7, 13, 20); participated in a CSN Faculty call (April 2, 30); participated in the monthly CT Laboratory Preparedness meeting/ Zoom call with the Department of Public Health and other state/federal agencies (April 6); hosted the CSN monthly Nanochem-Plant working group call (April 14); participated in a monthly Northeast Experiment Station Directors Zoom call (April 14); gave a Zoom lecture entitled "Nanotechnology in Agriculture: Balancing Applications and Implications" to a Plant Biology course at the University of Massachusetts Stockbridge School of Agriculture (10 attendees) (April 14); hosted the quarterly meeting of the CAES Board of Control via Zoom (April 15); was interviewed about nanotechnology in agriculture (https://www.utep.edu/science/chemistry/Resources/seminars.html) by Dr. Keith Pannell of the University of Texas for Science Studio, which is a radio show on Texas Public Radio (April 17); participated in a Zoom call with collaborators at the Yale University School of Public Health and the University of Minnesota regarding an NIEHS grant submission (April 21); participated in a Zoom call for the Governor's Council on Climate Change (GC3) Science and Technology Working Group (April 22); participated as a committee member in Carolina Valdes' (University of Texas, El Paso) qualifying exam via Zoom (25 participants) (April 23); participated in a Northeast Experiment Station Directors Zoom call focused on COVID -19 impacts on activities (April 28); and participated in a Zoom call with collaborators at the Harvard University School of Public Health and the University of Texas, El Paso regarding an NSF grant submission (April 30).

ANALYTICAL CHEMISTRY

DR. BRIAN EITZER, along with **DR. CHRISTINA ROBB** and **DR. SARA NASON**, participated in an online training in Compound Discoverer, a mass spectrometric analysis software package (April 7-8); was a participant in the North American Chemical Residue Workshop's (NACRW) organizing committee's Zoom call (April 9); along with **DR. CHRISTINA ROBB**, **MR. CRAIG MUSANTE**, and **MS. TERRI ARSENAULT**, participated in a monthly FDA FERN cCAP call (April 9), an EPA/AAPCO lab committee conference call (April 22), an APHL Cannabis Community of Practice conference call (April 23), an NACRW program committee conference call (April 29), and an EPA COVID-19 certification and training call (April 30).

KITTY PRAPAYOTIN-RIVEROS participated in the Sample Analysis Data Exchange - IT Implementation Phase Meeting on WebEx to discuss the NFSDX (National Food Safety Data Exchange) phase II Sample Data Elements Mapping File (April 7, 21); participated in the CT Weekly Office Hours for Teams with Microsoft Customer Success Manager (April 6, 13, 17, 20, 27); participated in a Technical Call for the Funding Opportunity Announcement for Animal Feed Regulatory Program Standards with optional funding for Preventive Controls for Animal Foods (April 14); attended the GoToWebinar - A Look at ISO/IEC 17025:2017 - Document Control and Control of Records by PJLA accreditation body (April 20); and attended the Connecticut Power Platform Discussion to discuss utilizing Microsoft Power Apps and Power Automate (April 21).

DR. CHRISTINA ROBB participated in the Plant Science Day Planning Committee meeting (April 7); attended the Analytical Chemistry Department meetings (April 9, 17, 24); attended the Analytical Chemistry Department Quality control meeting (April 9); attended the Microsoft State of CT Teams Training (April 13, 20, 27); discussed the Eastern Analytical Symposium short course selections with the EAS President (April 17); and discussed a protein MS project with the FDA Forensic Chemistry Centre (April 27).

ENTOMOLOGY

DR. KIRBY C. STAFFORD III was interviewed about ticks and tick bite prevention as people go outdoors by Kaitlyn McGrath, NBC Universal (April 2); was interviewed about tick activity and the need for personal tick bite prevention by Robert Miller, News-Times

(April 7); presented a webinar on ticks and tick control for the Connecticut Horticultural Society (April 23); and was interviewed about ticks and infection rates by Erica Moser, The Day (April 29).

DR. MEGAN LINSKE attended the annual Executive Committee meeting of the Northeast Section of the Wildlife Society as Outgoing Secretary and transitioned to President-Elect thereafter (April 23).

DR. GALE E. RIDGE presented a webinar about bed bugs to students at Southern Connecticut State University for their Environmental Health Training Program (April 15).

DR. VICTORIA L. SMITH participated via Zoom in a meeting of the Yale Biosafety Committee (20 participants) (April 16).

DR. KIMBERLY A. STONER presented a webinar entitled "Preserving Native Bee Diversity" for the Connecticut chapter of Wild Ones, a native plant conservation organization, via Zoom (31 attendees) (April 11); presented a webinar entitled "Planting for the Bees' Needs" for the Ecological Agriculture class of Dr. Eric Vukicevich at Connecticut College (28 attendees) and the webinar was recorded for additional students who were not able to attend (April 15); participated in the Agriculture and Working Lands Subgroup of the Governor's Council on Climate Change (20 attendees) (April 30).

ENVIRONMENTAL SCIENCES

DR. JOSEPH PIGNATELLO participated in a conference video meeting with faculty at Villanova University, Pacific Northwest National Laboratory, and Oregon Health and Science University regarding an ongoing research project (April 3); attended a virtual Council meeting of the Connecticut Academy of Science and Engineering (April 29); and participated in a conference video meeting with faculty at UC Davis concerning an ongoing research project (April 30).

DR. PHILIP ARMSTRONG was interviewed about plans to increase mosquito monitoring for EEE virus in Connecticut during 2020 by the CT Examiner (April 20); and gave an online lecture entitled "Nature Bites Back: Ticks, Their Diseases, and How to Protect Yourself" to Lathrop retirement communities in Northampton and Easthampton, MA (50 attendees) (April 27).

MR. GREGORY BUGBEE, as President-elect of the Northeast Aquatic Plant Management Society, participated in the Spring Executive Committee meeting via conference call (April 14); and with **MS. SUMMER STEBBINS**, presented the results of the CAES 2019 invasive aquatic plant survey of the lower portion of the Connecticut River at a meeting of the CT Resource Conservation and Development Council via Zoom (approx. 12 attendees) (April 21).

DR. DOUGLAS BRACKNEY did a SARS-CoV2 tele-Q & A session with high school students from Humanities Preparatory Academy in Brooklyn (approx. 20 student attendees) (April 28).

DR. ANDREA GLORIA-SORIA attended the Allied Genetics Conference - TACG 2020 online organized by the Genetics Society of America (April 22-25).

DR. GOUDARZ MOLAEI was interviewed about this year's tick season and concern over tick-borne diseases during the Coronavirus pandemic (https://www.huffpost.com/entry/coronavirus-tick-season-lyme_l_5e8f0a98c5b6b371812caabd) by Huffpost (April 9); was interviewed about measures to protect against tick-borne diseases during the

Coronavirus pandemic on the "Let's Go There" show on Channel Q radio (April 10); gave an invited talk via Zoom on the impact of climate change on vector-borne diseases to "Earth Day 2020 Climate Action: Joining the Conversation," Cheshire Academy, and served as a panelist (20 student attendees, 25 attendees total) (April 22); and was assigned to lead the Vector-Borne Disease subgroup of the "Connecticut Governor's Council on Climate Change (GC3) Adaptation Planning and Implementation Working Group."

DR. SARA NASON participated in a conference call for the Benchmarks and Publications for Non-targeted Analysis working group (April 2); with **DR. JASON WHITE** and **DR. NUBIA ZUVERZA-MENA**, participated in Zoom calls with collaborators from the Yale School of Public Health and the University of Minnesota regarding a collaborative grant proposal (April 16, 21); participated in a Zoom call with Dr. Krystal Pollitt (Yale) regarding ongoing collaborative work (April 24); and participated in a WebEx with collaborators from Yale, the University of Florida, Agilent, the Norwegian Institute for Air, and the Memorial University of Newfoundland regarding a new collaborative project (April 30).

MR. JOHN SHEPARD presented "Establishing and Maintaining Mosquito Colonies," as part of a Webinar entitled "Insecticide Resistance in Mosquitoes: Practical Guidance and Tips for Performing Your Own Monitoring Assays" for the Northeast Regional Center for Vector Borne Diseases (62 attendees) (April 1).

FORESTRY AND HORTICULTURE

DR. JEFFREY S. WARD participated in a Yankee SAF, Forest Management and Carbon Task Force conference call (April 10); participated in a New England Society of American Foresters Annual Meeting conference call (April 30).

DR. ABIGAIL A. MAYNARD made a video in the greenhouse at Lockwood Farm showing how to produce transplants for experiments for lower school science classes at Hamden Hall Country Day School (1 teacher, 32 students) (April 14); attended a meeting of the Governor's Council on Climate Change Agricultural/Soils subgroup via Zoom (April 30).

DR. SCOTT C. WILLIAMS participated in a conference call for the Editorial Advisory Board for The Wildlife Society's publication, The Wildlife Professional (April 15); hosted the Northeast Section of the Wildlife Society's Annual Executive Committee Zoom Meeting and moved from President to Immediate Past-President (April 23).

MR. JOSEPH P. BARSKY participated in the New England Society of American Foresters Annual Meeting conference call (April 30).

PLANT PATHOLOGY AND ECOLOGY

DR. WADE ELMER was awarded (in absentia) the Award of Merit in recognition of service to the Northeastern Division of the American Phytopathological Society (35 attendees) (March 12); participated in the CAES Board of Control Zoom meeting (April 15) (8 participants); participated as a committee member in Carolina Valdes' (University of Texas, El Paso) qualifying exam via Zoom (25 online attendees) (April 23).

DR. WASHINGTON DA SILVA was awarded the prestigious Schroth Faces of the Future Award from The American Phytopathological Society (APS) and was invited to present his research and vision on the Future of Virology Research as a keynote lecturer at the Annual

APS Meeting "Plant Health 2020" to be held in Denver, CO, August 8-12; the symposium was designed to acknowledge up-and-coming and forward-thinking scientists who are shaping the future of their respective scientific discipline (April 20); and participated as an advisor to Stephanie Preising's undergraduate honor thesis defense at Southern Connecticut State University via video conference call where she passed with flying colors (22 online attendees) (May 1).

DR. ROBERT E. MARRA participated in a Beech Leaf Disease Working Group Zoom meeting with collaborators from Ohio, West Virginia, Ontario (CA), New York, USDA-ARS, and the U.S. Forest Service (18 attendees) (April 16).

DR. WADE ELMER was awarded (in absentia) the Award of Merit in recognition of service to the Northeastern Division of the American Phytopathological Society.

VALLEY LABORATORY

DR. JATINDER AULAKH was awarded the Experiment Station Associates (ESA) Early Career Scientist Award for his project entitled "Is the Newly Discovered Palmer Amaranth Population in Connecticut Herbicide-Resistant?" (April 27).

MS. ROSE HISKES participated in a virtual Connecticut Invasive Plant Working Group symposium planning committee meeting (April 21).

DEPARTMENTAL RESEARCH UPDATES APRIL 2020

Aulakh, J. S. 2020. Weed control efficacy and tolerance of Canaan fir to preemergence herbicides. Weed Technology 34:208-213.

Abstract - PRE herbicides are the backbone of a successful weed management program in Christmas tree production. In a 2-yr field study, weed control efficacy and tolerance of newly transplanted Canaan fir to different PRE treatments were evaluated. Herbicide treatments consisted of two rates of each of atrazine plus mesotrione plus *S*-metolachlor at 561 + 150 + 1,504 and 1,122 + 300 + 3,008 g ai ha^{-1}, flumioxazin at 214 and 429 g ai ha^{-1}, hexazinone plus sulfometuron methyl at 289 + 27 and 480 + 46 g ai ha^{-1}, indaziflam at 20 and 41 g ai ha^{-1}, simazine plus oryzalin at 3,366 + 1,683 and 3,366 + 3,366 g ai ha^{-1}, and a nontreated control. Averaged over 2 yr, all PRE treatments controlled giant foxtail, large crabgrass, and redroot pigweed at least 80% throughout the summer. Only the high rates of atrazine plus mesotrione plus *S*-metolachlor maintained >80% season-long control of yellow foxtail. Horseweed was controlled >85% with flumioxazin at both rates and at high rates of atrazine plus mesotrione plus *S*-metolachlor, hexazinone plus sulfometuron methyl, and indaziflam. The season-long PRE control of both red sorrel and wild carrot was maintained ≥80% with atrazine plus mesotrione plus *S*-metolachlor and hexazinone plus sulfometuron methyl regardless of application rate. By 16 wk after treatment, within-row densities of weeds evaluated in this study were reduced >75% in plots treated with atrazine plus mesotrione plus *S*-metolachlor at both application rates or hexazinone plus sulfometuron methyl at 480 + 46 g ai ha^{-1}. Within-row weed densities in the nontreated control plots were 50, 32, 36, 25, 27, 31, and 19 plants m^{-2} for large crabgrass, giant foxtail, horseweed, redroot pigweed, red sorrel, wild carrot, and yellow foxtail, respectively. No discernible injury was observed in Canaan fir with any PRE treatment in both study years.

Baidaliuk, Artem, Sébastian Lequime, Isabelle Moltini-Conclois, Stéphanie Dabo, Laura B Dickson, Matthieu Prot, Veasna Duong, Philippe Dussart, Sébastien Boyer, Chenyan Shi, Jelle Matthijnssens, Julien Guglielmini, **Andrea Gloria-Soria**, Etienne Simon-Lorière, Louis Lambrechts, Novel genome sequences of cell-fusing agent virus allow comparison of virus phylogeny with the genetic structure of *Aedes aegypti* populations, *Virus Evolution*, Volume 6, Issue 1, January 2020, veaa018, https://doi.org/10.1093/ve/veaa018

Abstract - Flaviviruses encompass not only medically relevant arthropod-borne viruses (arboviruses) but also insect-specific flaviviruses (ISFs) that are presumably maintained primarily through vertical transmission in the insect host. Interestingly, ISFs are commonly found infecting important arbovirus vectors such as the mosquito *Aedes aegypti*. Cell-fusing agent virus (CFAV) was the first described ISF of mosquitoes more than four decades ago. Despite evidence for widespread CFAV infections in *A. aegypti* populations and for CFAV potential to interfere with arbovirus transmission, little is known about CFAV evolutionary history. Here, we generated six novel CFAV genome sequences by sequencing three new virus isolates and subjecting three mosquito samples to untargeted viral metagenomics. We used these new genome sequences together with published ones to perform a global phylogenetic analysis of CFAV genetic diversity. Although there was some degree of geographical clustering among CFAV sequences, there were also notable discrepancies between geography and phylogeny. In particular, CFAV sequences from Cambodia and Thailand diverged significantly, despite confirmation that *A. aegypti* populations from both locations are genetically close. The apparent phylogenetic discrepancy between CFAV and its *A. aegypti* host in Southeast Asia indicates that other factors than host population structure shape CFAV genetic diversity.

Cosme, L. V., **Gloria-Soria, A.**, Caccone, A., Powell, J. R. and Martins, A. J. 2020. Evolution of kdr haplotypes in worldwide populations of *Aedes aegypti*: Independent origins of the F1534C kdr mutation. *PLOS Neglected Tropical Diseases 14*(4), p.e0008219.

Abstract - *Aedes aegypti* is the primary vector of dengue, chikungunya, Zika, and urban yellow fever. Insecticides are often the most effective tools to rapidly decrease the density of vector populations, especially during arbovirus disease outbreaks. However, the intense use of insecticides, particularly pyrethroids, has selected for resistant mosquito populations worldwide. Mutations in the voltage gated sodium channel (Na_V) are among the principal mechanisms of resistance to pyrethroids and DDT, also known as

"knockdown resistance," *kdr*. Here we report studies on the origin and dispersion of *kdr* haplotypes in samples of *Ae. aegypti* from its worldwide distribution. We amplified the IIS6 and IIIS6 Na_V segments from pools of *Ae. aegypti* populations from 15 countries, in South and North America, Africa, Asia, Pacific, and Australia. The amplicons were barcoded and sequenced using *NGS* Ion Torrent. Output data were filtered and analyzed using the bioinformatic pipeline Seekdeep to determine frequencies of the IIS6 and IIIS6 haplotypes per population. Phylogenetic relationships among the haplotypes were used to infer whether the *kdr* mutations have a single or multiple origin. We found 26 and 18 haplotypes, respectively for the IIS6 and IIIS6 segments, among which were the known *kdr* mutations 989P, 1011M, 1016I and 1016G (IIS6), 1520I, and 1534C (IIIS6). The highest diversity of haplotypes was found in African samples. *Kdr* mutations 1011M and 1016I were found only in American and African populations, 989P + 1016G and 1520I + 1534C in Asia, while 1534C was present in samples from all continents, except Australia. Based primarily on the intron sequence, IIS6 haplotypes were subdivided into two well-defined clades (A and B). Subsequent phasing of the IIS6 + IIIS6 haplotypes indicates two distinct origins for the 1534C *kdr* mutation. These results provide evidence of *kdr* mutations arising *de novo* at specific locations within the *Ae. aegypti* geographic distribution. In addition, our results suggest that the 1534C *kdr* mutation had at least two independent origins. We can thus conclude that insecticide selection pressure with DDT and more recently with pyrethroids is selecting for independent convergent mutations in Na_V.

Cowles, R. S. 2020. Sulfur Amendment of Soil Improves Establishment and Growth of Firs in a Field Naturally Infested with Phytophthora. *Journal of Environmental Horticulture* 38(1):15–21.

Abstract - Acidification of soil from pH 6 to 4 by incorporating elemental sulfur reduced mortality and improved color and initial growth of Fraser fir, *Abies fraseri* (Pursh) Poir., and Canaan fir, *Abies balsamea* (L.) Mill. var. *phanerolepis* Fernald, planted into a field that had previously experienced significant losses consistent with phytophthora root rot. Acidifying the soil improved tree color starting the year of planting and persisting through five years. During their second year after planting, extension of terminal growth was 12.5 vs. 5.6 cm (4.9 vs. 2.2 in) for plots with soil pH of 4 and 6, respectively, averaged across tree species. In subsequent years, the growth rate of trees was unaffected by having acidified the soil. Over the course of five years, the average annual mortality rate for the trees was 1.4, 4.0, 9.7, and 12.2% for Canaan fir (pH 4), Canaan fir (pH 6), Fraser fir (pH 4), and Fraser fir (pH 6), respectively. However, all tree mortality for Canaan fir planted into acidified soil occurred during the first two years. A root dip with potassium phosphite at the time of planting only benefitted Fraser fir. Minimizing losses of trees in this field would require planting species less susceptible or resistant to phytophthora root rot infection and soil acidification.

Gloria-Soria, A., Mendiola, SY, Morley, VJ, Alto, BW, Turner, PE. Prior evolution in stochastic versus constant temperatures affects RNA virus evolvability at a thermal extreme. *Ecol. Evol.* 2020; 00: 1–11. https://doi.org/10.1002/ece3.6287

Abstract - It is unclear how historical adaptation versus maladaptation in a prior environment affects population evolvability in a novel habitat. Prior work showed that vesicular stomatitis virus (VSV) populations evolved at constant 37°C improved in cellular infection at both 29°C and 37°C; in contrast, those evolved under random changing temperatures between 29°C and 37°C failed to improve. Here, we tested whether prior evolution affected the rate of adaptation at the thermal-niche edge: 40°C. After 40 virus generations in the new environment, we observed that populations historically evolved at random temperatures showed greater adaptability. Deep sequencing revealed that most of the newly evolved mutations were de novo. Also, two novel evolved mutations in the VSV glycoprotein and replicase genes tended to co-occur in the populations previously evolved at constant 37°C, whereas this parallelism was not seen in populations with prior random temperature evolution. These results suggest that prior adaptation under constant versus random temperatures constrained the mutation landscape that could improve fitness in the novel 40°C environment, perhaps owing to differing epistatic effects of new mutations entering genetic architectures that earlier diverged. We concluded that RNA viruses maladapted to their previous environment could "leapfrog" over counterparts of higher fitness, to achieve faster adaptability in a novel environment.

Kruidhof, H. M., and **Elmer, Wade H**. 2020. Cultural control of arthropods and diseases

in the greenhouses in *Integrated Pest and Disease Management in Greenhouse Crops*, eds. M.L. Gullino, R. Albajes, P. Nicot, J.C. van Lenteren, Springer Inc., pp. 285-330.

Abstract - Cultural control measures can be broadly divided into (a) general agricultural practices that can affect pest and disease incidence (e.g., greenhouse climate control, fertilization, irrigation as well as crop density, training and pruning practices), (b) practices that are solely or mainly used for pest and disease control (e.g., sanitation and insect screens), and (c) practices used for both agricultural and crop protection purposes (e.g., choice of crop cultivar and growing medium, grafting, crop rotation and composting). In this book chapter, we describe the ways in which cultural control measures can influence pests and their natural enemies, diseases and their antagonists, and (induced) crop resistance. We discuss how this knowledge can be used to optimize integrated pest and disease management, with special reference to current developments, such as the shift from curative towards preventative pest and disease management, as well as developments in greenhouse energy saving practices and technologies used for sensing, monitoring, and decision making.

Li, K., Wu, G., Liao, Y., **Zeng, Q.**, Wang, H., and Liu, F. (2020) RpoN1 and RpoN2 play different regulatory roles in virulence traits, flagellar biosynthesis, and basal metabolism in *Xanthomonas campestris*. **Mol. Plant Path.** https://doi.org/10.1111/mpp.12938

Abstract - Homologous regulatory factors are widely present in bacteria, but whether homologous regulators synergistically or differentially regulate different biological functions remains mostly unknown. Here, we report that the homologous regulators RpoN1 and RpoN2 of the plant pathogen *Xanthomonas campestris* pv. *campestris* (Xcc) play different regulatory roles with respect to virulence traits, flagellar biosynthesis, and basal metabolism. RpoN2 directly regulated Xcc fliC and fliQ to modulate flagellar synthesis in *X. campestris*, thus affecting the swimming motility of *X. campestris*. Mutation of rpoN2 resulted in reduced production of biofilms and extracellular polysaccharides in Xcc. These defects may together cause reduced virulence of the rpoN2 mutant against the host plant. Moreover, we demonstrated that RpoN1 could regulate branched-chain fatty acid production and modulate the synthesis of diffusible signal factor family quorum sensing signals. Although RpoN1 and RpoN2 are homologues, the regulatory roles and biological functions of these proteins were not interchangeable. Overall, our report provides new insights into the two different molecular roles that form the basis for the transcriptional specialization of RpoN homologues.

Marra, Robert E., and **James A. LaMondia**. 2020. First Report of Beech Leaf Disease, caused by the foliar nematode, *Litylenchus crenatae mccannii*, on American Beech *(Fagus grandifolia*) in Connecticut. Plant Disease, "First Look." https://doi.org/10.1094/PDIS-02-20-0442-PDN

Abstract - First discovered in 2012 in Lake County, Ohio, Beech Leaf Disease (BLD) has since spread to stands of American beech (*Fagus grandifolia* Ehrh.) across much of northern Ohio, western and northern Pennsylvania, New York, and Ontario, Canada (Ewing et al., 2018), and has also been found on European beech (*Fagus sylvatica* L.) in Ohio. The disease is characterized by dark interveinal banding of leaves appearing soon after spring flush, and in advanced stages results in canopy thinning, followed in some cases by tree mortality. Nematodes extracted from symptomatic leaves of American and European beech in North America were confirmed to be most similar to *Litylenchus crenatae* Kanzaki (*Tylenchomorpha: Anguinidae*), a nematode associated with leaf gall symptoms on Japanese beech (*Fagus crenata*) (Kanzaki et al., 2019). However, because North American populations differ in morphology, host range, and ribosomal DNA marker from those in Japan, the North American nematodes associated with BLD have been designated subspecies *L. crenatae mccannii* (Carta et al., 2020). Inoculation of beech seedlings with freshly isolated *L. crenatae mccannii* nematodes resulted in BLD symptoms, confirming the nematode as a cause of BLD in North America (Carta et al., 2020). In the summer of 2019, BLD symptoms were found on American beech trees in Greenwich, Stamford, and New Canaan, Fairfield County, Connecticut. The disease was not observed beyond this area. Symptomatic leaf tissue contained females, males and juveniles with morphometrics consistent with *L. crenatae mccannii* (Carta et al., 2020). Sequence of a 3.6 kb segment of the ribosomal DNA from an isolate from Bartlett Arboretum in Stamford was deposited in the GenBank® database with accession number MT079193. A BLAST search returned a 100% match to similarly sized sequences encompassing partial 18S, partial 28S, and complete ITS and 5.8S sequences from North American *L. crenatae mccannii* strains 104H81 (GenBank® MK292137) and

104H88 (GenBank® MK292138) (Carta et al., 2020). Additionally, the BLAST search returned a 100% match to partial 28S (GenBank® LC383725), and 99% matches to partial 18S (GenBank® LC383723) and complete ITS and 5.8S (GenBank® LC383724) sequences from *Litylenchus crenatae* Kanzaki et al., 2019. This represents the first report of BLD in Connecticut and in New England. The American beech is an important and iconic tree of northern hardwood forests, serving as both habitat and food source for native wildlife. Given the rapid spread and mortality observed in OH, it is therefore important to document the occurrence and development of BLD as it spreads northward and eastward from southwestern CT.

Seelenbinder, John A. and **Christina S. Robb**. Chapter 10: Portable and Handheld Infrared Applications in *Portable Spectroscopy and Spectrometry*: Editors Pauline Leary, Richard Crocombe and Brooke Kammrath, published by John Wiley.

Abstract - Advancements in instrumentation and applications have given rise to portable analytical chemistry techniques, which enable field-based measurement of samples. Moving measurement out of the laboratory provides distinct advantages to several areas including widely dispersed agricultural and environmental samples. Additionally, these handheld techniques allow non-destructive testing of irreplaceable samples, whether they be very old archeological artifacts or the latest aerospace composites, and rapid response for both homeland security and forensic analysis. Portable instrumentation is the fastest growing segment of analytical chemistry; this chapter details the use and application of portable and handheld infrared instrumentation in a wide variety of fields.

Wijayawardene NN, Hyde KD, Al-Ani LKT, Tedersoo L, Haelewaters D, Rajeshkumar KC, Zhao RL, Aptroot A, Leontyev DV, Saxena RK, Tokarev YS, Dai DQ, Letcher PM, Stephenson SL, Ertz D, Lumbsch HT, Kukwa M, Issi IV, Madrid H, Phillips AJL, Selbmann L, Pfliegler WP, Horváth E, Bensch K, Kirk PM, Kolaříková K, Raja HA, Radek R, Papp V, Dima B, Ma J, Malosso E, Takamatsu S, Rambold G, Gannibal PB, Triebel D, Gautam AK, Avasthi S, Suetrong S, Timdal E, Fryar SC, Delgado G, Réblová M, Doilom M, Dolatabadi S, Pawłowska J, Humber RA, Kodsueb R, Sánchez-Castro I, Goto BT, Silva DKA, de Souza FA, Oehl F, da Silva GA, Silva IR, Błaszkowski J, Jobim K, Maia LC, Barbosa FR, Fiuza PO, Divakar PK, Shenoy BD, Castañeda-Ruiz RF, Somrithipol S, Lateef AA, Karunarathna SC, Tibpromma S, Mortimer PE, Wanasinghe DN, Phookamsak R, Xu J, Wang Y, Tian F, Alvarado P, **Li DeWei**, Kušan I, Matočec N, Maharachchikumbura SSN, Papizadeh M, Heredia G, Wartchow F, Bakhshi M, Boehm E, Youssef N, Hustad VP, Lawrey JD, Santiago ALCMA, Bezerra JDP, Souza-Motta CM, Firmino AL, Tian Q, Houbraken J, Hongsanan S, Tanaka K, Dissanayake AJ, Monteiro JS, Grossart HP, Suija A, Weerakoon G, Etayo J, Tsurykau A, Vázquez V, Mungai P, Damm U, Li QR, Zhang H, Boonmee S, Lu YZ, Becerra AG, Kendrick B, Brearley FQ, Motiejūnaitė J, Sharma B, Khare R, Gaikwad S, Wijesundara DSA, Tang LZ, He MQ, Flakus A, Rodriguez-Flakus P, Zhurbenko MP, McKenzie EHC, Stadler M, Bhat DJ, Liu JK, Raza M, Jeewon R, Nassonova ES, Prieto M, Jayalal RGU, Erdoğdu M, Yurkov A, Schnittler M, Shchepin ON, Novozhilov YK, Silva-Filho AGS, Liu P, Cavender JC, Kang Y, Mohammad S, Zhang LF, Xu RF, Li YM, Dayarathne MC, Ekanayaka AH, Wen TC, Deng CY, Pereira OL, Navathe S, Hawksworth DL, Fan XL, Dissanayake LS, Kuhnert E, Grossart HP, Thines M 2020 – Outline of Fungi and fungus-like taxa. Mycosphere 11(1):1060–1456, Doi 10.5943/mycosphere/11/1/8.

Abstract - This article provides an outline of the classification of the kingdom Fungi (including fossil fungi. i.e. dispersed spores, mycelia, sporophores, mycorrhizas). We treat 19 phyla of fungi. These are Aphelidiomycota, Ascomycota, Basidiobolomycota, Basidiomycota, Blastocladiomycota, Calcarisporiellomycota, Caulochytriomycota, Chytridiomycota, Entomophthoromycota, Entorrhizomycota, Glomeromycota, Kickxellomycota, Monoblepharomycota, Mortierellomycota, Mucoromycota, Neocallimastigomycota, Olpidiomycota, Rozellomycota and Zoopagomycota. The placement of all fungal genera is provided at the class-, order- and family-level. The described number of species per genus is also given. Notes are provided of taxa for which recent changes or disagreements have been presented. Fungus-like taxa that were traditionally treated as fungi are also incorporated in this outline (i.e., Eumycetozoa, Dictyosteliomycetes, Ceratiomyxomycetes and Myxomycetes). Four new taxa are introduced: Amblyosporida ord. nov. Neopereziida ord. nov. and Ovavesiculida ord. nov. in Rozellomycota, and Protosporangiaceae fam. nov. in Dictyosteliomycetes. Two different classifications (in outline section and in discussion) are provided for Glomeromycota and Leotiomycetes based on recent studies. The phylogenetic reconstruction of a four-gene dataset (18S and 28S rRNA, RPB1, RPB2) of 433 taxa is presented, including all currently described orders of fungi.

JOURNAL ARTICLES APPROVED APRIL 2020

An, J., P. Hu, F. Li, H. Wu, Y. Shen, **Jason C. White**, X. Tian, Z. Li, and J. P. Giraldo. Molecular mechanisms of plant salinity stress tolerance improvement by seed priming with cerium oxide nanoparticles. *Environmental Science & Technology*

Aulakh, Jatinder S. Comparison of preemergence herbicide treatments for weed control in Canaan fir (*Abies balsamea* var. *phanerolepis*). *CAES Bulletin*

Aulakh, Jatinder S. Lesser celandine (*Ficaria verna* Huds.) identification and management. *CAES Fact Sheet*

Aulakh, Jatinder S. Palmer amaranth: A new devastating weed at your doorsteps. *The Real Tree Line*

Castroagudin, V. L., J. Weiland, F. Baysal-Gurel, M. Cubeta, M. Daughtrey, N. Gauthier, **James LaMondia**, D. Luster, F. Peduto-Hand, N. Shishkoff, J. Williams-Woodward, X. Yang, N. LeBlanc, and J. Crouch. One clonal lineage of *Calonectria pseudonaviculata* is primarily responsible for the boxwood blight epidemic in the United States. *Phytopathology*

Gloria-Soria, Andrea, S. Y. Mendiola, V. J. Morley, B. W. Alto, and P. E. Turner. Prior evolution in stochastic versus constant temperatures affects RNA virus evolvability at a thermal extreme. *Ecology and Evolution*

Hiskes, Rose T. Acorn pip/woolly catkin gall, *Cynpidae*: *Callirhytis quercusoperator*. *CAES Fact Sheet*

Kang, H., **Wade Elmer**, Y. Shen, P. B. Asunción, **Nubia Zuverza-Mena**, **Chuanxin Ma**, **Jason C. White**, and C. L. Haynes. Silica nanoparticle dissolution rate controls the suppression of Fusarium wilt of watermelon (*Citrullus lanatus*). *ACS Nano*

Koelmel, J. P., M. Paige, J. J. Aristizabal-Henao, N. M. Robey, **Sara Nason**, et al. Towards comprehensive PFAS annotation using FluoroMatch software and intelligent LC-HRMS/MS acquisition methods. *Nature Methods*

Kruidhof, H. M. and **Wade H. Elmer**. Cultural control of arthropods and diseases in the greenhouse. Chapter in *Integrated Pest and Disease Management in Greenhouse Crops*, M. L. Gullino, R. Albajes, P. Nicot, and J. C. van Lenteren, editors.

LaMondia, James A. and Katja Maurer. *Calonectria pseudonaviculata* conidia dispersal and implications for boxwood blight management. *Plant Health Progress*

Li, C., R. Zhang, **Chuanxin Ma**, H. Shang, D. J. McClements, **Jason C. White**, and B. Xing. Food-grade titanium dioxide particles influence the bioaccessibility of vitamin D_3 under simulated gastrointestinal conditions. *Journal of Agricultural and Food Chemistry*

Machtinger, E. T. and **Scott C. Williams**. Practical guide to trapping *Peromyscus leucopus* and *Peromyscus maniculatus* for vector and vector-borne pathogen surveillance and ecology. *Journal of Insect Science*

Niu, Z., K. Zhang, **De-Wei Li**, J. Ma, and R. F. Castañeda-Ruiz. *Distobactrodesmium* gen. nov. to accommodate *Bactrodesmium rhamii* and notes on *Bactrodesmium*. *Mycotaxon*

Paesano, L., M. Marmiroli, M. G. Bianchi, **Jason C. White**, O. Bussolati, A. Zappettini, M. Villani, and N. Marmiroli. Data on miRNome changes in human cells exposed to nano- or ionic- forms of cadmium. *Data in Brief*

Seelenbinder, J. A. and **Christina S. Robb**. Portable and handheld infrared spectroscopy. Portable Spectroscopy and Spectrometry 1: Vibrational. *Optical and Bioanalytical Instrumentation and Approaches*, John Wiley.

Shang, H., **Chuanxin Ma**, C. Li, **Jason C. White**, B. Chefetz, T. Polubesova, and B. Xing. Copper sulfide nanoparticles suppress *Gibberella fujikuroi* infection in *Oryza sativa* seeds

by multiple mechanisms: Contact-mortality, nutritional modulation and phytohormone regulation. *Environmental Science: Nano*

Song, C., X. Cheng, **Jason C. White**, H. Zhang, L. Zhao, J. He, Y. Zhu, and Y. Wang. Metabolic profile and physiological response of cucumber exposed to engineered MoS_2 and TiO_2 nanoparticles. *Journal of Agricultural and Food Chemistry*

Wang, Q. H., Y. P. Ji, Y. Y. Qu, Y. K. Qi, **De-Wei Li**, and X. Q. Wu. The response strategies of *Colletotrichum gloeosporioides* s.s. for the stress of biological control agent *Bacillus amyloliquefaciens* deciphered by transcriptome. *Molecular Plant-Microbe Interactions*

ARTICLES OF INTEREST APRIL 2020

The Connecticut Agricultural Experiment Station's Virus Laboratory donated the following PPE to Saint Mary's Hospital on April 2, 2020, to help healthcare professionals combat the COVID-19 pandemic:

- 5 cases of nitrile gloves
- 2 cases of gowns
- 40 N95/N100 respirators
- 15 face shields

The Virus Laboratory also donated 2 QIAamp Viral RNA Mini kits which allowed for 500 extractions to the DPH Laboratory in Rocky Hill to support COVID testing in the state. Dr. Jason White, Director, was on a state-wide call on Monday, April 6, 2020, and our agency's contribution was specifically highlighted.

Image of the items loaded in a car for drop off to the hospital 4/2/2020. Angela Bransfield

Dakota Peter Thiel, born 4/22/20, 6 lb. 11 oz., 18 inches, and mother and boy are doing fine.

NEW STAFF, STUDENTS, AND VOLUNTEERS APRIL 2020

Dr. Susanna Keriö – Urban tree stress scientist at CAES

Dr. Susanna Keriö joined the Department of Forestry and Horticulture on April 13. She has expertise in disease resistance of trees to fungal pathogens, and the molecular and genetic factors associated with tree-fungus interaction. Her current research at CAES aims at applying this knowledge to develop innovative management strategies to reduce tree stress and to support tree health in urban environments. Her doctorate research at the University of Helsinki focused on the transcriptional and chemical defense responses of Norway spruce and Scots pine to the *Heterobasidion* root rot pathogens. In her postdoctorate at Oregon State University, Dr. Keriö's research aimed at identifying genetic variation in *Populus trichocarpa* associated with resistance to the Septoria leaf spot and stem canker pathogen *Sphaerulina musiva*. In Oregon, she witnessed firsthand the destruction caused by forest fires, sudden oak death, and Swiss needle cast. This reinforced her commitment to work towards improving tree resilience through applied research. Dr. Keriö looks forward to collaborating with forestry professionals and tree enthusiasts to address the future challenges of urban tree health in Connecticut.

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