

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION

Record of the Year

2018-2019



CAES

The Connecticut Agricultural Experiment Station

Putting Science to Work for Society since 1875

The Connecticut Agricultural Experiment Station, founded in 1875, was the first state agricultural experiment station in the United States. The Station has laboratories, offices, and greenhouses at 123 Huntington Street, New Haven 06511, Lockwood Farm for experiments on Evergreen Avenue in Hamden 06518, the Valley Laboratory and farm on Cook Hill Road, Windsor 06095, and a research center in Griswold and Voluntown. Station Research is conducted by members of the following departments: Analytical Chemistry, Entomology, Environmental Sciences, Forestry and Horticulture, Plant Pathology and Ecology, and the Valley Laboratory. The Station is chartered by the Connecticut General Statutes to experiment with plants and their pests, insects, soil and water and to perform analyses.

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BOARD OF CONTROL

The management of The Station is vested in a Board of Control as specified in section 22-79 of the General Statutes of Connecticut.

The members of the Board of Control as of June 30, 2019 were:

Governor Ned Lamont, President	Dr. Erol Fikrig
Terry Jones, Vice President	Ms. Joan Nichols
Paul C. Larson, Secretary	Dr. Dana Royer
Dr. Theodore G. Andreadis, Director	Ms. Patti J. Maroney
Commissioner Bryan Hurlburt	

The Board of Control met on August 8, 2018, October 17, 2018, January 16, 2019, and April 10, 2019.

STATION STAFF

The Experiment Station exists to advance scientific knowledge, and that advance depends completely upon the quality and dedication of its staff. The following was the staff of The Connecticut Agricultural Experiment Station as of June 30, 2019.

ADMINISTRATION

Dr. Theodore G. Andreadis, Director
Dr. Jason C. White, Vice Director
Michael P. Last, Chief Financial Officer
Dianne F. Albertini
Vickie M. Bomba-Lewandoski
Sandra E. Carney
Michael J. Cavadini
Lisa L. Kaczinski
Jennifer L. Stevens

ANALYTICAL CHEMISTRY

Dr. Jason C. White, Vice Director, Department Head
Dr. Ishaq Adisa
Michael A. Ammirata
Terri Arsenault
Dr. Roberto De La Torre-Roche
Dr. Brian D. Eitzer
Dr. Walter J. Krol
Dr. Chuanxin Ma
Dr. MaryJane Incorvia Mattina, Emeritus
Craig L. Musante
Kitty Prapayotin-Riveros
John F. Ranciato
Dr. Christina S. Robb
Dr. Nubia Zuverza-Mena

ENTOMOLOGY

Dr. Kirby C. Stafford III, Department Head
Dr. John F. Anderson, Emeritus
Tia Blevins
Mark H. Creighton
Katherine Dugas
Jeffrey M. Fengler
Dr. Megan A. Linske
Dr. Eliza A.H. Little
Morgan F. Lowry
Dr. Chris T. Maier
Dr. Gale E. Ridge
Dr. Claire E. Rutledge
Dr. Victoria L. Smith
Dr. Kimberly A. Stoner
Heidi R. Stuber
Tracy A. Zarrillo

ENVIRONMENTAL SCIENCES

Dr. Joseph J. Pignatello, Department Head
Dr. Philip M. Armstrong
Dr. Xiangyu Bi
Dr. Douglas E. Brackney
Angela B. Bransfield
Gregory J. Bugbee
Duncan W. Cozens
Alexander J. Diaz
Dr. Andrea Gloria-Soria
Dr. Josephine C. A. Hyde
Dr. Joseph R. McMillan
Michael J. Misencik
Dr. Goudarz Molaei
Dr. Sara L. Nason
Tanya A. Petruff
Dr. Brij L. Sawhney, Emeritus
Dr. Rohit Sharma
John J. Shepard
Summer Stebbins
Dr. Blaire T. Steven
Dr. Charles R. Vossbrinck
Dr. Zhengyang Wang
Dr. Yi Yang

FORESTRY AND HORTICULTURE

Dr. Jeffrey S. Ward, Department Head
Joseph P. Barsky
Joan L. Bravo
Dr. Martin P.N. Gent, Emeritus
Dr. David E. Hill, Emeritus
Dr. Abigail A. Maynard
Michael R. Short
Dr. Paul E. Waggoner, Emeritus
Dr. Scott C. Williams

GRISWOLD RESEARCH CENTER

Robert J. Durgy, Research Farm Manager

LOCKWOOD FARM

Richard M. Cecarelli, Research Farm Manager
Rollin J. Hannan
Michael M. McHill

MAINTENANCE

Eric M. Wagner, Maintenance Supervisor
Isaac K. Bildad
Eric J. Flores
Brian Hart
Ronald A. LaFrazier

Miguel Roman
Michael A. Scott

PLANT PATHOLOGY AND ECOLOGY

Dr. Wade H. Elmer, Department Head
Dr. Sandra L. Anagnostakis, Emeritus
Dr. Donald E. Aylor, Emeritus
Dr. Zhouqi Cui
Dr. Washington L. da Silva
Dr. Sharon M. Douglas, Emeritus
Dr. Francis J. Ferrandino
Regan B. Huntley
Dr. Yonghao Li
Dr. Robert E. Marra
Dr. Neil A. McHale, Emeritus
Dr. Richard B. Peterson, Emeritus
Dr. Neil P. Schultes
Dr. Teja S. Shidore
Peter W. Thiel
Dr. Lindsay R. Triplett
Dr. Israel Zelitch, Emeritus
Dr. Quan Zeng

VALLEY LABORATORY

Dr. James A. LaMondia, Department Head
Dr. Elisha B. Allan-Perkins
Dr. Jatinder S. Aulakh
Jane Canepa-Morrison
Dr. Carole A. Cheah
Dr. Richard S. Cowles
Jeffrey M. Fengler
Rose T. Hiskes
Dr. DeWei Li
James J. Preste, Research Farm Manager
Thomas M. Rathier, Emeritus
Diane Riddle
Michelle R. Salvas

NEW SCIENTIFIC STAFF

Dr. Washington da Silva



Dr. Washington da Silva joined the staff in the Department of Plant Pathology and Ecology as an Assistant Agricultural Scientist II in July 2018. He is a plant pathologist with expertise in the fields of diagnoses, bioinformatics, and molecular biology. Dr. da Silva received his B.Sc. from the Universidade Federal de Viçosa (Brazil), M.Sc. in Plant Health from Louisiana State University, and Ph.D. in Plant Pathology from Cornell University. He uses state-of-the-art technologies (e.g., high throughput sequencing) to study the biology and ecology of viruses infecting fruit crops. The top two priorities of his current research program are to develop and improve molecular diagnostics for plant viruses and to investigate plant-virus-vector interactions with the ultimate goal of translating findings into virus disease management. He is currently investigating the incidence, prevalence, and genetic diversity of grapevine viruses in the state of Connecticut.

Dr. Sara Nason



Dr. Sara Nason joined the staff in the Department of Analytical Chemistry and Department of Environmental Sciences as an Assistant Agricultural Scientist II in February 2019. Dr. Nason is an environmental chemist who received her B.S. in Geosciences and Environmental Studies from Princeton University and Ph.D. in Environmental Chemistry and Technology from the University of Wisconsin, Madison. She is conducting research on the use of liquid chromatography coupled with high resolution mass spectrometry (LC-HRMS) to detect contaminants in agricultural and environmental systems. She is interested in understanding how organic contaminants move and transform in the environment and how environmental releases of chemicals can lead to unintended human exposures and health impacts. Dr. Nason's current projects include: examining contaminant movement and transformation in agricultural systems that use recycled wastewater for irrigation, testing the effectiveness of remediation efforts for sites contaminated with per- and polyfluoroalkyl substances, and developing reliable and reproducible methods for suspect screening and non-targeted analysis studies using LC-HRMS.

Dr. Nubia Zuverza



Dr. Nubia Zuverza joined the staff in the Department of Analytical Chemistry as an Assistant Agricultural Scientist II in July 2018. She is a food chemist with expertise in phytoremediation and nanotechnology. Dr. Zuverza received her B.S. in Chemistry, M.S. in Metallurgy and Materials Engineering, and Ph.D. in Materials Science and Engineering from the University of Texas at El Paso. She is conducting research on the detection and analysis of emerging contaminants in food and food packaging, including: pharmaceutical and personal care products, genetically modified organisms, allergens and mycotoxins, and engineered nanomaterials.

RETIREMENTS

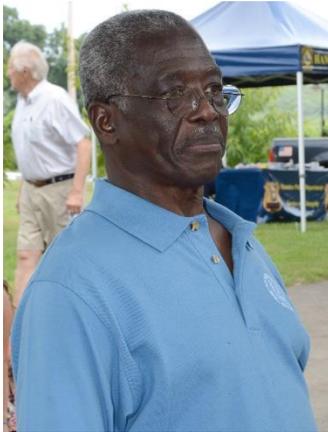
Dr. Chris T. Maier



Chris T. Maier joined the Station staff on June 20, 1977. Over the course of nearly 42 years, Chris conducted field and laboratory studies on a wide variety of insect pests of fruit trees, forests, and nursery stock. An outstanding naturalist, he focused much of his work on the activity and distribution of exotic invasive insects throughout the state and region. He provided extensive service to the growers and citizens of Connecticut assisting fruit growers, nurseries, and foresters by providing information on insect life cycles, distribution, and control and he worked closely with federal partners in the USDA and US Forest Service. A recognized authority on a wide variety of insect groups including flies, wood-boring beetles, bees, periodical cicadas, and many other insects, his contributions are manifest in an extensive scientific publication record. For over nearly forty-two years, Dr. Chris Maier ably served the citizens and growers of

Connecticut, enhancing the ability of researchers and growers to understand and handle the diversity of pests threatening the agricultural industry and our forests. His service truly exemplifies the Experiment Station motto: “Putting Science to Work for Society.” We honor Dr. Maier and his contributions on the occasion of his retirement.

Mr. Bancroft Nicholson



Bancroft Nicholson joined The Connecticut Agricultural Experiment Station in 1996 as a Maintenance Supervisor and proudly served the State of Connecticut and the Station for 22 years. As a hard-working, loyal, and dedicated Station staff member, Bancroft always provided outstanding and invaluable service and support to the agency in a courteous and professional manner. Bancroft managed the cleaning, maintenance, and renovation of our laboratory buildings and the necessary updating of the Station’s aging infrastructure. Bancroft’s skill, talent, dedication, and loyalty to the Experiment Station along with his professional and friendly personality are qualities that will leave a void and most certainly be missed. A true public servant and ambassador for the Experiment Station and the State of Connecticut, we honor and express gratitude to Bancroft Nicholson for his extraordinary service on the occasion of his retirement.

The Connecticut Agricultural Experiment Station 108th Plant Science Day

Lockwood Farm, Hamden, CT
Wednesday, August 8, 2018

Health

Food Safety

Agriculture

Environment

The collage features six photographs: a tall green plant with small flowers, a white hibiscus flower with red streaks, a man in a blue shirt and cap working with a beehive, a cluster of red and green apples, a purple butterfly orchid, and a large wooden pavilion with people seated underneath.





PLANT SCIENCE DAY 2018

The weather on Plant Science Day 2018 was in the 90s and hot and humid. A total of 937 guests visited Lockwood Farm, making it one of the more heavily attended Open Houses at the Farm in recent years.

Director Theodore G. Andreadis welcomed attendees in the Pavilion and gave opening remarks. Ms. Vickie Bomba-Lewandoski moderated the Short Talks and introduced the speakers.

All the short talks were very well attended:

SHORT TALKS:

Dr. Wade H. Elmer	Are Nanoparticles the New Weapon Against Plant Disease?
Dr. Quan Zeng	Fire Blight: History, Management, and New Challenges
Dr. Carole A. Cheah	Climate Impacts on Hemlocks and Hemlock Woolly Adelgid in the Northeast

The Demonstration Tent was full for all the demonstrations of the day:

DEMONSTRATION TENT:

Mr. Mark H. Creighton	Beekeeping Systems Used in Connecticut
Mr. Gregory J. Bugbee	Invasive Aquatic Plant Program

Attendees took advantage of several tours around the farm:

BUS TOURS – Dr. Neil Schultes and Dr. Abigail Maynard, Guides

Visitors wanting to cool off and take a narrated tour of Lockwood Farm rode an air-conditioned bus for a 30-minute ride. They were able to get off the bus at any plots that interested them and then rejoin the tour when the next bus came around. It was a very popular feature.

BARN EXHIBITS:

A steady flow of visitors went through the barn throughout the day to view the exhibits and listen to scientists explain their research.

- **The Gypsy Moth Outbreak of 2017.** Investigator: Dr. Victoria Lynn Smith. Assisted by Ms. Tia Blevins, Mr. Zachary Brown, and Mr. Jeffrey M. Fengler.
- **Select Agent Analysis at CAES.** Investigators: Dr. Christina S. Robb, Dr. Walter J. Krol, and Dr. Brian D. Eitzer.
- **Indoor Molds and Their Management.** Investigator: Dr. DeWei Li.
- **The New Crops Program – Creating Opportunities for Connecticut’s Farmers.** Investigator: Dr. Abigail A. Maynard. Assisted by Ms. Valerie Perzanowski.

- **Computational Biochemistry Applied to Agriculture.** Investigator: Dr. Charles R. Vossbrinck. Assisted by Dr. Jonas Barandun and Dr. Mirjam Hunziker
- **Using Nanoparticles to Suppress Plant Diseases.** Investigators: Dr. Wade H. Elmer and Dr. Jason C. White. Assisted by Mr. Peter W. Thiel, Dr. Chuanxin Ma, Dr. Roberto De La Torre-Roche, and Dr. Nubia Zuverza-Mena.

QUESTION AND ANSWER TENT:

Throughout the day, hundreds of questions were answered by the staff under the Question and Answer Tent. The tent was manned by Dr. Yonghao Li, Dr. Gale E. Ridge, Ms. Rose Hiskes, and Ms. Diane Riddle.

FIELD PLOTS:

The plots at Lockwood Farm are planted and maintained by The Connecticut Agricultural Experiment Station's scientists and technical staff, along with the help of Farm Manager Mr. Richard Cecarelli and his Research Technicians Mr. Rollin Hannan and Mr. Michael McHill as well as seasonal resource assistants Ms. Jamie Buonocore and Mr. Christopher Dunhill. Visitors were able to visit the following 81 field plots:

CHINESE CHESTNUT TREES	Dr. Sandra Anagnostakis
SHEET COMPOSTING WITH MAPLE AND OAK LEAVES	Dr. Abigail Maynard
ANNUAL PRODUCTION OF GLOBE ARTICHOKE	Dr. Abigail Maynard
DEMONSTRATION OF FIGS	Dr. Charles R. Vossbrinck, assisted by Mr. Mario DiNatale
USE OF NANOPARTICLES ON FUSARIUM CROWN ROT OF ASPARAGUS	Dr. Wade Elmer, assisted by Mr. Peter Thiel
COMMERCIAL CHESTNUT CULTIVARS	Dr. Sandra Anagnostakis
COMMERCIAL CHESTNUT SEEDLINGS	Dr. Sandra Anagnostakis
REMOTE ACCESS WEATHER STATION	Dr. Francis J. Ferrandino, assisted by Ms. Joan L. Bravo
TECHNICAL DEMONSTRATION TENT	
CONTROL OF BLIGHT ON AMERICAN CHESTNUTS	Dr. Sandra Anagnostakis
NEW HYBRID CHESTNUT ORCHARD	Dr. Sandra Anagnostakis
USE OF NANOPARTICLES OF METAL OXIDES TO SUPPRESS DISEASES OF EGGPLANTS, WATERMELONS, AND CABBAGE	Dr. Wade Elmer, Dr. Lindsay Triplett, Dr. Roberto De La Torre-Roche, Dr. Nubia Zuverza-Mena, Dr. Chuanxin Ma, and Dr. Jason White, assisted by Mr. Peter Thiel

TABLE GRAPE DEMONSTRATION PLOT	Dr. Francis J. Ferrandino, assisted by Ms. Joan L. Bravo
ENVIRONMENTALLY-FRIENDLY CONTROL OF POWDERY MILDEW ON LANDSCAPE PLANTS	Dr. Francis J. Ferrandino, assisted by Ms. Joan L. Bravo
EFFECT OF NANOPARTICLES OF CuO ON POWDERY MILDEW ON WINE GRAPES	Dr. Wade H. Elmer and Dr. Francis J. Ferrandino, assisted by Ms. Joan L. Bravo and Mr. Peter Thiel
STUDENT RESEARCH: CHRYSANTHEMUM WILT DISEASE TRIAL	Mr. Zach Seltzer, Mr. Lance Moore, Mr. Steven Miller, Ms. Tia Brown, Ms. Victoria Romero, Ms. Jillian Tate, Ms. Gillian Page, Ms. Ceara Wetterman, Ms. Collette McMahan, Mr. Melvin Mercado Ayala, and Mr. Kelvin Mintah, assisted by Dr. Lindsay Triplett and Dr. Wade Elmer
COMPARISON OF GRAFT UNION HEIGHT ON CHARDONNAY GRAPEVINES	Dr. Francis J. Ferrandino, assisted by Ms. Joan L. Bravo
SEEDLINGS OF OLD SURVIVING AMERICAN CHESTNUTS	Dr. Sandra Anagnostakis
WILD CHESTNUTS FROM TURKEY	Dr. Sandra L. Anagnostakis
INTEGRATING NITROGEN FERTILIZATION, HERBICIDES, AND OVERSEEDING FOR MUGWORT (<i>ARTEMISIA VULGARIS L.</i>) MANAGEMENT	Dr. Jatinder S. Aulakh, assisted by Mr. Nicholas Keegan and Ms. Jordan Wojciekofsky
IDENTIFICATION AND CONTROL OF COMMON WEEDS OF HOME GARDENS AND COOL SEASON HOME LAWNS	Dr. Jatinder S. Aulakh, assisted by Mr. Nicholas Keegan and Ms. Jordan Wojciekofsky
QUESTIONS AND ANSWERS TENT	Ms. Rose Hiskes, Dr. Yonghao Li, Ms. Diane Riddle, and Dr. Gale E. Ridge
COMPOSTING LEAVES USING THE STATIC PILE METHOD	Dr. Abigail Maynard
HAMDEN POLICE DEPARTMENT	
VERIZON WIRELESS	
THE FARMER'S COW	Ms. Kathy Smith
KIDS' KORNER	Ms. Terri Arsenault
SELF-GUIDED ACTIVITY FOR ALL	Ms. Terri Arsenault

CHILDREN, INCLUDING GIRL SCOUTS

EXPERIMENT STATION ASSOCIATES

Mr. Skip Hobbs

DESIGNER BIOCHARS: CAPTURING EXCESS
NUTRIENTS IN ANIMAL WASTES

Dr. Joseph J. Pignatello, assisted by Mr. Connor
McLaughlin

HANDS-ON CHEMISTRY

Mr. John Ranciato, Mr. Michael Ammirata, and
Dr. Jason C. White

NANOMATERIALS IN AGRICULTURE:
IMPLICATIONS AND APPLICATIONS

Dr. Roberto De La Torre-Roche, Dr. Chuanxin
Ma, Dr. Nubia Zuverza-Mena, Dr. Wade
Elmer, Mr. Peter Thiel, and Dr. Jason C.
White

CAES, CT DEPARTMENT OF AGRICULTURE
AND THE FDA AFRPS

Dr. Nubia Zuverza-Mena, Dr. Brian D. Eitzer,
Dr. Jason C. White, Mr. Wayne Nelson, and
Ms. Kate Ciarletta

THE PUBLIC HEALTH AND ENTOMOLOGY TENT:

STATEWIDE MONITORING PROGRAM FOR
MOSQUITO-BORNE VIRAL DISEASES IN
CONNECTICUT

Dr. Philip M. Armstrong, Dr. Theodore
Andreadis, and Mr. John Shepard, assisted by
Ms. Angela Bransfield, Mr. Michael Misencik,
Ms. Tanya Petruff, Ms. Stephanie Canales,
Mr. Daniel Cole, Mr. Duncan Cozens, Mr.
Christopher Driscoll, Mr. Ryan Gregory, Ms.
Noelle Khalil, Mr. Jack Miller, Mr. Michael
Olson, Ms. Demi Rodriguez, and Ms. Danielle
Sohai

TRACKING TICKS AND TICK-ASSOCIATED
DISEASES IN CONNECTICUT

Dr. Goudarz Molaei, assisted by Mr. Alex Diaz,
Ms. Mallery Breban, and Ms. Darya
Pokutnaya

THE BLACKLEGGED TICK (DEER TICK)
IXODES SCAPULARIS AND LONE STAR
TICK, *AMBLIOMMA AMERICANUM*

Dr. Kirby C. Stafford III, assisted by Ms. Heidi
Stuber and Ms. Sarah Hemstock

BLOOD FEEDING HABITS OF THE ASIAN
TIGER MOSQUITO, THE POTENTIAL
VECTOR OF ZIKA AND OTHER VIRUSES

Dr. Olivia T. Harriott and Dr. Goudarz Molaei,
assisted by Mr. Alexander Diaz

DISTRIBUTION, SURVIVAL, AND
ESTABLISHMENT OF THE LONE STAR
TICK, *AMBLIOMMA AMERICANUM*, IN
CONNECTICUT

Dr. Kirby C. Stafford III, Dr. Goudarz Molaei,
Dr. Scott C. Williams, Dr. Megan Linske, and
Dr. Eliza Little, assisted by Ms. Heidi Stuber,
Mr. Michael Short, and Ms. Sarah Hemstock

PASSIVE TICK SURVEILLANCE AND
SPATIOTEMPORAL DYNAMICS OF THE

Dr. Eliza A. H. Little, Dr. John F. Anderson, Dr.
Kirby C. Stafford III, and Dr. Goudarz Molaei,

LYME DISEASE SPIROCHETE INFECTION IN BLACKLEGGED TICKS IN CONNECTICUT, 1996-2016	assisted by Mr. Alexander Diaz, Ms. Mallery Breban, and Ms. Darya Pokutnaya
A WORLD OF VIRUSES	Dr. Douglas Brackney
ESTABLISHING BEE FORAGE TO ASSIST HONEY BEE GENETIC IMPROVEMENT	Dr. Richard S. Cowles
INVASIVE INSECTS IN THE NORTHEAST	Dr. Chris T. Maier, assisted by Ms. Tracy Zarrillo and Ms. Morgan Lowry
ORGANIC CONTROL OF FIRE BLIGHT ON APPLES	Dr. Neil Schultes, Dr. Quan Zeng, and Dr. Zhouqi Cui, assisted by Ms. Sali Diallo
SUPPRESSION OF POWDERY MILDEW OF PUMPKIN WITH NANOPARTICLES	Dr. Wade Elmer and Dr. Jason White, assisted by Mr. Peter Thiel
THE PAVILION AT LOCKWOOD FARM	
NATIVE WOODY SHRUBS	Dr. Jeffrey S. Ward, assisted by Mr. Joseph P. Barsky
INFLUENCE OF CROP TREE RELEASE ON BLACK BIRCH GROWTH	Dr. Jeffrey S. Ward, assisted by Mr. Joseph P. Barsky
BIRD AND BUTTERFLY GARDEN	Ms. Jane Canepa-Morrison and Mr. Jeffrey Fengler
VARIATION IN POLLINATOR VISITATION AMONG CULTIVATED VARIETIES OF ORNAMENTAL PLANTS	Dr. Kimberly A. Stoner, assisted by Ms. Morgan F. Lowry and Ms. Tracy Zarrillo
ENVIRONMENTALLY-FRIENDLY CONTROL OF POWDERY MILDEW ON VEGETABLE PLANTS	Dr. Francis J. Ferrandino, assisted by Ms. Joan L. Bravo
INVASIVE AQUATIC PLANT PROGRAM	Mr. Gregory Bugbee, assisted by Ms. Summer Stebbins
CHESTNUT SPECIES AND HYBRIDS	Dr. Sandra Anagnostakis
HEALTHY PLANTS—HEALTHY BUSINESS: SUPPORT OF THE GREEN INDUSTRY BY INSPECTION	Dr. Victoria L. Smith, assisted by Ms. Tia Blevins, Mr. Zachary Brown, Mr. Mark Creighton, and Mr. Jeffrey Fengler
THE COOPERATIVE AGRICULTURAL PEST SURVEY (CAPS) PROGRAM AND FARM BILL SURVEYS	Ms. Katherine Dugas, assisted by Mr. Zachary Brown and Mr. Adam Cohen
BIOLOGICAL CONTROL OF HEMLOCK	Dr. Carole A. Cheah

WOOLLY ADELGID AND MILE-A-MINUTE WEED	
IT GOES BOTH WAYS: A NATIVE AMERICAN BORER AS A POTENTIAL INVASIVE IN EUROPE AND ASIA	Dr. Claire E. Rutledge, assisted by Ms. Mioara Scott and Mr. Dennis Hicks
THE ROCK	
BEACH PLUM TRIALS	Dr. Abigail Maynard
PAWPAW TRIALS	Dr. Abigail Maynard
JAPANESE PLUM VARIETY TRIALS	Dr. Abigail Maynard
PINOT GRIS CULTURAL TRIALS	Ms. Joan L. Bravo and Dr. Francis J. Ferrandino
HYBRID AND VINIFERA WINEGRAPE CULTIVAR TRIAL	Ms. Joan Bravo and Dr. Francis J. Ferrandino
BUTTERNUT SQUASH TRIALS	Dr. Abigail Maynard
SWEET POTATO TRIALS	Dr. Abigail Maynard
HEIRLOOM TOMATO VARIETY TRIALS	Dr. Abigail Maynard
BRUSSELS SPROUTS TRIALS	Dr. Abigail Maynard
HOPS – VARIETY EVALUATION AND INTEGRATED PEST MANAGEMENT	Dr. James A. LaMondia, assisted by Ms. Michelle Salvas
CONNECTICUT BOTANICAL SOCIETY	Ms. Truda Steinnagel, Mr. David Yih, and Mr. Frank Kaputa
CONNECTICUT DEPARTMENT OF LABOR/ CONN-OSHA	Ms. Catherine Zinsser
CONNECTICUT DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION: WILDLIFE DIVISION	Mr. Paul Benjunas and Ms. Laura Rogers-Castro
CONNECTICUT DEPARTMENT OF AGRICULTURE	Ms. Rebecca Eddy
CONNECTICUT ENVIRONMENTAL COUNCIL	Ms. Erica Fearn
CONNECTICUT FARMLAND TRUST	Ms. Brianna Dunlap and Ms. Kathleen Doherty
CONNECTICUT HORTICULTURAL SOCIETY	Ms. Cheryl Marino

CT NOFA NORTHEAST FARMING ASSOCIATION	Mr. Patrick Corelli
CT PROFESSIONAL TIMBER PRODUCERS ASSOCIATION	Mr. Brennan Sheahan
FEDERATED GARDEN CLUBS OF CONNECTICUT, INC.	Ms. Polly Brooks
LYMAN HALL HIGH SCHOOL AGRICULTURAL SCIENCE AND TECHNOLOGY PROGRAM	Ms. Emily Picard
SLEEPING GIANT PARK ASSOCIATION	Ms. Julie Hulten
THE SOUND SCHOOL	Ms. Pebbles Lacross
SOUTH CENTRAL CONNECTICUT REGIONAL WATER AUTHORITY	Ms. Kate Powell, Ms. Lisa DiFrancesco, Mr. Jeff Yale, Mr. Ron Walters, and Ms. Nicole Smith
UCONN EXTENSION MASTER GARDENER PROGRAM	Ms. Jude Hsiang and Ms. Cheryl Cappiali
US DEPARTMENT OF LABOR/OSHA	Ms. Leona May
USDA FARM SERVICE AGENCY	Ms. Kathy Dangelo and Ms. Teresa Peavey
CONNECTICUT FARM BUREAU ASSOCIATION	Ms. Joan Nichols
USDA, ANIMAL AND PLANT HEALTH INSPECTION SERVICE, PLANT PROTECTION AND QUARANTINE	Mr. Eric Chamberlain and Mr. Ken DiVito

Lockwood Farm made a beautiful appearance due to the hard work of the farm crew, Richard M. Cecarelli, Farm Manager, Rollin J. Hannan, Jr., and Michael M. McHill, who worked on the plots, grass, trimming, and setup. The barns, buildings, and grounds were cleaned by the Maintenance crew – Bancroft Nicholson, Supervisor, Eric Flores, Brian Hart, Ronald A. LaFrazier, and Miguel Roman. They also delivered all items needed for the day to the farm. Tent setups were done by Eric Flores, Brian Hart, Ronald LaFrazier, and Miguel Roman. The podium, tables, and chairs setup in the pavilion, washing tables and chairs, and the cleaning of the cement floor were all done by Richard Cecarelli, Eric Flores, Brian Hart, Ronald LaFrazier, Michael McHill, and Miguel Roman.

At 10:45 a.m., Director Theodore G. Andreadis presented the Century Farm Award to Zentek Farms LLC of Cheshire, Connecticut.

CENTURY FARM AWARD

Zentek Farms LLC Cheshire, CT

The Century Farm Award is given to a farm that has been in family operation for more than 100 years. The recipient is selected by the Connecticut Agricultural Information Council.

Proclamation from Governor Dannel P. Malloy

Zentek Farms can be traced back to 1914 when Pawel and Aniela, Polish immigrants, put down their roots in Cheshire, Connecticut. They purchased property on Higgins Road to establish a dairy farm and soon began a family that resulted in ten children: Annie, Stella, Michael, Joseph, Stanley, Frank, Helen, Mary, Paul, and Louise. The children had various chores on the farm and they experienced long, hard hours of work. Eventually, Pawel and Aniela decided to shift from dairy to agricultural farming.



As Pawel and Aniela's children grew into adulthood and got married, most of them explored different avenues to make a living. Two of their children, Joseph and Stanley, remained bachelors and resided on the farm to continue in the business.

Paul Walter Zentek, named after his grandfather Pawel, began helping his uncles, Joe and Stanley, on the farm. Paul's interest in farming continued to expand as he grew older. He worked side by side with his uncles and incorporated many new ideas. He continued to farm the land with vegetables, however he also saw the benefits of raising bedding plants and Easter bulbs. Over the years, greenhouses were constructed on the farm. Presently, the greenhouses cover five acres of farmland. Although raising bedding plants has been a primary focus, Paul continues to farm fifty acres of vegetables each year.

In 1987, an eight-by-ten square foot vegetable stand was built. His wife, Donna Strollo Zentek, worked the stand while raising their boys, Joseph and Benjamin. In 2004, a larger vegetable and flower stand was built to accommodate their growing business. The Zentek Farms stand is best known for its sweet corn.

Today, Paul works the farm with his sons, Benjamin and Joseph, and his brother, Michael. Paul and Donna Zentek hope that their fourth-generation sons will continue in the footsteps of their great-grandparents, Pawel and Aniela.

As Governor, I am pleased to join The Connecticut Agricultural Experiment Station and the Connecticut Agricultural Information Council in presenting this Century Farm Award to Zentek Farms, who is most deserving of this honor.

EVENTS HELD AT THE STATION

Tick Management Workshop

Dr. Kirby C. Stafford III organized a tick management workshop entitled “Fighting the Bite: Management of Ticks and Risk of Tick-Borne Disease” in partnership with Erica Fearn, Connecticut Environmental Council, which was held in Jones Auditorium on February 21, 2019, with 114 registered attendees.

The speakers were:

- Dr. Kirby Stafford, The Connecticut Agricultural Experiment Station, “Tick Entomology, Lyme Disease & Other Tick Borne Diseases”
- Dr. Goudarz Molaei, The Connecticut Agricultural Experiment Station, “Tick Testing Lab - What We Are Seeing-Trends”
- Dr. Scott Williams, The Connecticut Agricultural Experiment Station, “What the Research Shows”
- Kevin Moran, Forshaw, “Calibration - Reading the Label, Correct Application”
- Zach Donais, Connecticut Department of Energy and Environmental Protection, “DEEP Update”
- Dr. Kirby Stafford, The Connecticut Agricultural Experiment Station, “Integrated Pest Management in Controlling Ticks and Tick Associated Diseases”
- Dr. Kirby Stafford, The Connecticut Agricultural Experiment Station, “Product Efficacy”
- Dr. Kimberly Stoner, The Connecticut Agricultural Experiment Station, “Pollinators: Protection Strategies”
- Rayda Krell, Western Connecticut University Tick Lab, “Spray Safe Play Safe Campaign”

Pollinator Conference

Dr. Kimberly Stoner organized the 4th annual pollinator conference, entitled “Creating and Improving Pollinator Habitat on Your Farm,” held in Jones Auditorium on March 14, 2019, and supported by a Specialty Crop Block Grant from the Connecticut Department of Agriculture and the U.S. Department of Agriculture. Ninety people attended. Tracy Zarrillo and Michael Cavadini assisted with organizing the conference. Materials from this conference and the three previous conferences, as well as fact sheets and other publications are on the Pollinator Information page of the CAES website: <https://portal.ct.gov/CAES/Publications/Publications/Pollinator-Information>

The speakers were:

- Dr. Kimberly Stoner, The Connecticut Agricultural Experiment Station, “Pollinator Habitats: What Can Recent Science Tell Us?”
- Emily May, Xerces Society for Invertebrate Conservation, “Creating Pollinator Habitat: Site Preparation, Design, Establishment, and Maintenance”
- Nancy Ferlow, Natural Resources Conservation Service, Natural Resource Conservation Service (NRCS), “Programs to Promote Pollinator Habitat”
- Mary Ellen Lemay, Hudson to Housatonic Regional Conservation Partnership, “Pollinator Pathway Initiatives from the Hudson to the Housatonic”
- Joan Milam, Dept. of Environmental Conservation, University of Massachusetts, “Pollinator Diversity and Abundance in New England Habitats”
- Zara Dowling, Dept. of Environmental Conservation, University of Massachusetts, “Pollinator Habitat Under Solar Arrays”
- Dina Brewster, CT NOFA and The Hickories, “Roundtable on Producing Native Plants for Pollinators”

Symposium on Mosquito-Borne Diseases in Connecticut

Fifty people attended the Symposium on Mosquito-Borne Diseases in Connecticut held on Thursday, April 11, 2019, at the CAES campus in New Haven. This was a cooperative effort by CAES, the Connecticut Department of Public Health, and the Department of Energy and Environmental Protection to update the public health community about these threats. The primary aim was to provide up-to-date information about the biology, epidemiology, and management of mosquito-borne diseases, and to highlight programs and services for local health departments and the public. Dr. Theodore Andreadis welcomed the attendees and spoke about “Jamestown Canyon Virus Revisited: Are We Neglecting an Under Recognized Disease?” Dr. Philip Armstrong gave a talk entitled “Mosquito Surveillance for West Nile Virus and Other Arboviruses in Connecticut” and John Shepard spoke about “Biology, Ecology, and Feeding Behavior of Mosquitoes in Connecticut.” Roger Wolfe from DEEP presented information on “Options for Mosquito Control” and Jocelyn Mullins from DPH spoke about “Surveillance for Mosquito-Borne Diseases Among Connecticut Residents.”

2019 Connecticut State AgriScience Fair

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

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

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

EVENTS HELD AT LOCKWOOD FARM

2018 Connecticut-FFA Forestry Career Development Event

On November 30, 2018, the Department of Forestry and Horticulture hosted the Connecticut-FFA Forestry Career Development Event (CDE) at the Lockwood Farm Pavilion. This year's Forestry CDE evaluated students' knowledge of forest management practices, compass reading, forest mensuration, forestry related equipment, wood product identification, and tree identification.

Forty-eight students from 12 State FFA Chapters participated in this year's event, with the 4-student team from E.O. Smith High School Agricultural Education Program taking first place. Students from E.O. Smith FFA will represent the State of Connecticut in regional and national competition at the 2019 Eastern States Exposition and the 2019 National FFA Convention in Indianapolis, IN.

Dr. Scott Williams, Mr. Michael Short, and Mr. Joseph P. Barsky of the Dept. of Forestry and Horticulture and Dr. Megan Linske of the Dept. of Entomology organized and oversaw the event. We would like to thank Eric Hansen of Ferrucci & Walicki for his assistance.



Student participants in the 2018 Connecticut-FFA Forestry Career Development Event.

EVENTS HELD AT THE VALLEY LABORATORY

Hops Research Meeting

Sixteen people attended the Connecticut Hop Growers Association Summer Quarterly meeting and Connecticut Agricultural Experiment Station Hops Summer Meeting and Field Day held Saturday, July 14, 2018, at the Valley Laboratory. CHGA President Alex DeFrancesco welcomed growers and spoke about current issues for the Hop Growers Association. Drs. Jim LaMondia and Elisha Allan-Perkins spoke about research plots and gave a tour of hop and barley field plots. Jim Preste demonstrated the HopsHarvester combine and barley combine. Dr. Jim LaMondia spoke about "Integrated pest management of hops" and Mark Zotti of the Department of Agriculture spoke about "FISMA and hops." Nathan L'Etoile of Four Star Farms in Massachusetts presented information on "Drying and storing hops for processing" and Alex DeFrancesco spoke about "Terroir and hops marketing." Talks were followed by a tour of Thrall Family Malt. The meeting qualified for 3.5 pesticide applicator re-certification credits.

Nursery and Landscape Research Tour

The Connecticut Agricultural Experiment Station Valley Laboratory hosted a meeting for nursery and landscape professionals on September 13, 2018. Speakers included Dr. Rich Cowles, who spoke about “Neonicotinoid Insecticides Research Results”; Dr. Yonghao Li, “Common Cultural/Disease Problems in 2017-18”; Ms. Rose Hiskes, “Common Insect Problems in the Landscape”; and Dr. Quan Zeng, who discussed “Fireblight: Hosts, Favorable Conditions and Management.” Field tours included Rose Hiskes, who spoke about “Rejuvenating a 20-year-old Landscape”; Mr. Thomas Rathier, “Soils and the Landscape”; Dr. James LaMondia, “The Latest on Boxwood Blight and Management”; and Dr. Jatinder Aulakh, “Crop Safety Trials for Container Ornamentals.” James Preste assisted with meeting preparation. The meeting qualified for pesticide recertification credits.

THE STATION IN THE COMMUNITY

UConn-CAES Spring Bedding Plant Meetings

CAES co-sponsored two UConn Bedding Plant Programs for Greenhouse Growers that were organized by Ms. Leanne Pundt (UConn), Dr. Rosa Raudales (UConn), and Dr. Yonghao Li in Torrington and Vernon on January 7, 2019, and February 14, 2019, respectively (70 attendees).

Tobacco Research Meeting

One hundred and ten people attended the Connecticut Agricultural Experiment Station’s annual Tobacco Research Meeting held at the East Windsor Scout Hall on February 26, 2019. 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. Joe Bonelli (UConn Cooperative Extension) and Colleen Kisselburgh (Arthur Carroll Insurance) discussed risk management in tobacco and the tobacco insurance program. Jim LaMondia spoke about the history of tobacco production in Connecticut from the 1630s to today and tobacco research in support of production especially in regards to plant breeding for resistance. Thomas Rathier, participating in his 40th tobacco research meeting, spoke about carbon and nitrogen in well drained tobacco soils. Christina Berger of the DEEP prepared a talk for growers that was delivered by Jim LaMondia about Ferbam fungicide registration issues and Worker Protection Standard updates. Martha Dorsey of the Farm Services Administration provided updates on FSA services to growers. Brianna Dunlap and members of the Tobacco Museum Board spoke about upcoming changes at the museum and the need for grower input and support. Mrs. Andrew Urbanowicz, Dave Arnold, and Paul Polek presented an update on the Connecticut-Massachusetts Tobacco Growers Association. 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 60 people received credit.

Mini-Symposium at Connecticut Conference on Natural Resources

Dr. Wade Elmer organized a symposium at the Connecticut Conference on Natural Resources on “Nanoparticles in the Environment: The Good News” held on March 8, 2019, at UConn in Storrs, CT. Six presentations from CAES scientists were delivered. Dr. Jason White spoke on “Nanotechnology and Agriculture - A Path to Global Food Security?”, Dr. Chuanxin Ma spoke on “Titanium Dioxide Nanoparticles Alleviate Tetracycline Toxicity to Terrestrial Plants,” Dr. Roberto De La Torre-Roche spoke on “Co-Exposure of Imidacloprid and Nanoparticle Ag or CeO₂ to *Cucurbita pepo*,” Dr. Nubia Zuverza-

Mena spoke on “Uptake of Nanoparticles by Plants,” and Dr. Wade Elmer spoke on “Nanoparticles for Suppression of Root Diseases” (33 attendees).

New Haven Public Schools Science Fair at Hillhouse High School

Dr. Marra was joined by Dr. Abigail Maynard and Mr. Joseph P. Barsky as special awards judges for the New Haven Public Schools Science Fair, choosing winners for the CAES award May 13-14, 2019, at the Floyd Little Athletic Center. The *Connecticut Agricultural Experiment Station Award* (\$200), for “Best project related to food, plants, insects, or the environment” went to the 4th grade class of Ms. Amy Todisco, of the West Rock Academy Magnet School, for a project titled, “Plastic Probz,” in which they explored the different rates of decomposition of different kinds of plastic bags, including those made of plant-based fibers.

Station Scientist Continues Third Year of Undergraduate Internship Program at CAES and Southern Connecticut State University

Dr. Lindsay Triplett and colleagues from the Southern Connecticut State University (SCSU), Dr. Silady and Dr. Roberts, started the third year of CAES and Southern CT State University’s joint USDA-funded internship program, the Summer Undergraduate Fellows in Plant Health and Protection, on June 10, 2019. Ten students from nine universities around the country worked on summer research projects with CAES and SCSU scientists. In June, the students received training in farm and lab safety and formal science communication, and set up a field plot testing the role of nanoparticle treatments on Chrysanthemum Wilt. The 2019 Plant Health Fellows were (L to R): Ethan Tippet (working with Dr. Washington da Silva), Olivia Rianhard (Dr. Bob Marra), Carlos Calderon (Dr. Lindsay Triplett), Harvey Ng (Dr. Nubia Zuverza), Kylee Brown (Dr. Quan Zeng), Esther Kim (Dr. Claire Rutledge), Kawai Navares (Dr. Elizabeth Roberts, SCSU), Alenka Mora (Dr. Jeff Ward), Amanda DeLucia (Dr. Wade Elmer), and Kate Manning (Dr. Blaire Steven).

UConn-CAES Greenhouse Education Workshop

A Greenhouse Education Workshop on “Biocontrol in the Greenhouse,” organized by Ms. Leanne Pundt (UConn), Dr. Rosa Raudales (UConn), and Dr. Wade Elmer, was held in Jones Auditorium on June 19, 2019 (65 attendees).

DONATIONS MADE TO THE COMMUNITY

Lockwood Farm

A total of 19,896 pounds of fresh produce, including cabbage, eggplants, peppers, tomatoes, winter squash, and assorted vegetables grown at Lockwood Farm were donated to the Albert J. Solnit Children's Center in Middletown, Connecticut Food Bank in Wallingford, Hamden/North Haven YMCA, Gianelli's Early Learning Center in Middletown, Masonicare in Wallingford, Unitarian Society of New Haven in Hamden, Walter Brooks House in New Haven, Waverly House in New Haven, and Wesley School in Middletown. Farm Manager Richard Cecarelli arranged for the distribution of the produce.

Valley Laboratory

A total of 9,311 pounds of fresh produce including butternut squash, acorn squash, muskmelons, summer squash, sweet corn, tomatoes, peppers and pumpkins grown at the Valley Laboratory were donated to Foodshare of Hartford. Mr. Preste, Drs. Abigail Maynard, David Hill, and James LaMondia generated the fresh produce, and Jim Preste and Dr. LaMondia organized the distribution effort. The Valley Laboratory also donated two bins of pumpkins to Northwest Park in Windsor and loaned irrigation equipment to the Connecticut Epilepsy Foundation in support of their Mud Volleyball Tournament Fundraiser. Mr. Preste coordinated the distribution of the irrigation equipment.

AWARDS AND RECOGNITION RECEIVED BY STATION STAFF

On August 27, 2018, Joseph Pignatello was appointed Associate Editor of *Soil Science Society of America Journal* for a three-year term.

On September 7, 2018, Scott Williams was appointed to the Editorial Advisory Board of The Wildlife Society's "The Wildlife Professional" as the Northeast Section representative.

On October 10, 2018, Megan Linske became Chair of the Northeast Section of the Wildlife Society (NETWS) Workshop Committee.

On December 14, 2018, the annual Louis A. Magnarelli Post-Doctoral Award was announced at the CAES Annual Recognition Awards Tea. The award was given to Washington da Silva, Ph.D. and Nubia Zuverza-Mena, Ph.D., from the Department of Plant Pathology and Ecology and the Department of Analytical Chemistry, respectively. The title of their project was "Using Nanoparticles to Deliver dsRNA for Controlling Destructive Plant Viruses." Seven proposals were submitted to the program this year and these were evaluated by a panel of five reviewers.

On January 9, 2019, Gregory Bugbee was elected Vice President of the Society at the Northeast Aquatic Plant Management Society meeting held in Albany, NY.

On February 15, 2019, Jeffrey Ward was elected Chair - Yankee Division, New England Society of American Foresters at the annual meeting held in Sturbridge, MA.

On March 1, 2019, Jason White was appointed as a Visiting Scientist in the Harvard University T.H. Chan School of Public Health.

On March 2, 2019, Jason White was recognized as an "Outstanding Reviewer" in 2018 by *Environmental Science: Nano*.

On April 15, 2019, Scott Williams was appointed President of the Northeast Section of The Wildlife Society.

On April 30, 2019, Robert Marra was presented the Sigma Xi Quinnipiac Chapter "Outstanding Paper of the Year Award" for "Estimating Carbon Loss Due to Internal Decay in Living Trees Using Tomography: Implications for Forest Carbon Budgets" (Environmental Research Letters 2018) at Luce Ristorante in Hamden.

THE PUBLIC SPEAKS

On July 5, 2018, Zachary Borgstedt wrote the following to Theodore Andreadis about Gale Ridge and Rose Hiskes. “I was referred to you by Dr. Gale Ridge. I would just like to pass on a big “Thank You” to your department. Dr. Ridge and Ms. Rose from the Windsor agriculture department were exceptionally helpful in helping me solve a bird mite problem. I would like to recognize them for their professionalism and efficient efforts in helping me solve what type of bug was causing an issue, and how to best handle the problem. I hope this message reached you soon and I hope they hear about this recognition from you directly or their immediate supervisors. Again they were both extremely helpful. My family and I are grateful for the free service and insight your department provided. Thanks again and best regards.”

On July 18, 2018, John W. Bahre of Collinsville wrote the following to Yonghao Li. “Thank you so much for spending time to help me diagnose the problem on my apple trees. Your knowledge and expertise is very helpful in identifying the issue and providing mitigation solutions.”

On September 25, 2018, Joanne M. D’Angelo, President of The Garden Club of Woodbridge, wrote the following to Gale Ridge. “For years, I’ve called your office with questions about insects and you’ve always been accessible, patient and informative—an invaluable resource for Connecticut residents. Thus, I was delighted when you agreed to speak at our September meeting. I must confess, I had reservations about the subject—bed bugs, something many of us live in fear of and don’t want to think about. True to form, your talk was fascinating, reassuring, and absolutely must-know information. We have a few extra copies of your handout and plan to donate them to the Woodbridge Public Library so that others may benefit from your knowledge. In fact, when I visited the Library late last week to discuss it, I was asked if we had publicized the meeting because our meeting would have been standing room only. There is clearly much community interest in the subject, but I don’t think we could have fit more people in my house! Thank you so much for educating us about this important topic.”

On October 2, 2018, Nancy Mulvey wrote the following to Theodore Andreadis about Greg Bugbee and other CAES staff members. “I have been coming to CAES for many years for help with grass. Bugs and flower problems. Every person that I have spoken to has been very helpful in solving my specific problem. I take the advice given to me and am happy to say my problem goes away. I cannot imagine not having CAES available not only to help me but many other people. The people who work at CAES help us to keep our yards environmentally controlled for the good of all. Greg in the Soil Testing has been particularly helpful by answering my questions on grass problems. I would not know where to turn if CAES was not around. CAES serves a very important service to Connecticut residents.”

On October 26, 2018, Gregory Foran, Parks Superintendent and Tree Warden, Town of Glastonbury, wrote the following to Rose Hiskes. “You and your associates never fail to amaze me. Whether it be the classes you conduct like last night, your accessibility and thoroughness as in this instance, or the wealth of information that is available through you – it really is a treasure to people like me and the average consumer as well. Thank you for your help with all of this, and the constant and continuing education! Have a great weekend.”

On November 24, 2018, Jacqueline Alvarez wrote the following to Theodore Andreadis about Gale Ridge. “I am writing this letter of commendation for the remarkable services rendered to me by Dr. Gale Ridge. Her guidance proved invaluable in resolving my ongoing issue with drain flies. In 2015 my exterminator identified the pesky flies and told me they could easily be eradicated. I purchased a gallon of drain gel, as he suggested, and applied it faithfully each evening for two months, to no avail. The onset of colder weather eventually lessened the number of flies and by November there were none. In June of 2016, those annoying flies reappeared and I purchased a new gallon of drain gel. Recognizing this treatment was less than

effective, my research led me to your Agricultural Experiment Station. I had the extreme good fortune to speak with Dr. Ridge and during our initial conversation, she requested a small sample of the flies. When she called to confirm they were in fact drain flies, she recommended I have my drains professionally snaked by a plumber. Unfortunately, my plumber at the time, did not snake drains, and the absence of flies that winter led me to believe two years of gel might have finally proved effective. Sadly, the cycle repeated itself in the summer of 2017 and for the second year, I contacted Dr. Ridge. I explained why I had been unable, rather than unwilling, to follow her advice the previous year. She could not have been more patient and understanding, however she strongly recommended all the drains be snaked and the flies would be gone. I was able to contact a professional to snake the drains, and as Dr. Ridge predicted, the summer of 2018 was free from any flies. Mr. Andreadis, my career in business spanned a period of thirty-two years in Macy's, twenty-five of which were spent as a Human Resources Director in six different locations. I quickly learned that the customers who had a negative experience in our stores were far more likely to contact store management than those who were satisfied. With that in mind, I wanted to be certain to inform you of my sincere appreciation for the exemplary service extended me by Dr. Ridge. Her professionalism and vast wealth of knowledge are exceeded only by her patience, willingness and ability to educate the person to whom she is speaking. My conversations with Dr. Ridge were like taking a master class. In an effort to thank her personally, I left a voice mail on 11-12-18. On Tuesday 11-20 when she returned my call she explained she had been away at a conference in Vancouver and only just heard my message. I am continually impressed by her attention to detail and level of professionalism. Dr. Gale Ridge is truly an asset to The Connecticut Agricultural Experiment Station and exemplifies its mission. Thank you, Mr. Andreadis, for your time and attention to this rather lengthy commendation. I trust it will serve to highlight precisely how rare it is to interact with an individual who possesses the level of expertise demonstrated by Dr. Ridge. Kindly express my sincere appreciation to her.”

On December 27, 2018, Christina Zick, Farm Credit East, wrote the following to Vickie Bomba-Lewandoski. “I just wanted to take the time to say thank you for your help/station at Auer Farm in October. Your willingness to help at events like this is admirable. Looking forward to doing a similar event in Fall 2019. THANK YOU!

On January 3, 2019, Kirsten M. Walker wrote the following to Theodore Andreadis about Kirby Stafford and Gale Ridge. “Please accept the enclosed donation to CAES as my thanks to your staff for helping me give my husband one of the best Christmas presents ever! I hope my small amount helps CAES to continue its mission so excellently. Dr. Kirby Stafford and Gale Ridge went above and beyond to help me identify two unique beetles gifted to my husband which had rested in a box for over 50 years. As I secretly gathered the story behind the beetles and they researched the science, Dr. Stafford helped me purchase the proper display case. Ms. Ridge kept in contact with me regularly as they were repaired, properly labeled and mounted. They were both so gracious and helpful. I watched in anticipation as my husband opened the gift on Christmas Day and his reaction was worth it all. He can't wait to show his father and mother who are 91 and 82. I will admit that he did ask where the original box was they had been in. It was a “Batman Bop Box” from the 60s with real cotton inside (his family is from the south) which had kept the beetles protected all those years. Though that toy is long gone, maybe I should preserve that box for next Christmas? Ha-ha!

On January 4, 2019, Steven M. Everett, First Selectman, Town of Columbia and Mark B. Walter, Town Administrator, Town of Columbia wrote the following to Theodore Andreadis about Gregory Bugbee. “On behalf of the Lake Management Advisory Committee (LMAC) for the Town of Columbia, CT we want to acknowledge and thank the remarkable help and support from the Connecticut Agricultural Experiment Station's Scientist, Greg Bugbee. As background, in November 2016 we discovered that Columbia Lake had an invasive species, *Phragmites australis* (PA) in six locations on or near the lakebed. After a year of conservative measures to remove the PA, not only did we fail but the PA multiplied. We then reached out to other municipalities with lakes to secure their advice. Everyone we spoke with recommended that the 'go to' person was Greg Bugbee. And that recommendation was 'spot on'. We began interacting with Greg

in October 2017 while simultaneously initiating research regarding the use of herbicide approved for PA and the practical ramifications of using it at Columbia Lake. The research addressed questions regarding the efficacy and timing of herbicide treatment for PA, understanding the risks and rewards of herbicide use and navigating the science, emotions and politics of using an herbicide on our lake. Greg as an objective advisor was instrumental in guiding us through all aspects. He made himself available for two public meetings in December 2017 and June 2018. He provided the scientific rationale for our treatment protocol as well as offering sound perspectives to allay emotional concerns. The outcome of his support was unanimous approval by our Board of Selectmen to treat and eradicate the PA. Treatments started this September. Mr. Andreadis, we sincerely appreciate the time, effort and input Greg provided to help the Town of Columbia achieve a successful outcome of removing an invasive species from our lake. Beyond his notable expertise described above, Greg was customer focused, timely in his responses and a wonderful CAES representative. Thank you again for providing this service to protect our natural resources as Columbia Lake.”

On January 18, 2019, Gerald G. Giordano, Senior Horticulture Consultant, Extension Community Educator, and Cooperative Extension Agent, Elmsford, NY wrote the following to Richard Cowles. “What can I say except...it’s another successful presentation by Rich Cowles! Everyone loved it and are saying it’s the best presentation they ever attended. Carmine Serpe, local legend and certified arborist for...it’s got to be over 60 years because the guy is in his 90s and a good friend...said it’s the best presentation he’s heard. And, let me tell you, he can see chinks a mile away. You’re a genius and your presence lifts every program to new heights. I just wish I could have heard the whole talk. Where did you say you’d be giving it again? I think the time was right for that presentation – people were so ready for that hemlock update. It’s amazing how attached people are to trees, and what a hold tree species have on people in the fabric of our society and human history. Thanks for all you do and your keen insights.”

On April 17, 2019, Giri Bogavelli and Ritha Pai wrote the following to Goudarz Molaei. “Our sincere thanks for your alacrity in this matter. You have gone above and beyond the call of your duty and we are truly appreciative of that.”

On April 29, 2019, Claudia Ebert wrote the following to Goudarz Molaei. “I want to thank you so very much for your assistance in retrieving my deer tick. You were so helpful and always a pleasure to talk to. I am grateful that you were so gracious and understanding. Many thanks again. I hope you have a lovely spring.”

On April 30, 2019, Tony Spinelli wrote the following to Goudarz Molaei. “On behalf of the Association of Retired Employees of Northeast Utilities (ARENU), I want to thank you for the excellent and extremely valuable program “Nature’s Revenge: The Plague of Diseases Caused by Mosquito- and Tick-Borne Illnesses.” As we are now well into the mosquito and tick season you have given us valuable information on the diseases we should watch for as well as measures to mitigate their effect upon us. We appreciate your taking the time from your busy schedule for making this presentation to us on April 17th and I apologize for not thanking you sooner. You are truly an excellent source of information on the growing number of diseases we are now subject to. We also want to thank Dr. Andreadis for referring you to us. Please let us know if there are other topics you would like to cover at future meetings next year. Again, we truly appreciate your time and expertise and we wish you every success in your valuable research and teaching.

On May 25, 2019, Leanne Pundt, UConn Extension Coordinator, wrote the following to Wade Elmer. “I just wanted to thank you and CAES for all the extra support to me and the greenhouse growers this spring season. Dr. Li has been very helpful and gracious about all the samples I have been dropping off this spring,

as I was not alternating from UConn one week to CAES the next week, like in the past few years. And I know he has been overwhelmed with woody plant samples! Again, thank you very, very much.”

On June 6, 2019, William Hamilton wrote the following to Goudarz Molaei, Alex Diaz, and Mallory Breban. “I delivered the tick personally on May 24th. I received a wonderful greeting from the administrator--do not recall her name--and pleasant conversations from Mallory and Alex as well. I am grateful for having brought the tick in since it tested Positive. Mallory heard the whole story! I previously had Babesiosis/Lyme Disease (clinically judged) definitely confirmed in YR 2000 by Dr. Stephen Phillips after having been bitten in 1993 and going untreated for 7 years because of a Not Test--No Treat Doctrine with only 1 Infectious Disease specialist for 3 months prior to meeting Dr. Phillips. What a trip it was --17 physicians -- and hospitals such as St. Francis, UCONN, UMASS, and Mayo Clinic in 1996, and then Norwalk Hospital in 1999-2000 with Dr. Katz and afterward with private practice. Years of treatment after October 2000--Diagnosis: Stephen Phillips helped significantly. I was able to carry on through my career until 2007. I was given a 25% chance of "recovery" by Dr. Katz in 2001. It was not a full recovery but it was/is manageable. I went all the way through Rocephin (8 mo) and 2 1/2 yrs of Immunoglobulin G infusion from Dr. Amiran Katz after antibiotic pill treatment by Dr. Stephen Phillips and the passage of the CT long term antibiotic bill allowing for long term antibiotic care and coverage by a Neurologist. Passed with the assistance of Atty. General Blumenthal (now Senator). I am a most thankful and lucky older gentleman. My physician intelligently has ordered antibiotics this morning after a Gold Star compassionate call from him at 7:40 am! He will monitor me and make certain I receive great care. He has been my PMC for 13-14 years. This confirmation of the tick being positive though I understand it is not definitively in my body is far more than I was aware of when I was bitten in my own back yard on September 24, 1993! This bite occurred in the same backyard! I endured amazingly ignorant personal statements from incredibly bright and well established physicians. NO (positive) TEST--NO TREAT of course. Perhaps the worst I can repeat was the statement: "I didn't see it." Questioning my honesty. The debilitation and harassment I endured should not have happened to anyone. Back in YR 2000, Dr. Phillips was a savior because he had an amazing test result of multiple concentrations of Babesiosis 7 years after the bite. I am thankful for the excellent service from the CAES--Professional and comforting. Thank you, again.”

On June 17, 2019, David Alleva wrote the following to Goudarz Molaei. “Thank you for providing this valuable service and letting me know so promptly!!”

On June 19, 2019, Steve Kearns from The Greenscene, Manchester, wrote the following to James LaMondia about staff members at the Valley Laboratory. “I want to let you know that our company, The Greenscene from Manchester, CT and me in particular really appreciate the great help that Rose Hiskes and Dianne Riddle have provided to our company. They both are a credit to your station. We have used your station's input and advice over the past decade to help service our customers, educate our workforce, and grow our business. You oversee a first class operation; Rich Cowles, yourself, and any of the personnel I have talked to have always been informative, patient, and helpful. Your efforts are greatly appreciated.”

On June 24, 2019, Bob Henault wrote the following to Gale Ridge. “I want to thank you for seeing me this morning in your office. I learned that I have Carpet Beetles and Darkling Beetles. I now know what to do to control them. I also learned a lot about bed bugs that I didn't know before. Who could have known that a vacuum crevice tool is the weapon of choice for bed bugs and not toxic chemicals and heat! In addition, I learned that insects are most easily controlled by keeping a tidy house. If one just cleans up the crumbs in the kitchen, the cockroaches will leave. Cleaning up any hair around the baseboards and vacuuming will usually eliminate insects who prefer to hang out there. But what amazed me most of all was how interesting you made the topic. Who knew that insects could be so interesting! I guess it is true that enthusiasm is infectious. The residents of the State of Connecticut are very fortunate to have your expertise available to them. If I ever have another insect problem, I will know where to go for help and advice.”

On June 24, 2019, Leanne Pundt, UConn Extension Coordinator, wrote the following to Wade Elmer. “Thanks so much for being at the conference last week and the support of CAES. Here is a comment from one of the speakers: “I learned so much from all the speakers and attendees. You did a fantastic job organizing the program and having everything run so smoothly.” I would not have been able to do this without you!”

On June 29, 2019, Dr. Joey S. Mayorquin, Citrus Research Board, Visalia, California, wrote the following to Quan Zeng. “Thank you so much for reviewing the proposals... We greatly appreciate your time, efforts and scientific contribution to the California citrus industry.”

SCIENTIFIC OFFICERSHIPS AND MEMBERSHIPS ON STATE,
NATIONAL, OR REGIONAL COMMITTEES

ADMINISTRATION

THEODORE G. ANDREADIS

- Adjunct Professor, Department of Pathobiology, University of Connecticut
- Clinical Professor, Epidemiology of Microbial Disease Division, Yale University School of Public Health
- Administrative Advisor, Multi-State Research Project NE-1043: Biology, Ecology & Management of Emerging Disease Vectors
- Administrative Advisor, Multi-State Research Project NE-1306: Management of the Marmorated Stink Bug
- Subject Editor, *Journal of Medical Entomology*
- Member, Connecticut Academy of Science and Engineering
- Member, State of Connecticut Mosquito Management Program
- Member, Selection Committee, Connecticut Century Farm Award

DEPARTMENT OF ANALYTICAL CHEMISTRY

JASON C. WHITE

- Immediate Past President, International Phytotechnology Society
- Managing Editor, *International Journal of Phytoremediation*
- Editorial Board, *Environmental Pollution*
- Editorial Board, *NanoImpact*
- Editorial Advisory Board, *Environmental Science & Technology*
- Editorial Advisory Board, *Environmental Science & Technology Letters*
- Science Advisory Board, Annual International Conference on Soils, Sediments, Water, and Energy
- Advisor, Nanotechnology Advisory Group, Society of Environmental Toxicology and Chemistry
- Member (ad-hoc), FDA Food Emergency Response Network (FERN) Method Coordination Committee (MCC)
- Member, FDA Flexible Funding Model (FFM) Workgroup

BRIAN D. EITZER

- Member, Conservation Commission for the Town of Bethany
- Member, Regional Water Authority Representative Policy Board
- Member, Organizing Committee for the North American Chemical Residue Workshop

CHRISTINA S. ROBB

- Board Member, Eastern Analytical Symposium (Program Vice-Chair 2017, Program Chair 2018)

DEPARTMENT OF ENTOMOLOGY

KIRBY C. STAFFORD III

- Member, Board, Connecticut Coalition Against Bed Bugs
- Member, Tick IPM Working Group
- Member, NEVBD Tick Working Group
- Member, Tick Biology, Ecology, and Control Subcommittee of the Tick-Borne Disease Working Group

- Assistant Clinical Professor Department of Medical Sciences, Frank H. Netter MD School of Medicine, Quinnipiac University

JOHN F. ANDERSON

- Nominating Committee, Connecticut Academy of Science and Engineering
- Clinical Professor, Yale University School of Public Health

CHRIS T. MAIER

- Curatorial Affiliate in Entomology, Peabody Museum of Natural History, Yale University
- Member, Advisory Committee, Cooperative Agricultural Pest Survey, USDA
- Member, Connecticut Endangered Species Committee, Invertebrate Subcommittee
- Research Associate, Division of Plant Industry, Florida Department of Agriculture and Consumer Services
- Research Associate, Mohonk Preserve, New Paltz, New York

GALE E. RIDGE

- Chair, Connecticut Coalition Against Bed Bugs
- Assistant Clinical Professor, Department of Medical Sciences, Frank H. Netter MD School of Medicine, Quinnipiac University
- Member, EPA FIFRA Scientific Advisory Board
- Member, State Health Improvement Plan (SHIP)
- Honorary Member, Connecticut Pest Management Association (CPCA)

CLAIRE E. RUTLEDGE

- Director (board member), Connecticut Tree Protective Association
- Treasurer, Connecticut Tree Protective Association
- Chair, Education Committee, Connecticut Tree Protective Association

VICTORIA LYNN SMITH

- Member and Past President, Eastern Plant Board
- Member, National Plant Board Systems Approach to Nursery Certification Committee
- Member, New England Wildflower Society, Connecticut Task Force
- Member, Yale Biosafety and Recombinant DNA Committee
- Member, Northeast Area Association of State Foresters Firewood Working Group
- Member, USDA-APHIS-PPQ Early Detection-Rapid Response Committee
- Member, National Clean Plant Network Fruit Tree Committee

KIMBERLY A. STONER

- Member, Multi-State Research Project NC1173 – Sustainable Solutions to Problems Affecting Bee Health
- Organizer and Member, Connecticut Native Plant, Pollinator, and Wildlife Working Group
- Member, Connecticut Friends of Right-of-Way Habitat Stakeholder Group
- Member of M.S. graduate committee, Benjamin Gluck, University of Connecticut
- Member of Ph.D. graduate committee, John Campanelli, University of Connecticut

TRACY ZARRILLO

- Secretary, Hamden Land Conservation Trust

DEPARTMENT OF ENVIRONMENTAL SCIENCES

DR. JOSEPH J. PIGNATELLO

- Editorial Board, *Molecules*
- Editorial Board, *Environmental Engineering Science*
- Agriculture, Food & Nutrition Technical Board Chair, Connecticut Academy of Science and Engineering

DR. PHILIP ARMSTRONG

- Clinical Associate Professor, Department of Epidemiology of Microbial Diseases, Yale School of Public Health
- Member, Multi-State Research Project NE-1443: Biology, Ecology, and Management of Emerging Disease Vectors
- Chair, Executive Council of the American Committee on Medical Entomology
- Guest Editor, *PLOS Neglected Tropical Diseases*

DR. DOUGLAS E. BRACKNEY

- Assistant Adjunct Professor, Section of Infectious Diseases, Yale School of Medicine
- Assistant Adjunct Clinical Professor, Microbial Diseases Division, Yale School of Public Health

MR. GREGORY J. BUGBEE

- Vice President, Northeast Aquatic Plant Management Society
- Panelist, Northeast Aquatic Nuisance Species Panel
- Chairman, Connecticut River Hydrilla Working Group
- Director, Clear Lake Improvement Association
- Contributor for CT updates, *Northeast Aquatic Plant Management Society Newsletter*

DR. GOUDARZ MOLAEI

- Associate Clinical Professor, Department of Epidemiology of Microbial Diseases, Yale School of Public Health

MR. JOHN SHEPARD

- Treasurer, Northeastern Mosquito Control Association

DR. BLAIRE STEVEN

- Adjunct Assistant Research Professor, Department of Natural Resources and the Environment, University of Connecticut

DR. ANDREA GLORIA-SORIA

- Laboratory Associate, Department of Ecology and Evolutionary Biology, Yale University

DEPARTMENT OF FORESTRY AND HORTICULTURE

JEFFREY S. WARD

- Chair, Yankee Division, Society of American Foresters
- Program Chair, New England Society of American Foresters
- Field Tour Coordinator, 2020 national Society of American Foresters convention
- Secretary, Connecticut Tree Protection Examination Board
- Secretary, Connecticut Invasive Plant Council

- Member, Audubon Connecticut Science Committee
- Ex-Officio Member, Goodwin Scholarship Committee

JOSEPH P. BARSKY

- Vice Chair, State Consulting Committee for Agricultural Science and Technology Education
- Editor, NESAF News Quarterly, New England Society of American Foresters
- Park Naturalist, Sleeping Giant Park Association
- Member, Consulting Committee, Vernon E. Cleaves Agricultural Science and Technology Program
- Member, Connecticut Environmental Review Team

MARTIN P. N. GENT

- Associate Editor, *Journal of Plant Nutrition*

ABIGAIL A. MAYNARD

- Member, Editorial Board, *Compost Science & Utilization*
- Ex-Officio Member, Connecticut Council on Soil and Water Conservation
- Member, State Technical Committee
- Member, Steering Committee, 2019 New England Vegetable and Berry Conference

SCOTT C. WILLIAMS

- Adjunct Professor, Department of Natural Resources and the Environment, University of Connecticut, Storrs
- President, The Wildlife Society, Northeast Section
- Executive Treasurer, Connecticut Urban Forest Council
- Certified Wildlife Biologist, The Wildlife Society
- Associate Editor for peer-reviewed journal, *Animals*
- Editorial Advisory Board Member to The Wildlife Professional
- Scientific Advisor, Middlesex Community College Environmental Science Advisory Board
- Scientific Advisor, Fairfield County Municipal Deer Management Alliance
- Graduate Advisor, Ph.D. student Acima Cherian, University of Connecticut, Storrs

DEPARTMENT OF PLANT PATHOLOGY AND ECOLOGY

WASHINGTON DA SILVA

- Member Thesis, Advisory Committee, Universidade Federal Rural do Semi-Árido (UFERSA), Brazil
- Member, American Phytopathological Society (APS) and the Brazilian Society of Plant Pathology (SBF) Chair
- Member, Connecticut Farm Wine Development Council
- Member, Science/Education Committee, Connecticut Farm Wine Development Council
- Associate Editor, Portuguese Translations for the Plant Health Instructor/APS Education Center

WADE H. ELMER

- Associate Editor, *Crop Protection*
- Member, Widely Prevalent Fungi List Committee, American Phytopathological Society
- Member, Ornamental Disease Committee, Secretary American Phytopathological Society
- Member, Northeast Research, Extension and Academic Programs Committee for IPM
- Member, Program Committee, Connecticut Greenhouse Growers Association
- Member, Thesis Advisory Committee, University of Connecticut

- Member, Thesis Advisory Committee, University of Texas at El Paso
- Member, Thesis, Advisory Committee, Federal University, Lavras, BRAZIL

FRANCIS J. FERRANDINO

- Member, Connecticut Wine Council
- Member of the Science/Education committee of Connecticut Wine Council

YONGHAO LI

- Member, Tree Improvement Committee, Connecticut Christmas Tree Grower Association
- Member, Scholarship Committee, Connecticut Nurserymen's Foundation
- Member, Honorary Advisory Board, Edgerton Park Conservancy

ROBERT E. MARRA

- Member, Phytopathology Committee, Mycological Society of America
- Member, Forest Pathology Committee, American Phytopathological Society
- Member, Research Thesis Advisor, Southern Connecticut State University
- Member, Connecticut Conference on Natural Resources Steering Committee. Founding Member
- President, Executive Committee, Northeast Division of the American Phytopathological Society
- Member, West Haven Tree Commission

NEIL P. SCHULTES

- Fellow, The Linnaean Society of London
- Vice President and Executive Board Member, Quinnipiac Chapter of Sigma Xi

LINDSAY R. TRIPLET

- Senior Editor, *Plant Disease*
- Associate Editor, *Phytobiomes*
- Faculty Affiliate, Colorado State University
- Adjunct Faculty, Quinnipiac Netter School of Medicine
- Member, APHIS Widely Prevalent Bacteria Committee
- Member, Thesis Advisory Committee, Michigan State University
- Member, Bacteriology Committee, American Phytopathological Society

QUAN ZENG

- Member, New England, New York and Canada Tree Fruit Pest Working Group
- Member, Bacteriology Committee, American Phytopathological Society

VALLEY LABORATORY

ELISHA ALLAN-PERKINS

- Co-chair of American Phytopathological Society Careers 101 Adhoc Committee
- Member of the American Phytopathological Society Family Friendly APS Adhoc Committee

JATINDER AULAKH

- Member, Connecticut Invasive Plants Working Group

CAROLE CHEAH

- Fellow of the Cambridge Philosophical Society, UK

JAMES A. LAMONDIA

- Northeast Regional Project NE-1040, “Plant-parasitic Nematode Management as a Component of Sustainable Soil Health Programs in Horticultural and Field Crop Production Systems”
- Senior Editor, *Journal of Nematology*
- Chair, Connecticut Agricultural Information Council
- Member, Century Farm Award Selection Committee
- Ex-Officio Member, Connecticut Tree Protection Examining Board
- Worker Protection Standards Trainer for the Valley Laboratory
- CT Vegetable & Small Fruit Growers’ Conference Steering Committee
- GLOBAL Globodera Alliance Advisory Board
- American Phytopathological Society Professional Development Forum
- Past Chair, Northeastern American Phytopathological Society Division Forum

DEWEI LI

- Past President, Pan-American Aerobiology Association
- Associate Editor, *Aerobiologia*
- Editorial Board Member, *Fungal Biology and Biotechnology*

THOMAS M. RATHIER

- Past President, Member of the program, tree improvement and merit award committees, The Connecticut Christmas Tree Growers Association

LECTURES, SEMINARS, AND INTERVIEWS

During the year, staff members present formal lectures and seminars to organized groups outside The Station. They also describe their research to organized groups visiting The Station. Occasionally they report their research to elected officials. At still other times newspaper, radio, and TV reporters interview our staff. These occasions are listed below.

ALLAN-PERKINS, ELISHA

- Presented “Scientific Presentations Don’t Have to Be Boring: Designing Slides with Your Audience in Mind” as an American Phytopathological Society Webinar <https://www.apsnet.org/edcenter/resources/Webinars/Pages/Scientific-Presentations-Don%27t-Have-to-be-Boring.aspx> *March 20, 2019*

ANDREADIS, THEODORE G.

- Was interviewed for a story about the research, diagnostic, and service activities of the Experiment Station by Kathy Czepiel, Nutmeg Press *July 26, 2018*
- Was interviewed about current West Nile virus activity in Connecticut by Steve Pancione, NBC Connecticut *August 2*
- Was interviewed about Plant Science Day 2018 by Ray Andrews, WQUN AM 1220, in Hamden *August 2*
- Was interviewed about the early season build-up of West Nile virus in Connecticut by Kent Pierce, WTNH TV 8, New Haven *August 3*
- Presided over a quarterly meeting of the Station’s Board of Control held at Lockwood Farm *August 8*
- Was interviewed about the extraordinarily wide distribution and levels of West Nile virus circulating in the state and risk of human infection by Fox 61 *August 22*
- Was interviewed about the recent occurrence of human cases of West Nile virus in the state and the continued risk for human exposure by Mackenzie Rigg, Connecticut Mirror and WTIC Radio *August 24*
- Was interviewed about ticks and the prevalence of tickborne diseases in Connecticut this season by Amanda Cuda, Connecticut Post *September 10*
- Participated in an Invasive Plant Council meeting held at the Valley Laboratory in Windsor *September 11*
- Attended a reception at the annual meeting of the National Association of State Departments of Agriculture (NASDA) held at The Society Room of Hartford *September 12*
- Hosted Beverly Samuel, National Program Leader for the USDA National Institute of Agriculture (NIFA), and provided an overview of the Station’s research, diagnostic, and regulatory programs *September 19*
- Participated in an Executive Board meeting of the Experiment Station Associates held at the Station *September 19*
- Presented a seminar entitled “Reflections on the Ecology and Epidemiology of Mosquito-borne Viruses in Connecticut: An Analysis from Twenty Years of Research and Surveillance” held at the Station *September 26*
- Participated in a joint meeting of State Agricultural Experiment Station Directors and Association of Research Directors held in Lincoln, NE *October 1-3*
- Presented comments on the greatest challenge that should be addressed through NIFA’s research, education, and extension programs, the most-needed breakthrough in science/technology that would advance the state’s agricultural enterprise, and top priorities in food and agricultural research, extension, or education that NIFA should address at a listening session sponsored by the USDA National Institute of Food and Agriculture held in Hartford *October 11*
- Presided over a quarterly meeting of the Station’s Board of Control held at the Valley Laboratory in Windsor *October 17*

- Presented a talk entitled “Jamestown Canyon Virus Revisited: Are We Neglecting an Under Recognized Vector-Borne Disease” at the 64th Annual Meeting of the Northeastern Mosquito Control Association held in Nashua, NH (150 attendees) *December 3-5*
- Presented an overview of the research, testing, and surveillance activities conducted by staff of the CAES Center for Vector Biology & Zoonotic Disease and the Northeast Regional Center of Excellence in Vector-Borne Diseases at the “Workshop on Mosquito and Biting Flies” sponsored by the Connecticut Groundkeepers Association and held at the Station (75 attendees) *January 15, 2019*
- Presided over a quarterly meeting of the Station’s Board of Control held in Hartford *January 16*
- Presented an update of Experiment Station research and survey activities on forest insects and pest- and tick-associated diseases at the Annual Meeting of the Connecticut Tree Protective Association held in Plantsville (300 attendees) *January 17*
- Presented an update on Experiment Station activities at a meeting of the Experiment Station Associates Board of Directors held at the Station (8 attendees) *January 23*
- Hosted and participated in the 2nd Annual Meeting of the Northeast Regional Center for Excellence in Vector-Borne Diseases held in Jones Auditorium (100 attendees) *January 24-25*
- Presented welcoming remarks and an overview of the Experiment Station and its various research, regulatory, and public service programs to representatives from the National Future Farmers of America Organization who were visiting the Station (6 attendees) *February 19*
- Presented an overview of the history and current operation of the Experiment Station’s research, regulatory, and public service programs in a “Behind the Scenes Tour of CAES” for the Experiment Station Associates (12 attendees) *February 20*
- Presented welcoming remarks to a group of Connecticut professional pest control operators in a workshop on Fighting the Bite: Management of Ticks and Risk of Tick-Borne Disease sponsored by the Connecticut Environmental Council and held in Jones Auditorium (105 attendees) *February 21*
- Presented a talk entitled “Jamestown Canyon Virus Revisited: Are We Neglecting an Under Recognized Vector-Borne Disease” at the 85th Annual Meeting of the American Mosquito Control Association held in Orlando, FL (1,000 attendees) *February 25-28*
- Participated in Ag Day at the Capitol in Hartford *March 20*
- Presented a talk entitled “Jamestown Canyon Virus Revisited: Are We Neglecting an Under Recognized Mosquito-Borne Disease” at the 16th Arbovirus Surveillance and Mosquito Control Workshop and participated as Administrative Advisor in the annual meeting of Multi-State Project, NE-1443, Biology, Ecology & Management of Emerging Disease held in St. Augustine, FL (50 attendees) *March 26-28*
- Presided over a quarterly meeting of the Station’s Board of Control held at the Station *April 10*
- Presented a talk entitled “Jamestown Canyon Virus Revisited: Are We Neglecting an Under Recognized Disease?” at the Symposium on Mosquito-Borne Diseases in Connecticut held in Jones Auditorium (50 attendees) *April 11*
- Was interviewed about the new “Active Tick Surveillance Program” funded with a grant from the Centers for Disease Control and Prevention by Greg Hladky, Hartford Courant *April 12*
- Was interviewed about the Experiment Station’s research and surveillance programs on ticks, mosquitoes, and associated vector-borne diseases in the state by Aaron Kupec, WTIC Radio *April 16*
- Presented welcoming remarks and an update on Experiment Station activities at the Annual Meeting of the Experiment Station Associates held in Jones Auditorium *April 17*
- Was interviewed about the new “Active Tick Surveillance Program” for the State of Connecticut by Charity Scott, Wall Street Journal *April 23*
- Presented a lecture entitled “Global Climate Change and Mosquito-borne Diseases” to a class of MPH students at the Yale University School of Public Health (20 attendees) *April 24*

- Participated in a “boot camp” workshop on mosquitoes, ticks, and associated vector-borne diseases sponsored by the Northeast Regional Center for Excellence in Vector-Borne Diseases held at Fordham University’s Louis Calder Center in Armonk, NY (20 student attendees) *May 14-15*
- Was interviewed about the current climate and outlook for ticks, mosquitoes and associated vector-borne diseases this season by Amanda Cuda, Connecticut Post *May 15*
- Was interviewed about the impact of climate change on the establishment of native and exotic tick species and emergence of tick-borne diseases by Danielle Abreu, NBC Bay Area *May 16*
- Participated in a press event held at Jones Family Farm in Shelton to announce the start of the seasonal “wine trail passport” program with Lt. Governor Susan Bysiewicz, Commissioner of Agriculture Bryan Hurlburt, Associate Dean and Associate Director for UConn Extension in the College of Agriculture, Health and Natural Resources Michael O’Neil, and CAES Board of Control Vice President Terry Jones *May 17*
- Was interviewed about the statewide prevalence and distribution of the causal agent of Lyme disease, *Borrelia burgdorferi* in the tick, *Ixodes scapularis* and the risk of acquiring Lyme disease in different regions of the state by Amanda Cuda, Connecticut Post *May 28*
- Participated in a joint summer meeting of the Northeastern Regional Association of State Agricultural Experiment Station and Extension Directors held in conjunction with CARET/AHS held in Washington, DC *June 2-5*
- Presented an update on CAES activities at a Board Meeting of the Experiment Station Associates held at the Station *June 19*
- Presented welcoming remarks and an overview of the Experiment Station and its various research, regulatory, and public service programs to a group of students from Central Connecticut State University (15 attendees) *June 20*

ARMSTRONG, PHILIP M.

- Was interviewed about the statewide mosquito surveillance program and the spread of West Nile virus in Connecticut by the Connecticut Post *July 17, 2018*
- Was interviewed about the statewide mosquito surveillance program and the spread of West Nile virus in Connecticut by WTIC *July 17*
- Was interviewed about the statewide mosquito surveillance program and the spread of West Nile virus in Connecticut by WTIC *July 19*
- Was interviewed about the statewide mosquito surveillance program and the spread of West Nile virus in Connecticut by the New London Day *July 24*
- Was interviewed about the statewide mosquito surveillance program and the rise and spread of West Nile virus in Connecticut by Fox News 61 *August 1*
- Was interviewed about the statewide mosquito surveillance program and the rise and spread of West Nile virus in Connecticut by Nutmeg TV *August 7*
- Was interviewed about the statewide mosquito surveillance program and the rise and spread of West Nile virus in Connecticut by Coastal CT Magazine *August 9*
- Was interviewed about the statewide mosquito surveillance program and the rise and spread of West Nile virus in Connecticut by the Connecticut Post *August 10*
- Was interviewed about the statewide mosquito surveillance program and the rise and spread of West Nile virus in Connecticut by News Channel 8 *August 10*
- Was interviewed about the statewide mosquito surveillance program and the rise and spread of West Nile virus in Connecticut by WTIC *August 10*
- Spoke to incoming students in the Epidemiology of Microbial Diseases Program at the Yale School of Public Health about research opportunities at CAES (40 attendees) *August 21*
- Was interviewed about the detection of EEE virus in mosquitoes in eastern Connecticut by News Channel 3 *October 1*

- Was interviewed about the detection of EEE virus in mosquitoes in eastern Connecticut by WTIC *October 3*
- Gave a lecture for the pre-meeting course “Vector-borne Disease Risk and Prevention for the Clinician” (35 attendees), chaired the American Committee of Medical Entomology Council Meeting (12 attendees), and chaired two symposia on medical entomology (50 attendees) at the Annual Meeting of the American Society of Tropical Medicine & Hygiene held in New Orleans, LA *October 27-31*
- Was interviewed about 2018 being a record season for West Nile virus infection in Connecticut in both mosquitoes and people by the Connecticut Post *November 5*
- Gave a talk entitled “Evaluation of Novel Trapping Methods for Monitoring *Aedes* spp.” at the Annual Meeting of the Northeastern Mosquito Control Association held in Nashua, NH (approx. 150 attendees) *December 4*
- Gave a talk entitled “Vector Competence of *Ae. Albopictus*-Populations from the Northeastern US for Chikungunya and Zika Viruses” at the Annual Meeting of the Northeast Regional Center for Excellence in Vector-Borne Diseases held in Jones Auditorium (140 attendees) *January 24, 2019*
- Gave a lecture entitled “Dengue and Other Arboviral Diseases” for the Principles of Infectious Diseases course held at the Yale School of Public Health (30 student attendees) *January 29*
- Gave a talk entitled “Mosquito Surveillance for West Nile Virus and Other Arboviruses in Connecticut” at the Symposium on Mosquito-Borne Diseases in Connecticut held at in the Jones Auditorium (50 attendees) *April 11*
- Was interviewed about the spring weather conditions that favor high mosquito populations by NBC Connecticut *May 8*
- Was interviewed about the spring weather conditions that favor high mosquito populations by News Channel 8 *May 15*
- Gave a lecture entitled “Arthropod Biology and Behavior” for the Vector Biology Boot Camp Course held at the Louis Calder Center in Armonk, NY (40 attendees) *May 14*
- Held a press event in the Johnson-Horsfall atrium with Connecticut Senator Richard Blumenthal on the public health threat and response to mosquito-borne diseases in Connecticut *June 3*
- Gave a talk entitled “Mosquito Biology, Disease Risk, and Personal Protection” at the 16th Annual Conference of the International Society of Travel Medicine in Washington, D.C. (150 attendees) *June 6*

AULAKH, JATINDER S.

- Spoke about “Weed Control in Christmas Trees” at the CT Christmas Tree Growers Association twilight meeting held in Broad Brook (45 attendees) *July 24, 2018*
- Talked about weed management at the CT Christmas Tree Growers Association twilight meeting held at Hickory Ridge Tree Farm in Coventry *September 22*
- Attended the 2018 CIPWG symposium, organized an invasive plants display, and staffed the CAES display booth in Storrs *October 4*
- Presented a poster entitled “Role of N-Fertilization and Herbicides in Integrated Management of Mugwort in a Cool-Season Grass Pasture” (approx. 140 visitors) and served as co-chair for the turf and ornamental section at the Northeastern Plant, Pest, and Soil Conference held in Baltimore, MD *January 8-10, 2019*
- Presented a talk entitled “Weed Control Efficacy and Christmas Tree Tolerance to Pre- and Post-Emergence Herbicides” (approx. 60 attendees) and served as chair for the teaching and extension section and co-chair for the turf and ornamental section at the Weed Science Society of America Conference held in New Orleans, LA *February 11-14*
- Spoke about weed management updates at the CAES annual Tobacco Research Meeting held at the East Windsor Scout Hall (110 attendees) *February 26*
- Presented a talk on post-emergence weed management options at the annual meeting of the Connecticut

- Christmas Tree Growers Association held in Middletown (55 attendees) *March 2*
- Was interviewed about Japanese knotweed management by Henry Graber, staff writer from Slate *March 18*
- Talked about pesticide formulations, pesticide hazards and first aid, personal protective equipment, and pesticide transport, storage and security in the commercial pesticide applicators training classes held at the Valley Laboratory in Windsor *April 18, 25*

AYLOR, DONALD E.

- Presented an invited talk entitled “Atmospheric Dispersal of Plant Pathogens over Multiple Spatial and Temporal Scales” at the International Congress of Plant Pathology (ICPP 2018) held in Boston, MA (100 attendees) *August 3, 2018*
- Was a judge for the final round of the Connecticut Tech Challenge held at Sacred Heart University in Fairfield. Teams of engineering students from colleges throughout Connecticut competed in the challenge by designing a technological solution to combat automobile accidents caused by distracted driving (36 attendees) *November 15*

BARSKY, JOSEPH P.

- Served as a judge at the 2018 Big-E Agriscience Fair held in West Springfield, MA (9 students) *September 14, 2018*
- Hosted Luke O’Leary and Ambra Tennery of the National FFA Organization and Alexa DeAndrade, Milton Natusch, and Daniel Quinn of the Connecticut FFA Organization, and led a tour of CAES facilities (3 students, 2 adults) *February 19, 2019*
- Presented a research poster entitled “Mature Oak Crop Tree Growth” at the New England Society of American Foresters 99th Annual Winter Meeting held in Burlington, VT (450 attendees) *March 27-29*
- Co-organized the 2019 Agriscience Fair and hosted tours for students (45 students) *May 2*
- Served as a judge for the New Haven Science Fair (6 students) *May 13*
- Participated in the accreditation review of The Sound School in New Haven (15 students, 5 teachers) *June 5*
- Participated in the Forest Action Plan 2020 Roundtable held at Naugatuck Valley Community College in Waterbury *June 13*

BLEVINS, TIA M.

- Participated in the 2018 HIS-Eastern Chapter’s Interstate Inspection held in Reading, PA, discussing Pennsylvania’s spotted lanternfly compliance agreements and issues dealing with importing products from Pennsylvania. The group reviewed the process for allowing permitting via SANC (Systems Approach to Nursery Certification) program. Attendees also visited two locations to witness spotted lanternfly outbreaks, which included adult and egg mass life stages (35 participants) *October 22-24, 2018*
- Participated in the 45th annual Horticultural Inspection Society - Eastern Chapter’s meeting in Portland, Maine. As Archivist, Tia presented the archival report to the members, worked on the Planning Committee, Audit Committee and moderated a roundtable discussion about eCommerce Nurseries (16 participants) *April 8-11, 2019*

BRACKNEY, DOUGLAS E.

- Gave an invited seminar entitled “Navigating Anatomical Barriers to Transmission: An Arbovirus Tale” at the National Emerging Infectious Diseases Laboratory within the Boston University School of Medicine (approx. 60 attendees) *September 26, 2018*
- Gave a talk entitled “Tissue Expansion Induced Basal Lamina Micro-Perforations Facilitate Arbovirus Spread in *Aedes spp.* Mosquitoes” at the 68th Annual American Society of Tropical Medicine and Hygiene conference held in New Orleans, LA (approx. 100 attendees) *October 27-November 1*

- Gave an invited seminar entitled “Navigating Anatomical Barriers to Infection: An Arbovirus Tale” in the Department of Pathobiology and Veterinary Sciences at the University of Connecticut in Storrs (approx. 30 attendees) *February 28, 2019*
- Gave a talk entitled “Navigating Anatomical Barriers to Transmission: An Arbovirus Tale” at Southern Connecticut State University in New Haven (approx. 20 students, 30 attendees total) *March 8*
- Gave a poster entitled “Broadly Cross Neutralizing Antibodies and Peptide Inhibitors Can Effectively Block the Ability of Dengue Virus to Infect Mosquito Cells and Mosquitoes” at the Positive Strand RNA viruses Keystone Symposium held in Killarney, Ireland *June 9-13*
- Gave a poster entitled “Generation of Axenic *Aedes aegypti* Mosquitoes to Study Vector-Microbiome Pathogen Interactions” at the Jacques Monod Integrated Insect Immunology Conference held in Roscoff, France *June 24-28*

BRANSFIELD, ANGELA B.

- Hosted Benjamin Fontes and Peter Reinhardt from Yale University’s Office of Environmental Health and Safety and, with Dr. Philip Armstrong, discussed the Station’s Biosafety Level 3 laboratory *July 13, 2018*
- Participated in the American Biological Safety Association’s Select Agent Community webinar “Entity Experiences Preparing for Select Agent Inspections” *August 6*
- Participated in the Federal Select Agent Program webinar “eFSAP Inspections Module Training” *February 6, 2019*
- Participated in the Federal Select Agent Program webinar “eFSAP Form 1 Amendments Training” *February 14*
- With Mr. Michael Misencik, met with Terry Jones, Vice President of the Station’s Board of Control, and guests to discuss the Biosafety Level 3 laboratory and mosquito surveillance program *March 18*
- Participated in The American Biological Safety Association’s (ABSA) Select Agent Community Webinar “Training Curriculum Development: Select Agent Entity Experiences” *March 21*
- With Dr. Philip Armstrong and Mr. Michael Misencik, met with a team of FBI Special Agents and discussed the Station’s select agent program, security features of the BSL3 laboratory, and research conducted in the BSL3 laboratory *April 8*
- Was interviewed as part of a study on vaccination of laboratory staff through the Special Immunizations Program by Ms. Lane Warmbrod of the Johns Hopkins Center for Health Security *April 12*

BUGBEE, GREGORY J.

- Gave a talk entitled “Connecticut’s Invasive Aquatic Plant Problem – The State of the State” and administered the multistate aquatic license recertification program at the 58th Annual Meeting of the National Aquatic Plant Management Society held in Buffalo, NY (approx. 125 attendees) *July 16-18, 2018*
- Updated the Bashan Lake Association on the control of phragmites and variable watermilfoil at their annual meeting held in East Haddam (approx. 75 attendees) *July 26*
- Was interviewed about the extent of the invasive water chestnut problem in Connecticut by the Danbury News-Times *August 1*
- Gave a talk entitled “Container Gardening Indoors and Out” to the Morris Cove Garden Club at the East Haven Firehouse (approx. 30 attendees) *September 12*
- Judged the Future Farmers of America Science Fair at The Big E in West Springfield, MA *September 14*
- With Ms. Summer Stebbins, presented a poster entitled “Surveillance and Management of Invasive Aquatic Plants” at the biannual meeting of the Connecticut Invasive Plant Working Group held at the University of Connecticut in Storrs (approx. 200 attendees) *October 4*
- Spoke on “New Methods of Aquatic Weed Management” at the annual meeting of the Crystal Lake

- Association held at the Town Hall in Ellington (approx. 50 attendees) *October 4*
- Spoke on “The CAES IAPP 2018 Aquatic Plant Survey of Lower Bolton Lake” at the annual meeting of the Lower Bolton Lake Association held in Manchester (approx. 75 attendees) *October 22*
- With Ms. Summer Stebbins, gave an Invasive Aquatic Plant Workshop at the annual meeting of the Connecticut Association of Inland Wetland and Conservation Commissions in Cromwell (approx. 40 attendees) *November 11*
- With Ms. Summer Stebbins, presented an invasive aquatic plant table at the CIPWG meeting held at the University of Connecticut in Storrs (approx. 200 attendees) *November 28*
- Gave a talk entitled “2018 Aquatic Plant Survey of Lower Bolton Lake” to the Lower Bolton Lake Association (approx. 50 attendees) *November 11*
- Gave two talks on Hydrilla in the Connecticut River before the Northeast Aquatic Nuisance Species Panel in Portsmouth, NH (approx. 25 attendees) *December 3-4*
- With Ms. Summer Stebbins, gave the talk “Brazilian Waterweed - Maybe Not as Tough as It Looks” and proctored the aquatic herbicide recertification program at the Northeast Aquatic Plant Management Society meeting held in Albany, NY *January 8-10, 2019*
- Was interviewed about control of Eurasian watermilfoil in Candlewood Lake by winter drawdown by the News-Times *February 6*
- With Ms. Summer Stebbins, led a meeting via conference call of the Connecticut River Hydrilla Task Force (approx. 10 attendees) *February 8*
- Spoke about “Soil Testing and Invasive Aquatic Plants” to a Future Farmers of America tour group (approx. 10 attendees) *February 19*
- Spoke on “Soil Testing and Invasive Aquatic Plants” in a “Behind the Scenes Tour of CAES” for the Experiment Station Associates (approx. 15 attendees) *February 20*
- Was interviewed about Hydrilla in Coventry Lake by The Chronicle *March 5*
- With Ms. Summer Stebbins, spoke on “Hydrilla in the Connecticut River” at a meeting of the Friends of Silvio O. Conte Wildlife Refuge (approx. 25 attendees) *March 15*
- With Ms. Summer Stebbins, spoke on “Hydrilla in the Connecticut River” at a meeting of the Connecticut River Gateway Commission (approx. 25 attendees) *March 28*
- With Ms. Summer Stebbins, gave an “Invasive Aquatic Plant Workshop” to an Environmental Studies class at Three Rivers Community College in Norwich (approx. 30 attendees) *April 3*
- With Ms. Summer Stebbins, gave an “Invasive Aquatic Plant Workshop” as part of a CT DEEP Water Quality Monitoring Conference at Three Rivers Community College in Norwich (approx. 40 attendees) *April 5*
- With Ms. Summer Stebbins, gave a Benthic Barrier training session to staff of the Town of Middlefield at Lake Beseck (approx. 10 attendees) *April 18*
- Gave a talk entitled “Composting” to the Kensington Garden Club at the Berlin-Peck Library in Berlin (approx. 40 attendees) *April 18*
- Served as a judge for the Northeast Regional Sigma Xi Student Research Conference at Quinnipiac University in Hamden *April 24*
- With Ms. Summer Stebbins gave a Benthic Barrier training session at Lake Beseck in Middlefield (approx. 25 attendees) *April 26*
- Served as judge at the Future Farmers of America Science Fair held in Jones Auditorium *May 2*
- Gave a talk entitled “CAES Invasive Aquatic Plant Program” to the Bantam Lake Protective Association Board of Directors at the White Memorial Conservation Center in Litchfield (approx. 12 attendees) *May 16*
- Spoke on “Hydrilla in the Connecticut River” at a meeting of the Northeast Aquatic Nuisance Species Panel held in Springfield, MA (approx. 35 attendees) *June 3*
- Participated in Hydrilla surveillance training in conjunction with the US Army Corp of Engineers on the Connecticut River held in Agawam, MA (approx. 20 attendees) *June 4*

- Participated as a panelist on the Northeast Aquatic Nuisance Species Panel and updated the Panel on CT's invasive aquatic plant issues (approx. 25 attendees) *June 5*
- Spoke on "Hydrilla in the Connecticut River and 2019 CAES IAPP Surveillance" at an outing sponsored by the Gateway Commission on a river boat cruise in the Connecticut River (approx. 50 attendees) *June 12*
- Spoke on "Connecticut's Invasive Aquatic Plant Problem" at a workshop sponsored by the Sustainable Essex Committee at the Essex Town Hall (approx. 25 attendees) *June 18*
- Spoke on "Hydrilla in the Connecticut River" at a meeting of the Capital Region Council of Governments held in Hartford (approx. 25 attendees) *June 19*
- Was interviewed about invasive aquatic plants in Lake Quassapaug in Middlebury by the Republican-American *June 25*

CHEAH, CAROLE A.

- Met with Beverly Samuel, USDA NIFA National Program Leader, at Lockwood Farm to give an update on research on biological control of hemlock woolly adelgid *September 19, 2018*
- Presented a poster entitled "Biological Control of Mile-a-Minute Weed in CT" and assisted at the CAES display at the 2018 CIPWG Symposium on Invasive Plants held at the University of Connecticut in Storrs *October 4*
- Presented an evening lecture on invasive hemlock woolly adelgid and mile-a-minute weed as the inaugural fall lecture of the Edgerton Conservancy Garden Lecture series, held at the Edgerton Park Carriage House in New Haven (12 attendees) *October 11*
- Gave a workshop presentation on climate impacts on hemlock sustainability at the 41st Connecticut Association of Conservation and Inland Wetlands Commissions Annual Meeting & Environmental Conference held in Cromwell (30 attendees) *November 17*
- Attended and helped staff the CAES booth at the Annual Meeting of the Connecticut Tree Protective Association held in Plantsville *January 17, 2019*
- Was interviewed for an article on biological control of mile-a-minute weed on Charles Island, Silver Sands State Park, Milford, by Jill Dion, Editor for the Milford Mirror *January 18*
- Was filmed and interviewed on the impacts of winters and climate change on hemlock woolly adelgid on eastern hemlocks by Nate Murray and Cody Pfister of Local Motives, Inc., a nonprofit organization from Ohio, which is producing video documentaries from all 50 states to communicate local perspectives on environmental issues such as climate change *January 25*
- Was interviewed on the effects of the polar vortex on hemlock woolly adelgid and other stressors of eastern hemlock by Patrick Skahill for WNPR/CT Public Radio *January 30*
- Gave a presentation on predictions of winter mortality of hemlock woolly adelgid at the 2019 Forest Health Monitoring Workshop held in Jones Auditorium (50 attendees) *March 5*
- Presented a hemlock tour and talk to members of the West Hill Beach Club in New Hartford (12 participants) *March 29*
- Gave a presentation on climate impacts on eastern hemlocks for the Weantinoge Land Trust at the Gunn Memorial Library in Washington (25 attendees) *May 14*
- Gave a talk on trees under siege to the Breakfast Club at the McAuley Retirement Community in West Hartford (35 attendees) *May 29*

COWLES, RICHARD S.

- Participated in the CT Beekeepers Association workshop on making overwintering nucleus colonies in Hamden (35 attendees) *July 7, 2018*
- Presented "Managing Armored Scales" and "Phytophthora Root Management" for the Christmas Tree Farmers' Association of New York, Ballston Spa, NY (100 attendees) *July 13-14*
- Spoke about "Gypsy Moths, Spruce Budworm, and Phytophthora" at the CT Christmas Tree Growers

- Association twilight meeting held in Broad Brook (45 attendees) *July 24*
- Presented a poster entitled “Establishing Bee Forage to Assist Honey Bee Genetic Improvement” at Plant Science Day in Hamden *August 8*
 - Participated in the School IPM Workshop hosted by UConn Cooperative Extension by presenting “Insect Management in Schoolground Turf” in East Haddam (120 attendees) *August 14*
 - Conducted a pest diagnostic walking tour at Connecticut College for the National Plant Diagnostic Information Network (30 attendees) *August 16*
 - Presented “Neonicotinoid Research Update” at the Nursery and Landscape Research Tour held at the Valley Laboratory in Windsor (8 attendees) *September 13*
 - Discussed his honey bee research with the talk “The Queen of Your Dreams” to the Back Yard Beekeepers Association in Weston (25 attendees) *September 26*
 - Presented “Adapting our Landscapes for Climate Change” for the East Windsor Garden Club in Broad Brook (20 attendees) *October 16*
 - Presented a lecture entitled “The Queen of Your Dreams” for Bio 388 (Biology of Bees and Pollinator Ecology, 15 attendees) followed by a modified talk with the same title to Master Gardeners at the University of Rhode Island (35 attendees) *October 25*
 - Presented “Erythritol vs. Spotted Wing Drosophila” for the Massachusetts Blueberry Growers’ Association in Westborough, MA (25 attendees) *November 4*
 - Discussed “Winter Moth and Gypsy Moth” to the New England Chapter of the International Society for Arboriculture in Mystic (250 attendees) *November 5*
 - Presented “Insecticide Resistance” at the New England Greenhouse Conference held in Boxboro, MA (150 attendees) *November 8*
 - Presented “The Queen of Your Dreams” for the Connecticut Entomological Society in New Haven (35 attendees) *November 16*
 - Presented “Turf and Landscape Insect Update” for the Site One’s education seminar held in Darien (50 attendees) *January 15, 2019*
 - Presented “Turf and Landscape Insect Update” for the Site One’s education seminar held in Meriden (80 attendees) *January 16*
 - Discussed “The Eastern Hemlock Pest Complex: Thirty Years Later” with the NY State Turf and Landscape Association in Westchester, NY (80 attendees) *January 15*
 - Discussed “Hard to Control Pests” with nursery and greenhouse managers at the Helena educational seminars held in Ledyard (70 attendees) *January 16*
 - Shared “Phytophthora Root Rot” with the NJ Christmas Tree Growers’ Association in Bordentown, NJ (80 attendees) *January 26*
 - Taught “Ready, Set, Plant!” to the Christmas Tree Farmers of New York regional meeting in Millbrook, NY (30 attendees) *January 31*
 - Presented “Neonic Alternatives?” for the New England Vegetable and Berry Growers’ Association in Hudson, MA (50 attendees) *February 9*
 - Presented a webinar on “Evaluating the Performance of Turkish and Trojan Fir (CoFirGE),” with John Frampton, Bert Cregg, Chal Landgren, and Gary Chastagner, (archived at: [Watch the Turkish and Trojan Fir Webinar](#)) *February 13*
 - Met with and briefly presented his efforts to rear queens to the CT Queen Breeders’ Association in Cheshire (15 attendees) *February 17*
 - Was interviewed about the recent discovery of the box tree moth in Ontario, Canada by Jennifer Zurko of Grower Talks Magazine *February 25*
 - Presented “Zimmerman Pine Moth” for the CT Christmas Tree Growers’ Association in Middletown (55 attendees) *March 2*
 - Spoke on “Not Dead Yet – Preserving Stressed Ash and Oaks” for the CT Tree Protective Association in New Haven (100 attendees) *March 25*

- Was interviewed by Greg Hladky of the Hartford Courant on the subject of pollinator plantings and bee health, for which an article was published on May 30 (<https://www.courant.com/news/connecticut/hc-news-dot-flowers-20190530-xhs2ew7blvdrfp3pcumx36gmoa-story.html>) *May 29*
- Presented “Update on Hartford EAB study” to the Hartford Tree Advisory Commission, Hartford (12 attendees) *June 5*
- Discussed management of armored scales and phytophthora root rot at the Christmas Tree Farmers’ Association of New York twilight meeting, New Grangeville, NY (40 attendees) *June 20*
- Presented “Turf, Shrub, and Tree Insect Pests” for the Municipal Turf Academy, University of Connecticut, Storrs (60 attendees) *June 25*
- Hosted at his farm and presented research efforts and practical tips for growing Christmas trees for the CCTGA twilight meeting held in Broad Brook (67 attendees) *June 26*

CREIGHTON, MARK H.

- Demonstrated the proper techniques to open hives and discussed building the apiary program at The Sound School in New Haven (7 students and advisors) *July 5, 2018*
- Assisted with a honey bee program of instruction at Lockwood Farm in Hamden for students affiliated with a Yale University program for disadvantaged youths (6 students) *July 14*
- Demonstrated beehive assembly at Lockwood Farm in Hamden for students affiliated with a Yale University program for disadvantaged youths (6 students) *July 21*
- Instructed and assisted with beehive painting at Lockwood Farm in Hamden for students affiliated with a Yale University program for disadvantaged youths (8 students) *July 29*
- Assisted youths from a Yale University Program for disadvantaged youths in building and painting beehives for their apiary program at Lockwood Farm in Hamden *August 4*
- Manned a honey bee information table on Plant Science Day and spoke on beekeeping systems used in Connecticut in the demonstration tent, which was attended by over 100 visitors *August 8*
- With Dr. Lindsay Triplett, visited Spring Glen Church in New Haven and spoke about honey bees and beekeeping; the youngsters were very excited to view the bees in the observation hive (12 attendees) *August 26*
- Visited the Beth El Keser Synagogue in New Haven and spoke about honey bee health issues (30 attendees) *September 2*
- Visited The Sound School in New Haven and demonstrated honey bee hive inspections (20 students and staff) *September 13*
- Staffed a CAES booth at The Big E in West Springfield, MA, speaking to several hundred visitors on the mission of CAES and on honey bee health topics *September 18*
- Set up a bee health booth and discussed bee-related topics at the Franklin Wildlife Center in Franklin (48 visitors) *September 22*
- Participated in a workshop on black bear management strategies at the UCONN Extension Office in Torrington where he presented a beekeeper’s perspective on the problem and discussed various management strategies, educational programs, and the value of a limited bear hunting season *November 7*
- Spoke about the various methods used to feed bees and winter preparation at the Sound School’s monthly beekeepers meeting held in New Haven. A new honey extractor and supporting equipment were donated to the club under the School Beekeeping Grant, supported by a Specialty Crop Grant funded by the U.S. Department of Agriculture and administered by the Connecticut Department of Agriculture *November 29*
- Presented beekeeping information to The Sound School Beekeeping program in New Haven (20 student attendees) *December 10*
- Was interviewed by a student from Fairfield Wheeler Interdistrict Magnet School in Bridgeport for an honors project on honey bee health-related topics *December 13*

- Attended and presented on honey bee health at the Connecticut Beekeepers Association Bee School held in Jones Auditorium (110 new beekeepers) *January 12, 2019*
- Spoke on bee health topics with a question and answer session at the conclusion of the presentations at the Connecticut Beekeepers Association “Bee School” held in Falls Village (114 new beekeepers) *February 2*
- Hosted the Connecticut Beekeepers Association winter meeting held in Jones Auditorium (98 attendees) *February 9*
- Spoke about “Beekeeping Basics” at the Northern Connecticut Agricultural Summit held at Asnuntuck Community College (25 attendees) *March 2*
- Spoke about best beekeeping management practices at a zoning meeting for the Town of East Lyme and answered questions on beekeeping related to regulations being considered to allow beekeeping in Niantic and East Lyme *March 21*
- Spoke to a group about our honey bee registration laws and collected twenty-five registrations while attending the Backyard Beekeepers Association meeting held in Weston (120 beekeepers) *March 26*
- Spoke with members of the New Canaan High School Beekeeping Club on honey bee biology and varroa mite management strategies (20 attendees) *April 1*
- Spoke about honey bees and their role in pollination at Brown Middle School in Madison (160 students) *April 11*
- Gave a lecture about basic bee biology to twelve members of the executive staff and regional sales managers at Koster Keunen, Inc., in Watertown followed by a tour of the facility. Koster Keunen is one of the world’s largest purchaser of honeybee wax and makes honeybee wax related compounds for industry *April 16*
- Spoke about basic beekeeping to visitors at the Canterbury Public Library (20 attendees) *May 13*
- Spoke about beekeeping and pollination at Joshua Center in Dayville (20 high school students) *May 28*
- Attended the CT Beekeepers Association meeting at Lockwood Farm in Hamden with guest speaker Keith Delaplane from the University of Georgia and conducted hive inspections with the 75 members in attendance *June 1*

CUI, ZHOUQI

- Gave an oral presentation entitled “*Dickeya dadantii* Forms Elongated Cells During the Infection of Potato Tubers: Causal Conditions, Molecular Basis, and Implications to Pathogenicity” at the Sussex Plant Biology Symposium held in Jones Auditorium (70 attendees) *September 14, 2018*
- Attended the 2nd International Symposium on Fire Blight of Rosaceous Plants and gave an oral presentation entitled “Role of Type III Secretion System During the Infection of Apple Flowers by *Erwinia amylovora*” in Traverse City, MI (70 participants) *June 20, 2019*

da SILVA, WASHINGTON

- Presented a talk entitled “Grapevine Virus Diseases” at the Connecticut Winegrape Growers Twilight Meeting held at Paradise Hills Vineyards in Wallingford (40 adults, 10 youths) *July 29, 2018*
- Presented a poster entitled “Does Transmission Mode Shape PVY Quasispecies? Insights from Illumina Deep Sequencing” at the International Congress of Plant Pathology held in Boston, MA (100 attendees) *July 29-August 3*
- With his Ph.D. student from Brazil, Darlan Borges, attended and presented a poster entitled “Grapevine Leafroll Disease is Widespread in Connecticut” at the Annual Meeting of the Northeastern Division of the American Phytopathological Society held in State College, PA *April 2-5, 2019*
- Presented a seminar entitled “Small Things Considered: The Impact of Plant Viruses on Wine Production” at Quinnipiac University for the Quinnipiac Chapter of Sigma Xi, The Scientific Research Society (41 students) *April 12*
- Served as a judge at the Northeast Regional Sigma Xi Student Research Conference held at Quinnipiac University in Hamden (54 students, 12 adults) *April 24*

- Gave a Skype presentation (Skype a Scientist Program) to first grade students for a program near the Twin Cities of Minnesota called Young Scholars, which works to recognize and support gifted learners (12 attendees) *April 23*
- With Ph.D. student Darlan Borges and interns Stephanie Preising and Ethan Tippett, attended the 2019 CT Farm Wine Twilight Meeting held at Paradise Hills Vineyard & Winery in Wallingford, and presented “Grapevine Viruses Identification” (65 attendees) *June 19*

DE LA TORRE-ROCHE, ROBERTO

- Gave a presentation entitled “Co-Exposure of Imidacloprid and Weathered or Unweathered Silver Nanoparticles to *Cucurbita pepo* (Zucchini): Contaminant Bioaccumulation and Translocation” at the 15th International Phytotechnologies Conference held in Novi Sad, Serbia (30 attendees) *October 1-5, 2018*

DUGAS, KATHERINE

- Staffed a CAES and CAPS table at the CT Tree Protective Association summer meeting held at the Farmington Club in Farmington *July 19, 2018*
- Staffed a CAES and CAPS table at the CT Nursery & Landscape Association Summer Field Day held at Lockwood Farm in Hamden *July 25*
- Set up and staffed a CAES display table at the Woodstock Fair (146 attendees) *September 1-3*
- Staffed a Forest Pest booth at the annual CT Association of Conservation and Inland Wetlands Commissions (CACIWC) meeting held in Cromwell *November 17*
- With Dr. Kirby Stafford and Dr. Victoria Smith, ran the fall CT Agricultural Pest Survey Committee meeting held in Jones Auditorium (10 attendees) *November 20*
- Conducted a training at the Rhode Island DEM office in Providence in the use of the NAPIS database for the State Survey Coordinators of RI and MA at USDA-APHIS-PPQ request *December 4*
- Staffed a CAPS and Forest Pest booth at the Annual Meeting of the CT Tree Protective Association held in Plantsville *January 17, 2019*
- Staffed a CAPS and Forest Pest booth at the CT Nursery and Landscape Association Winter Symposium held in Plantsville *January 23-24*
- Hosted an Entomology table activity as part of the Girl Scouts STEMagination Family Science Night held at Naugatuck Valley Community College (53 scouts and 39 scout leaders were in attendance) *February 15*
- Staffed the CAES booth and displayed general Station information and a selection of pamphlets and publications at the CT Flower Show held in Hartford *February 22 and 24*
- Gave a talk entitled “CAPS Program: Targets for 2019” at the annual Forest Health Monitoring Workshop held in Jones Auditorium *March 5*
- Staffed a table covering CAES services and Forest Pest information including spotted lanternfly at the Master Gardener Association Annual Symposium held at Connecticut College in New London *March 16*
- Staffed a Forest Pest Outreach booth at North Haven Earth Day (approx. 70 people) *April 6*
- Staffed a Forest Pest Outreach booth at Hamden Earth Day (~200 people) *April 27*
- Attended and ran the state Cooperative Agricultural Pest Survey (CAPS) committee meeting in the Slate Board Room (10 participants) *June 17*

DURGY, ROBERT J.

- Led a tour of the Griswold Research Center for visiting students from Norwich Technical High School (19 students, 3 adults) *September 27, 2018*
- Taught Math Calculations and Calibration for Pesticide Applicators Training in Wallingford (19 attendees) *November 28*

- Attended as a member of the steering committee and ran the audio-visuals at the CT Vegetable and Small Fruit Growers Meeting held in East Windsor (288 attendees) *January 7, 2019*
- Taught a Connecticut Master Gardeners Training Course on vegetables in Haddam (70 attendees) *February 5*
- Taught a Connecticut Master Gardeners Training Course on vegetables in Stamford (23 attendees) *February 11*
- Taught a Connecticut Master Gardeners Training Course on vegetables in Bethel (32 attendees) *February 14*
- Taught a Connecticut Master Gardeners Training Course on vegetables in Brooklyn (25 attendees) *February 22*
- Taught Math Calculations and Calibration for Pesticide Applicators Training in Farmington (37 attendees) *February 26*
- Taught a Connecticut Master Gardeners Training Course on vegetables in Farmington (38 attendees) *March 6*
- Taught a course on Integrated Pest Management and Backpack Calibration in Waterbury (8 attendees) *June 6*

EITZER, BRIAN D.

- Presided over two sessions and was interviewed for an e-book by LCGC magazine, which was published along with the conference, at the North American Chemical Residue Workshop held in Naples, FL *July 22-25, 2018*
- Presented a talk entitled “Analytical Challenges in Studies of Pesticides and Pollinators” and presided over a session at the Eastern Analytical Symposium held in Princeton, NJ (25 attendees) *November 12-13*
- Was a judge at the Connecticut Science & Engineering Fair held at Quinnipiac University in Hamden *March 12-13, 2019*
- Presented a talk entitled “Tracking Honey Bee Pesticide Exposure at Ornamental Nurseries” at the 2019 American Chemical Society Meeting held in Orlando, FL (30 attendees) *March 30-April 3*
- Was an instructor for the LB511 FDA/FERN Chemistry Training for LC-MS held in Cincinnati (12 attendees) *April 22-26*
- Presented a keynote address entitled “Challenges in Determining the Exposure of Pollinators to Pesticides” at the Latin American Pesticide Residue Workshop held in Foz do Iguacu, Brazil (140 attendees) *May 6-8*
- Presented two talks entitled “An Inter-Lab Study of a Non-Target Data Acquisition – Target Data Analysis Method for Pesticides in Foods Using Liquid Chromatography-High Resolution Mass Spectrometry: The Connecticut Participation Experience” and “FERN CHE.0008 - LC/MS Poison Screen: Extension to Q Exactive” at the Food Emergency Response Network Cooperative Agreement Program technical meeting held in Baltimore, MD (50 attendees) *June 18-19*

ELMER, WADE H.

- Gave an invited talk entitled “Using Nanoparticles to Control Plant Disease” at the Ag Innovate Conference held in San Francisco, CA (33 attendees) *July 11-13, 2018*
- Presented a poster entitled “Using Nanoparticles of Metalloids and Metallic Oxides in Plant Disease Suppression” at the International Congress of Plant Pathology held in Boston, MA (100 attendees) *July 29-August 3*
- Was interviewed about how nanoparticles of micronutrients can suppress plant disease by John Burgeson, Connecticut Post *August 8*
- Presented a poster entitled “Using Nanoparticles of Metalloids and Metal Oxides in Plant Disease Suppression” at the Sussex Plant Biology Symposium (organized by Yale University) held in Jones Auditorium (70 adults) *September 14*

- With Drs. Zhouqi Cui, Washington da Silva, Yonghao Li, Robert Marra, Quan Zeng, and Teja Shidore, met with Beverly Samuel, National Program Leader for the USDA National Institute of Agriculture (NIFA), and discussed research programs in the department *September 19*
- With Dr. Jason White, co-sponsored an All-Hands meeting of the NSF Sustainable Nanotechnology Center in Jones Auditorium *September 21-22*
- With Dr. Jason White, co-presented “Nano-Enabled Agriculture: What Are the Important Chemistry-Driven, Mechanistic Questions Relevant to Nanoparticle Interactions/Uptake/Transport in Plants” at the All-Hands meeting of the Center for Sustainable Nanotechnology held in Jones Auditorium (85 attendees) *September 21*
- Gave a presentation entitled “Metalloid and Metal Oxides for Plant Disease Control” at the 2nd Quantifying Exposure to Engineered Nanomaterials from Manufactured Products Workshop held in Washington, DC (22 adults) *October 9*
- Presented a talk entitled “Using Mineral Nutrition to Prevent Diseases in Greenhouse Crops” at the UMass Extension meeting “Greenhouse Production 2019 – Focus on Pest Management” held in Marlborough (35 adults) *January 9, 2019*
- Presented an invited lecture entitled “Nanoparticles for Plant Disease Management” at the New York Botanic Gardens in Bronx, NY (15 adults) *February 8*
- Organized a Mini-Symposium on “Nanoparticles in the Environment: The Good News” and presented a talk entitled “Nanoparticles for the Suppression of Root Diseases” at the Connecticut Conference on Natural Resources held at UConn in Storrs (32 attendees) *March 11*
- Gave a presentation entitled “Nanoparticles for Suppression of Fusarium Root Disease” at the Annual Meeting of the Northeastern Division of the American Phytopathological Society held in State College, PA (32 adults) *April 2-5*
- Hosted Dr. Pam Marrone of Marrone Bio Innovations for discussion and a CAES seminar *April 9*
- Served as a judge for the Northeast Regional Sigma Xi Student Research conference (54 students, 12 adults) *April 24*
- Attended the Gordon conference on Environmental Nanotechnology and presented a poster entitled “Metallic nanoparticles for plant disease suppression” and served on a career discussion panel for graduate students (42 attendees) *June 1-2*
- Co-sponsored the 2019 Greenhouse Biological Control Conference held in Jones Auditorium (70 attendees) *June 19*

GENT, MARTIN P. N.

- Gave a talk entitled “Modeling Translocation and Metabolism in Plants” at the International Horticultural Congress held in Istanbul, Turkey *September 14, 2018*

GLORIA-SORIA, ANDREA

- Gave a lecture entitled “Historical and Modern Movements of the Yellow Fever Mosquito, *Aedes aegypti*” to the Mystic Aquarium staff (15 attendees) *October 17, 2018*
- Gave a talk entitled “Transmission of Arboviruses by Mosquito Vectors to Live Vertebrate Hosts is Underestimated by in Vitro Assays” at the MUVE, Biology and Ecology of Disease Vectors symposia of the Entomological Society of America, Entomological Society of Canada and Entomological Society of British Columbia Joint Annual Meeting held in Vancouver, BC, Canada (70 attendees) *November 11*
- Was interviewed on “It Takes a Mosquito to Fight a Mosquito” by the New York Times for the Fixes column (<https://www.nytimes.com/2019/01/08/opinion/mosquito-fighting-tropical-disease.html>) *January 4, 2019*

- Presented a poster entitled “Transmission of Arboviruses by Mosquito Vectors to Live Vertebrate Hosts is Underestimated by *in vitro* Assays” at the 2019 Northeast Regional Center for Excellence in Vector-borne Diseases meeting held in Jones Auditorium (120 attendees) *January 24*
- Mentored a student from Amity High School, Jack Tajmajer, who won 3rd place in the CT-STEM Fair under the Environmental category with a project entitled “Inter-Specific Competition Between Two Invasive Mosquito Species: *Aedes aegypti* and *Aedes albopictus*, over Multiple Generations” (approx. 183 students total, 58 participating in the Environmental category) *February 9*
- Gave an invited seminar entitled “Transmission of Arboviruses by Mosquito Vectors to Live Vertebrate Hosts is Underestimated by *in vitro* Assays” to the Powell-Caccone research group at the Ecology and Evolutionary Biology Department at Yale University (15 attendees) *March 5*

HISKES, ROSE T.

- With Dr. Yonghao Li, reviewed tree diseases with Arboriculture 101 students in Wallingford (39 students) *October 24, 2018*
- Staffed a Connecticut Invasive Plants Working Group table at the Connecticut Association of Conservation and Inland Wetlands Commissions Conference held in Rocky Hill *November 17*
- Presented an invasive insect scenario to Connecticut Tree Protective Association Arboriculture 101 students during review night in Wallingford (39 students) *December 5*
- Staffed the CAES booth at the Hartford Flower Show in Hartford *February 23, 2019*
- With Dr. Yonghao Li, staffed the CAES booth at the Connecticut Groundskeepers Association winter conference held in Rocky Hill *February 27*
- With Dr. Yonghao Li, instructed the Connecticut Tree Protective Association arborist certification students about plant diseases at the Tree Conditions Lab in Wallingford (28 attendees) *February 27*
- Gave a talk on Butterfly Gardening to the Wild Ones group at Connecticut College in New London (38 attendees) *March 9*
- Assisted the Connecticut Tree Protective Association Arboriculture 101 students with diagnosing insect tree problems at the hands-on night in Wallingford (35 attendees) *April 10*
- Co-chaired a Steering Committee Meeting and General Meeting of the Connecticut Invasive Plant Working Group held at the Valley Laboratory in Windsor *April 11*
- With Mr. Thomas Rathier and Dr. Jatinder Aulakh, taught a Private Applicator Pesticide Certificate Test Preparation Class to tobacco, vegetable, and fruit growers (29 attendees) *April 18*
- With Mr. Thomas Rathier and Dr. Jatinder Aulakh, taught a Private Applicator Pesticide Certificate Test Preparation Class to tobacco, vegetable, and fruit growers (29 attendees) *April 25*
- Gave a talk entitled “What’s Bugging Your Plants” to the Branford Garden Club at the Public Library in Branford (19 attendees) *June 4*
- Gave a talk entitled “What’s Bugging Your Plants” at the Strong Family Farm in Vernon (8 attendees) *June 30*

HYDE, JOSEPHINE

- Gave an invited talk entitled “The Axenic Mosquito to Study Host Microbiome Interactions” at the 7th Annual Symbiosis Symposium held in Jones Auditorium (54 attendees) *October 4, 2018*
- Gave a poster at the Animal-Microbe Symbioses Gordon Research Seminar (approx. 50 total attendees; approx. 30 students) and Animal-Microbe Symbioses Gordon Research Conference (approx. 130 attendees; approx. 50 students) *June 15-21, 2019*

KROL, WALTER J.

- Served as a judge for the 2018 Big E Future Farmers of America Agriscience Fair held in West Springfield, MA *September 14, 2018*
- Presented a talk entitled “Pesticide Residues in Food Sold in Connecticut from Old to ISO” at the local

section meeting of the New Haven Section of the American Chemical Society (40 attendees) *March 27, 2019*

LaMONDIA, JAMES A.

- Participated in the Connecticut Hop Growers Association Summer Quarterly meeting, conducted a research plot tour with Dr. Elisha Allan-Perkins, and spoke about integrated pest management of hops during the Connecticut Agricultural Experiment Station Hops Summer Meeting and Field Day held at the Valley Laboratory (16 attendees) *July 14, 2018*
- Conducted a tour of research plots with Roger Black and Rene Ramos of Imperial Tobacco, and Michael Hartley, Greg Seamster and Marc Mentzer of Lancaster Leaf *July 19*
- Participated in a meeting of the Journal of Nematology Editorial Board, chaired a contributed paper session on nematode management, and presented “Rotation Crops for Management of *Pratylenchus penetrans* in Connecticut” at the annual meeting of the Society of Nematologists held in Albuquerque, NM (100 attendees) *July 23-24*
- With Dr. DeWei Li, conducted a tour of Valley Laboratory research plots and a broadleaf tobacco farm for Xueliang Ren, visiting scholar from Guizhou Academy of Tobacco Institute, China *August 17*
- Welcomed participants and spoke about boxwood blight and disease management at the Nursery and Landscape Research Tour held at the Valley Laboratory in Windsor (6 attendees) *September 13*
- Participated in the CT Hop Growers Association Brewer Hop Lot Day held in Northford (12 attendees) *October 4*
- Taught a class on identification, biology, and management of tree diseases to students in the Connecticut Tree Protective Association’s Arboriculture 101 class held in Wallingford (40 attendees) *October 10*
- Spoke about the Hops research program at the Station at the Board of Control meeting held at the Valley Laboratory in Windsor *October 17*
- Spoke about nematode management research results at the annual meeting of the Northeast Regional Multistate Nematology Technical Committee (NE-1640) held in Northampton, MA (15 attendees) *October 24-26*
- Spoke about identification and management of rose diseases at the Connecticut Rose Society meeting held in Plainville (45 attendees) *November 4*
- Conducted a short course on plant parasitic nematodes at the Northeast Agribusiness and Crop Consultants Association Conference held in Syracuse, NY (35 participants) *November 28 & 29*
- Participated in the Connecticut Agricultural Information Council meeting regarding Agriculture Day at the Capitol and the Connecticut Outstanding Young Farmer Award held at the Valley Laboratory in Windsor *December 4*
- Spoke about hop production in Connecticut and integrated pest management at the CT Hop Growers Association annual meeting held in Northford (25 attendees) *January 12*
- Was interviewed about tobacco in Connecticut by Mark Baldwin of Borealis Press in Maine *February 21*
- Chaired the Connecticut Agricultural Information Council meeting regarding Agriculture Day at the Capitol and the Connecticut Outstanding Young Farmer Award in Windsor *February 21*
- Spoke about the history of tobacco production in Connecticut from the 1630s to today and tobacco research in support of production especially in regards to plant breeding for resistance and presented a talk for growers prepared by Christina Berger of the DEEP about Ferbam fungicide registration issues and Worker Protection Standard updates as a part of the Connecticut Agricultural Experiment Station’s annual Tobacco Research Meeting held at the East Windsor Scout Hall *February 26*
- Was interviewed about Agriculture Day at the Capitol and the Outstanding Young Farmer Award program conducted by the Connecticut Agricultural Information Council by Mark Hood for the Dept. of Agriculture Weekly Agricultural Report *March 6*

- Taught a class on identification, biology, and management of tree diseases to students in the Connecticut Tree Protective Association's Arboriculture 101 class in Wallingford (40 attendees) *March 6*
- Participated in Agriculture Day at the Capitol, speaking about the 2018 Century Farm Award recognizing Zentek Farms (100 attendees) *March 20*
- Presented a seminar entitled "Connecticut Cigar Wrapper Leaf: The Result of Practical Research and Over 380 Years of Tobacco Production" at the annual meeting of the Experiment Station Associates held in Jones Auditorium (18 attendees) (April 17);
- Spoke about the history of tobacco production in Connecticut from the 1630s to today and tobacco research in support of production especially in regard to plant breeding for resistance at the Nutrient Ag Solutions Grower meeting held in Windsor Locks (70 attendees) *April 30*
- Was interviewed about farmer interest in hemp production in CT by Davis Dunavin of WSHU *May 14*
- Spoke about the Experiment Station and Valley Laboratory research and outreach and the Valley Laboratory Garden as a part of the 2019 Windsor Garden Club senior citizen garden tour (15 attendees) *June 27*

LI, DEWEI

- Participated in two pre-congress field trips (July 14-15) and presented a poster, co-authored with A. Jalsrai and Neil P. Schultes, entitled "*Botryotrichum domesticum* sp. nov., a New Hyphomycete from an Indoor Environment" at the 11th International Mycological Congress (IMC11) held in San Juan, Puerto Rico *July 15-21, 2018*
- Presented a poster entitled "*Phytophthora abietivora*, a New Species Isolated from Diseased Christmas Trees in Connecticut, USA," coauthored with Drs. James A. LaMondia, Richard S. Cowles, and Neil P. Schultes, at the MASSMyco meeting held at Harvard University in Cambridge, MA *October 20*

LI, YONGHAO

- Presented "Plant Disease Diagnostics" to the Summer Undergraduate Fellows in Plant Health and Protection program in New Haven (10 adults) *July 18, 2018*
- Staffed the CAES booth at the CT Tree Protective Association Summer Meeting held in Farmington *July 19*
- Was interviewed about growing palm trees in Connecticut by Ms. Linda Lambeck, Connecticut Post *July 24*
- Spoke about common disease problems of Christmas trees at the CT Christmas Tree Growers Association twilight meeting held in New Milford (40 adults) *July 24*
- Co-sponsored The Sentinel Plant Network Workshop held at the Connecticut College Arboretum in New London and instructed the Diagnostics 102 labs (44 attendees) *August 16-17*
- Presented "Pruning 101" to members of the Spring Glen Garden Club in Hamden (15 adults) *September 10*
- Presented "Common Disease Problems 2017-18" at the Nursery and Landscape Research Tour held at the Valley Laboratory in Windsor (10 adults) *September 13*
- Presented "Backyard Small Fruit 101" to the Morris Cove Garden Club in New Haven (15 adults) *October 10*
- Instructed the tree disease section of the Tree Conditions Lab for the CTPA Arboriculture 101 Training Program in Wallingford (36 adults) *October 24*
- Spoke about the PDIO and plant disease diagnosis to Southern Connecticut State University students and faculty in Dr. Elizabeth Roberts' Mycology class in New Haven (15 adults) *October 30*
- Presented "Backyard Composting 101" to the Caudatowa Garden Club in Ridgefield (22 adults) *November 13*
- Presented "Plant Diseases and Their Management in Organic Gardens and Landscapes" for the CT

- NOFA Accreditation Course in Organic Land Care in East Hartford (55 adults) *November 14*
- Staffed the CAES booth at the Vegetable & Small Fruit Growers' Conference held in South Windsor *January 7, 2019*
 - Presented a talk entitled "Selection and Care of Houseplants" to the Guilford Garden Club in Milford (24 adults) *January 8*
 - Presented a talk entitled "Pruning 101" to the Burlington Garden Club in Burlington (32 adults) *January 10*
 - Staffed the CAES booth at the Annual Meeting of the CT Tree Protective Association held in Plantsville *January 17*
 - Staffed the CAES booth at the CT Nursery & Landscape Association's Winter Symposium held in Plantsville *January 23*
 - Participated in the UConn Bedding Plant Program for Greenhouse Growers and presented "Root Rots, Mildews, and Blights" in Torrington (40 adults) *January 29*
 - Presented "Organic Gardening" for The Green Café program at Yale University in New Haven (38 adults) *February 7*
 - Presented "Root Rots, Mildews, and Blights" in the UConn Bedding Plant Program for Greenhouse Growers held in Vernon (30 adults) *February 14*
 - Talked about the Plant Disease Information Office and seed testing in a "Behind the Scenes Tour of CAES" for the Experiment Station Associates (12 adults) *February 20*
 - Was interviewed about careers in plant science and job opportunities by Lexie Arnoldi, a high school student from The Morgan School in Clinton *February 20*
 - Presented "Plant Disease Prevention in Organic Gardens and Landscapes" at the CT NOFA Winter Conference held in Bridgeport (42 adults) *February 23*
 - Presented "Native Plants, Container Gardening, and Perennial Diseases" to the East Hartford Garden Club in East Hartford (45 adults) *February 25*
 - With Ms. Rose Hiskes, staffed the CAES booth at the CT Grounds Keepers Association Conference held in Cromwell *February 27*
 - With Ms. Rose Hiskes, spoke about tree diseases for the CTPA Tree Conditions Class held in Wallingford (28 adults) *February 27*
 - Presented "Disease Management Updates" at the CT Christmas Tree Growers Association Annual Meeting held in Middletown (60 attendees) *March 2*
 - Presented "What's Causing Oak Decline?" at the Forest Health Monitoring Workshop held in Jones Auditorium (60 attendees) *March 5*
 - Presented "Pruning 101" to members of the Haddam Garden Club in Haddam (68 attendees) *March 7*
 - Presented "All About Fungi and Fungicides - What Every Gardener Needs to Know" in the UConn Advanced Master Gardener Class held in Fairfield (25 attendees) *March 12*
 - Presented "Boxwood Blight and Common Diseases in Landscapes" for the Boxwood Blight Lunch & Learn Program held at SiteOne Landscape Supply in East Haven (35 attendees) *March 27*
 - Attended and presented "Plant Disease Updates in Connecticut" in the Extension & Industry Session at the Annual Meeting of the Northeastern Division of the American Phytopathological Society held in State College, PA (60 adults) *April 2-5*
 - Attended the National Plant Diagnostic Network 2019 Conference and presented a poster entitled "Outbreaks of Boxwood Blight in Connecticut" and gave a talk entitled "Highlights of Plant Diseases in 2018" in Indianapolis, IN (25 adults) *April 16*
 - Presented "Pruning 101" for the Long Hill Garden Club in Trumbull (55 adults) *April 22*
 - Presented "Boxwood Blight in Connecticut" in the Expert Panel Discussion at the Sam Bridge Nursery & Greenhouses in Greenwich (65 adults) *April 27*
 - Presented "Organic Gardening" in the Canterbury Public Library in Canterbury (15 adults) *May 6*
 - Presented "Backyard Composting" in the Showroom event at the Torrison Stone & Garden in Durham

- (9 adults) *May 18*
- Presented “Invasive Species” to the Hooker School Science Club members in New Haven (15 youths and 1 adult) *May 21*
- Gave a 4-day on-site training of disease diagnostics and document management to Ms. Abby Beissinger, a new plant diagnostician at UConn *June 4, 5, 11, and 12*
- Was interviewed about epidemics of anthracnose on sycamore and oak trees this spring by Robert Miller from the Danbury News-Times *June 17*
- Spoke about the Plant Disease Information Office to CCSU students and faculty during a tour of the Station (18 adults) *June 20*
- Presented “Backyard Small Fruit 101” for a Cheshire Public Library event in Cheshire (16 adults) *June 24*
- Presented “Gardening with Native Plants” for a Rockville Public Library event in Vernon (10 adults) *June 25*
- Presented “Disease Management in Christmas Tree Farms” at the CCTGA Twilight Meeting held in Broad Brook (60 adults) *June 26*

LINSKE, MEGAN A.

- Conducted Leadership Institute interviews with Dr. Erin McCance, consultant for Joro Consulting, and Dr. John McDonald, President of the Wildlife Society *August 20, 2018*
- Gave a poster presentation entitled “*Ixodes scapularis* Reservoir Host Diversity and Abundance Impacts on Dilution of *Borrelia burgdorferi* in Residential and Woodland Habitats in Connecticut, United States” at the 15th Annual International Conference on Lyme borreliosis and Other Tick-borne Diseases at the Centers for Disease Control and Prevention in Atlanta, GA (300 attendees) *September 13*
- Demonstrated small rodent trapping and handling techniques to undergraduate students in the Wildlife Sampling Techniques class at the University of Connecticut in Storrs *September 17*
- Hosted Isabell MacInnes during her Churchill Fellowship by providing a tour of CAES and a demonstration of tick sampling methodology in Lyme *October 24-25*
- Conducted a Northeast Section Wildlife Society Workshop Committee conference call on workshop selections for the Northeast Fish and Wildlife Agencies (NEAFWA) Conference in April 2019 *November 13*
- With Dr. Scott Williams, Mr. Michael Short, and Mr. Joseph Barsky, led a field trip for 11th and 12th grade students from the Cooperative Arts and Humanities High School’s Environmental Studies class at Lockwood Farm and discussed research and career opportunities *November 28*
- With Dr. Scott Williams, Mr. Michael Short, and Mr. Joseph Barsky, conducted the CT Forestry CDE with 12 participating high schools at Lockwood Farm (60 attendees) *November 29*
- Attended and presented a poster entitled “Determining Effects of Winter Weather Conditions on Nymphal *Ixodes scapularis* and Adult *Amblyomma americanum* Survival in Connecticut and Maine, USA” at the Northeast Regional Center for Excellence in Vector-Borne Diseases annual conference held in Jones Auditorium (94 attendees) *January 24-25*
- Discussed vector-borne and zoonotic disease ecology research and careers for the National FFA Organization’s tour of the CAES *February 19*
- Presented current research entitled “Determining Effects of Winter Weather Conditions on Nymphal *Ixodes scapularis* and Adult *Amblyomma americanum* Survival in Connecticut and Maine, USA” for the Northeast Regional Center for Excellence in Vector-Borne Diseases Trainee Seminar Series (10 attendees) *March 11*
- Spoke to Lyman Hall High School students about career paths and research opportunities at CAES (16 students) *March 11*
- Discussed careers in wildlife biology and management with Girls Scouts for the STEM guest speaker series held at West Side Middle School in Waterbury (15 students) *March 21*

- Judged students' presentations for Quinnipiac University's Sigma Xi Student Research Conference *April 24*
- Gave an invited lecture entitled "Blacklegged Tick Reservoir Host Diversity and Abundance Impacts on Dilution of *Borrelia burgdorferi* in Residential and Woodland Habitats in Connecticut" at the International Urban Wildlife Conference held in Portland, OR (30 attendees) *June 4*
- Was interviewed about professional development and leadership in vector-borne and zoonotic disease research by Justin Shew for the Wildlife Society's Leadership Institute *June 14*

LITTLE, ELIZA A. H.

- Presented a talk entitled "Spatiotemporal Dynamics of *Ixodes scapularis*, *Borrelia burgdorferi* Infection, and Lyme Incidence in Connecticut: What Can We Learn from Longitudinal Passive Surveillance Data?" while attending the Entomological Society of America, Entomological Society of Canada, and Entomological Society of British Columbia Joint Annual Meeting held in Vancouver, BC, Canada (70 attendees) *November 11-14, 2018*

MAIER, CHRIS T.

- Exhibited new entomological books at a meeting of the Connecticut Entomological Society at the University of Connecticut, Storrs (ca. 40 attendees) *October 19, 2018*
- Presented a poster entitled "Two Alien Beetles, *Callidiellum rufipenne* (Cerambycidae) and *Pyrrhalta viburni* (Chrysomelidae), Expand Their Distributional Range in Connecticut" while attending the Entomological Society of America, Entomological Society of Canada, and Entomological Society of British Columbia Joint Annual meeting held in Vancouver, BC, Canada (70 attendees) *November 11-14*
- Discussed the exotic velvet longhorn beetle at an Advisory Committee Meeting of the Cooperative Agricultural Pest Survey held in Jones Auditorium (10 attendees) *November 20*
- Discussed new exotic insects that may threaten Connecticut fruit orchards at the Annual Meeting of the Connecticut Pomological Society held in Middletown (ca. 100 attendees) *November 27*
- Presented a display on longhorned beetles in firewood and distributed manuals on caterpillars feeding on conifers at the Annual Meeting of the Connecticut Tree Protective Association held in Southington *January 17, 2019*
- Spoke about "Two Alien Beetles Expand Their Distributional Range in Connecticut" at the Forest Health Monitoring Workshop held in Jones Auditorium *March 5*

MARRA, ROBERT E.

- Co-organized and co-led a forest pathology field trip in Myles Standish State Park, Carver, MA for the International Congress of Plant Pathology. The field trip took place in various parts of Myles Standish State Park. Dr. Marra and colleagues introduced the international group to the cooperative and complementary roles of scientists and staff from federal and state agencies and universities. Site visits and subjects included: cranberry bogs; white pine, pitch pine, and red pine stands to discuss the ecology and management of diseases affecting these trees; salt marshes and Sudden Vegetation Dieback; nondestructive detection and quantification of internal decay using tomography (56 adults) *July 28, 2018*
- Presented "Accurately Accounting for Decay and Carbon Loss in Trees: A Novel Nondestructive Approach Using Tomography" as part of Yale University's Sussex Plant Biology Symposium held in Jones Auditorium (70 adults) *September 14*
- With Ms. Alysha Auslender, a SCSU Master's student with Dr. Robert Marra, presented a poster entitled "Development of Microsatellite Markers for Population Genetic Analyses of the Saltmarsh Pathogen, *Fusarium palustre*" at the Yale University Sussex Plant Biology Symposium held in Jones Auditorium (70 adults) *September 14*
- Presented a lecture on fungal mating systems to the Mycology (BIO-432) class at Southern Connecticut

- State University in New Haven (15 adults) *November 1*
- Presented a talk on Oak Wilt at the annual meeting of the New England chapter of the International Society of Arboriculture (NE-ISA) held in Mystic (250 adults) *November 5*
- Was interviewed about nondestructive detection of internal decay in trees at his Great Mountain Forest research site in Norfolk by Patrick Skahill of WNPR *November 12*
- Presented a talk entitled “Drought and Its Impact on Trees” to the Guilford Garden Club in Guilford (60 adults) *January 9, 2019*
- Assisted in staffing the CAES table at the Annual Meeting of the Connecticut Tree Protective Association held in Plantsville (749 adults) *January 17*
- Presented “Accurately Accounting for Decay and Carbon Loss in Trees: A Novel Nondestructive Approach Using Tomography,” to the Department of Plant Science and Landscape Architecture at the University of Connecticut in Storrs, followed by a meeting with graduate students (35 adults) *February 8*
- Presented “On the Lookout for Wilt” for the Forest Health Monitoring Workshop in Jones Auditorium (70 adults) *March 5*
- Presented “The Effects of Climate Change on Agriculture” as part of a panel discussion sponsored by the Massaro Community Farm at the Woodbridge Town Library (40 adults) *March 13*
- Presented “Fungi of the Forest” for the Cheshire Land Trust, at the Cheshire Town Hall (60 adults) *March 28*
- Was interviewed by Jan Ellen Spiegel about his work quantifying carbon loss due to internal decay in trees, for the MIT publication, “Undark” *April 26*
- Was interviewed at Lockwood Farm by Jan Ellen Spiegel about his work quantifying carbon loss due to internal decay in trees, for the MIT publication, “Undark” *May 31*
- Presented a talk entitled “On the Lookout for Oak Wilt” at the annual meeting of the Tree Wardens Association of Connecticut held at Stony Creek Brewery (75 adults) *June 6*
- Performed a demonstration of tree tomography at Lockwood Farm for a journalist from the science publication “Undark” *June 16*

MAYNARD, ABIGAIL A.

- Spoke about growing vegetables to campers at Hamden Hall Summer Camp (5 adults, 55 youths) *July 23, 2018*
- Spoke on “Composting and Utilization of Compost” to a Sustainability class at Hamden Hall Country Day School (30 students, 2 teachers) *October 11*
- Gave a tour of Lockwood Farm to a kindergarten class from Hamden Hall Country Day School (18 students, 2 teachers) *October 27*
- Spoke on “Composting and Utilization of Compost” to the Trumbull Garden Club (72 adults) *October 22*
- Reported on Station activities at a quarterly meeting of the Council on Soil and Water Conservation held in Vernon (18 adults) *November 8*
- Spoke about winter botany to 3rd graders at Hamden Hall Country Day School (18 children, 2 teachers) *December 10*
- Reported on Station activities at a quarterly meeting of the Council on Soil and Water Conservation held in Middletown (18 adults) *January 16, 2019*
- Was interviewed about the Station and the New Crops Program by Joanie Stiers from Connecticut Grown Magazine *February 11*
- Spoke on “Composting and Utilization of Compost” to the Branford Garden Club (41 adults) *March 5*
- Reported on Station activities at a quarterly meeting of the Council on Soil and Water Conservation held in Middletown (11 adults) *April 24*

- Judged posters at the Sigma Xi poster competition held at Quinnipiac University in Hamden *April 24*
- Presented a talk entitled “Growing Unusual Vegetables” as part of the 2019 Garden Series at the Avon Free Public Library in Avon (22 adults) *April 30*
- Judged entries for the CAES prize at the New Haven Science Fair at Hillhouse High School (580 students, 205 teachers) *May 13, 14*

McMILLAN, JOSEPH R.

- Served as a judge for the Northeast Regional Sigma Xi Student Research Conference held at Quinnipiac University in Hamden *April 24, 2019*
- Presented a poster entitled “Mosquito Diversity, Viral Transmission, and the Risk of Arboviral Exposure in Human Populations” at the Yale School of Public Health’s Emerging Microbial Disease Program’s Annual Research Day (approx. 70 students, 100 attendees total) *April 29*
- Gave a talk entitled “The Things They Carry: The Biology and Control of Mosquito-borne Diseases in Connecticut,” as a part of the Town of Darien Health Department’s Fight the Bite: The Challenge of Tick- and Mosquito-borne Diseases held at the Darien Public Library (approx. 20 attendees) *May 21*

MOLAEI, GOUDARZ

- Was interviewed on the current status of tick activity, tick-borne diseases in Connecticut, and tick bite prevention by WNPR <http://wnpr.org/post/connecticut-s-tick-crisis-won-t-be-going-away-anytime-soon> *July 2, 2018*
- Was interviewed on the current status of lone star tick activity and its potential public health threat by NBC Connecticut <https://www.nbcconnecticut.com/news/local/Heavy-Population-of-Lone-Star-Tick-Found-in-South-Norwalk-488316391.html> *July 17*
- Organized an exhibit on tick-borne pathogens and tick bite prevention and safety at the Stafford Middle School “Safe Day” event in Stafford Springs (approx. 180 students out of approx. 207 attendees) *August 31*
- Was interviewed about the tick outlook for Connecticut so far this year by NBC Connecticut <https://www.nbcconnecticut.com/news/local/Tick-Outlook-for-Connecticut-So-Far-This-Year-492896861.html> *September 10*
- Was interviewed about ticks and Lyme disease by the Connecticut Post <https://www.ctpost.com/local/article/Do-lots-of-ticks-mean-lots-of-Lyme-Maybe-not-13219038.php> *September 10*
- Conducted a workshop on tick identification and testing for Prof. David Della-Giustina of Yale-New Haven Hospital and a group of Residents and others from the Yale School of Medicine and Yale-New Haven Hospital (7 attendees) *September 19*
- Hosted two groups of faculty and graduate students attending the Center for Sustainable Nanotechnology symposium on tours of the Tick Testing Laboratory (15 attendees) *September 21*
- Was interviewed about the first East Asian longhorned tick found in the state by the Connecticut Post (<https://www.ctpost.com/local/article/First-person-bitten-by-east-Asian-longhorned-tick-13271684.php>) *October 1*
- Was interviewed about the first East Asian longhorned tick found in the state by WTIC NewsTalk 1080 *October 1*
- Was interviewed about the first East Asian longhorned tick found in the state by WFSB, Eyewitness News 3 *October 1*
- Was interviewed about the first East Asian longhorned tick found in the state by Fox 61 (<https://fox61.com/2018/10/01/evidence-of-bite-by-exotic-east-Asian-tick-reported-in-connecticut/>) *October 1*
- Was interviewed about the first East Asian longhorned tick found in the state by the Daily Voice Newtown (<https://newtown.dailyvoice.com/news/first-bite-victim-of-asian-longhorned-tick-reported->

[in-fairfield-county/742673/](#)) *October 1*

- Was interviewed about the first East Asian longhorned tick found in the state by News 12 *October 2*
- Was interviewed about the first East Asian longhorned tick found in the state by WTIC-AM *October 3*
- Was interviewed about the first East Asian longhorned tick found in the state by the Newtown Bee *October 12*
- Was interviewed about the first East Asian longhorned tick found in the state by WTNH Channel 8 (<https://www.wtnh.com/news/health/uconn-research-scientists-issue-warning-on-rare-tick/1536790794>) *October 19*
- Gave an invited talk entitled “The Enduring Challenge and Future Outlook of Tick-borne Diseases” to the Yale University School of Medicine (50 attendees) *October 10*
- Gave an invited talk entitled “Nature’s Revenge: Plague of Emerging Vector-borne Diseases in the 21st Century” to the Biology Department, Central Connecticut State University (6 faculty and 14 student attendees) *October 16*
- Hosted Isabell MacInnes, a Churchill Fellowship Awardee from the Health Protection and Screening Services, NHS Western Isles, Scotland, in the Tick Testing Laboratory *October 24*
- Gave two talks entitled “Spatiotemporal Dynamics of *Ixodes scapularis*, *Borrelia burgdorferi* Infection, and Lyme Disease Incidence in Connecticut: What Can We Learn from Longitudinal Passive Surveillance Data?” and “Population Genomics of *Culiseta melanura*, the Principal Vector of Eastern Equine Encephalitis Virus in the United States” at the 2018 Entomological Society of America, Entomological Society of Canada, and Entomological Society of British Columbia Joint Annual Meeting held in Vancouver, BC, Canada *November 11 & 14*
- Was interviewed about the activity of the East Asian longhorned tick *Haemaphysalis longicornis* in Connecticut and New England by WTNH Channel 8 (<https://www.wtnh.com/news/health/invasive-tick-species-has-made-its-way-to-connecticut/1639780124>) *December 4*
- Was interviewed about the activity of the East Asian longhorned tick *Haemaphysalis longicornis* in Connecticut and New England by New Hampshire Public Radio *December 4*
- Was interviewed about the activity of the East Asian longhorned tick *Haemaphysalis longicornis* in Connecticut and New England by The Public Radio, Rhode Island *December 4*
- Was interviewed about tick activity and human Lyme disease cases by the New Haven Register (<https://www.nhregister.com/news/article/Connecticut-not-likely-to-see-drop-in-Lyme-13530044.php>) *January 13, 2019*
- Gave a talk entitled “Ticks and Tick-borne Diseases in Connecticut” at CAES to a symposium organized by Mosquito and Biting Fly Review, Connecticut Grounds Keepers Association, and CT Turf & Irrigation (71 attendees) *January 15*
- Gave poster-pitch introductions for his co-authored posters entitled “Passive Tick Surveillance in Connecticut: Spatiotemporal Patterns of Pathogen Infection in *Ixodes scapularis* and Human Disease Cases,” “Distribution, Abundance, and Host Association of the Asian Tiger Mosquito, *Aedes albopictus*, as a Potential Vector of Arboviruses in Mid-Atlantic USA,” and “Vector-Host Interactions and Population Genomics of *Culiseta melanura* (Diptera: Culicidae), the Principal Vector of Eastern Equine Encephalitis Virus in the USA,” at the Annual Meeting of the Northeast Regional Center for Excellence in Vector-borne Diseases held in Jones Auditorium (110 attendees) *January 24-25*
- Gave a talk entitled “New Threats of Old Enemies: Enduring Challenge of Vector-borne Diseases in the 21st Century” to members of Y’s Men of Meriden, CT (60 attendees) *January 29*
- Participated in the Internship and Career Fair, Department of Biology, Central Connecticut State University, New Britain, and gave a short talk on mosquito and tick research projects and the Tick Testing Laboratory (70 attendees) *February 4*
- Gave a short talk on the Tick Testing Laboratory and research on ticks and tick-borne pathogens in a “Behind the Scenes Tour of CAES” for the Experiment Station Associates (12 attendees) *February 20*
- Gave an invited talk entitled “Passive Tick Surveillance: Tracking Ticks and Tick-borne Pathogens in Connecticut” in a symposium “Fighting the Bite, Managing of Ticks and Risk of Tick-borne Diseases”

- held in Jones Auditorium (110 attendees) *February 21*
- Was interviewed about ticks by News 8 WTNH (<https://www.wtnh.com/news/health/will-connecticut-residents-see-less-ticks-this-summer-/1846415878>) *March 13*
 - Was interviewed about the consequences of warming temperatures on rodent and tick abundance and tick-borne diseases in Connecticut by the Wilton Bulletin *March 13*
 - Was interviewed about the outlook for tick activity in the upcoming spring and summer by WFSB Channel 3 (https://www.wfsb.com/news/doctors-warn-of-tick-dangers-as-population-rises/article_734a9b26-496a-11e9-beaf-e713248c8226.html) *March 18*
 - Was interviewed on tick reproduction and the prospect of tick abundance and activity this season by the Republican-American *April 12*
 - Was interviewed about whether a mild winter will impact ticks by the Wilton Bulletin <https://www.wiltonbulletin.com/138544/will-a-mild-winter-impact-ticks/> *April 15*
 - Gave an invited talk entitled “Nature’s Revenge: Persistent Challenge of Mosquito- and Tick-borne Diseases in Connecticut” to the Association of Retired Employees of Northeast Utilities (ARENU) in Berlin (30 attendees) *April 17*
 - Was interviewed about the Asian longhorned tick by the MV (Martha’s Vineyard) Times <https://www.mvtimes.com/2019/04/19/asian-longhorn-tick-continues-northward-march/> *April 19*
 - Attended the 5th Annual EMD Research Day Symposium, Department of Epidemiology of Microbial Disease, Yale School of Public Health, to witness Dasha Pokutnaya, an MPH student who conducted her internship and thesis under his supervision, present her thesis work (approx. 60 attendees) *April 29*
 - Was interviewed about ticks by the Republican-American, <https://www.rep-am.com/local/news-local/2019/05/05/right-to-be-ticked-off-tiny-creepy-bugs-post-dangerous-threat/> *May 5*
 - Was interviewed about ticks by WFSB-TV-DT Channel 3, https://www.wfsb.com/news/tips-to-stay-tick-free-as-weather-warms/article_f64d1bf4-730c-11e9-bae6-cf1f544286a1.html *May 10*
 - Was interviewed about ticks by the Connecticut Post, <https://www.sfchronicle.com/local/article/Time-for-ticks-almost-time-for-mosquitoes-13848279.php> *May 15*
 - Was interviewed about tick activity, Lyme disease, areas with higher tick abundance and activity, and the risk of infection with tick-borne diseases by WPLR *May 16*
 - Organized a public information event as a part of the Town of Darien Health Department’s Fight The Bite: The Challenge of Tick- and Mosquito-borne Diseases, and presented a talk entitled “Passive Tick Surveillance and Testing Program: Tracking Ticks and Associated Pathogens in Connecticut” (approx. 20 attendees) *May 21*
 - Was interviewed about ticks and Lyme disease by the Connecticut Post, <https://www.ctpost.com/local/article/Study-reveals-more-information-about-Lyme-13900908.php> *May 28*
 - Was interviewed about ticks and Lyme disease by News 8 WTNH, <https://www.wtnh.com/news/health/lyme-disease-hot-zones-based-on-tick-population-in-ct-released/2034253454> *May 28*
 - Was interviewed about ticks and Lyme disease by News 3 WFSB, https://www.wfsb.com/news/study-maps-out-spots-in-ct-with-greater-risk-of/article_c3c5a2de-8151-11e9-bbc9-a7cebe11911a.html *May 28*
 - Was interviewed about Lyme disease across the state by 1080 WTIC NEWSTALK - WTIC Radio, <https://omny.fm/shows/mornings-with-ray-dunaway/morning-show-w-dr-goudarz-molaei-5-30-19> *May 30*
 - Was interviewed about the passive tick surveillance program at CAES by The Day, New London *May 30*
 - Hosted a group of faculty and students from Central Connecticut State University at the Tick Testing Laboratory and spoke on ticks (17 attendees) *June 17*
 - Was interviewed about the underreporting of Lyme disease cases in Connecticut and the impact of

temperature on tick populations by Christy Colasurdo, a freelance journalist *June 20*

NASON, SARA L.

- Organized a visit by eight CAES staff scientists and visiting scholars to tour the water treatment plant of the Greater New Haven Water Pollution Control Authority in New Haven *April 11, 2019*
- Served as a judge for the Northeast Regional Sigma Xi Student Research Conference held at Quinnipiac University in Hamden *April 24*

PIGNATELLO, JOSEPH J.

- With Dr. Yi Yang, co-authored a talk entitled “Tailored Carbons as Non-Conventional Adsorbents and Adsorbent-Catalysts” (approx. 20 students out of approx. 40 attendees), and, with Yi Yang and Jaehong Kim of Yale University, co-authored a talk entitled “Oxidation of Organic Contaminants by Unactivated Peroxymonosulfate: Roles of Reactive Species and Direct Oxidation” (approx. 40 students out of approx. 80 attendees), both talks in the Environmental Chemistry Division at the American Chemical Society Annual Meeting held in Boston, MA *August 19-23, 2018*
- Participated in an oral presentation of the grant application “Innovative Treatment Options to Mitigate Munitions Constituent Transport on DoD Testing and Training Ranges” with W. Xu and others before the Technical Scientific Review Panel at DoD Strategic Research and Development Program (SERDP) offices in Arlington, VA *September 12-13*
- Gave a talk entitled “Biochars Tailored to Remove Nutrients from Animal Wastes” at the Soil Science Society of America International Soils Meeting held in San Diego, CA (50 attendees total, about 35 students) *January 8, 2019*
- Served as a judge for the Northeast Regional Sigma Xi Student Research Conference held at Quinnipiac University in Hamden *April 24*

PRAPAYOTIN-RIVEROS, KITTY

- Attended the 5th governmental food and feed laboratory accreditation meeting in Houston, Texas, and gave a presentation entitled “Transitions to the New ISO/IEC 17025 Standard,” along with Ms. Terri Arsenault (~100 attendees) *April 8-11, 2019*
- Participated in the WebEx call for Partnership for Food Protection Information Technology Work Group (PFP IT WG) hosted by the Office of Regulatory Science FDA, and gave a talk on the state perspective on the National Food Safety Data Exchange (NFSDX) participation *April 29*

RIDGE, GALE E.

- Was interviewed about the lone star tick by Steven Rosenbaum, NBC News *July 13, 2018*
- Spoke about bed bug management to visitors from the Yale University Biosafety Group *July 13*
- Was interviewed about good bugs and bad bugs in and around the home by Harlan Levy, Journal-Inquirer *July 23*
- Visited the Yale School of Nursing with Christopher Nelson, Connecticut Pest Elimination, to address a cluster of office staff who complained of being “bitten” by insects. No biting arthropods were detected, but humidity was very low (15%) and a key protagonist in the staff suffered from depression *August 22*
- Spoke about bed bugs to the Woodbridge Garden Club in Woodbridge (30 attendees) *September 18*
- Presented a talk about bed bugs to the Connecticut Association for Public Health Nurses in Madison (48 attendees) *September 20*
- Hosted two groups of visiting scientists who were attending a Center for Sustainable Nanotechnology meeting at CAES and spoke about her research and the functions of the Insect Information Office *September 21*
- Presented a talk about bed bugs in libraries at the New Haven Free Public Library in New Haven (39 attendees) *October 2*

- Presented a talk about economically important exotic arthropod pests of plants and humans to the Woodbridge Garden Club in North Haven (23 attendees) *October 23*
- With Dr. Kirby Stafford, presented two talks on ticks, bed bugs, and forensic entomology to the students of Alice Bray, Central Connecticut State University (14 attendees) *October 25*
- Gave a talk entitled “Delusions of Parasitosis, the Ugly Stepsister to the Human Bed Bug Narrative” while attending the Entomological Society of America, Entomological Society of Canada, and Entomological Society of British Columbia Joint Annual Meeting held in Vancouver, BC, Canada *November 13*
- Spoke about bed bugs to staff at the Connecticut Department of Mental Health in Stamford (45 attendees) *December 11*
- Was interviewed in a Yale University podcast entitled “When We Talk About Animals” with a focus on delusions of parasitosis *December 12*
- Presented a CAES Seminar entitled “The Devil’s Bait: Chaos of Delusory Parasitosis, Where Lives Are Ruined and Occasionally Lost” (70 attendees) *February 6, 2019*
- Presented a talk about bed bugs to nursing students and health department staff members as part of recertification training at Southern Connecticut State University (44 attendees) *March 27*
- Was interviewed about the recently introduced crazy snake worm *Amyntas agrestis*, which is a serious threat to Connecticut’s forest floor ecosystem, by Bob Miller of the Danbury News-Times *April 3*
- Was interviewed for two broadcasts, one on delusions of parasitosis and the other on bed bug biology and behavior, by Foster Brusca from the California based Pest Posse, an online service for the California Pest Management industry *April 10*
- Delivered an environmental speech as part of the Sustainable CT lecture series entitled “Turning Eden into Dust,” which addressed the changing environment and its impact on native species in Connecticut with 800 threatened or endangered species of plants, arthropods, mammals, birds, and reptiles (40 attendees) *May 9*
- Was interviewed about delusions of parasitosis by Lou Carter at WIHS for broadcast *May 23*
- With Dr. Kirby Stafford, presented a joint talk about Forensic Entomology to staff at the Connecticut Chief States Attorney’s Office in Hartford (20 attendees) *June 12*
- Hosted students from Central Connecticut State University visiting the Insect Information Office as part of a Station tour (17 attendees) *June 20*

ROBB, CHRISTINA S.

- Participated in the FDA 50-State Conference Call/Webinar to Discuss FY2018 Microbiological Surveillance Sampling Assignments for Frozen Berries and Bagged Salad *August 15, 2018*
- Participated in board meetings of the Eastern Analytical Symposium (EAS) *September 14, 2018, October 19, December 7*
- Participated in the Eastern Analytical Symposium (EAS) held in Princeton, NJ, of which she was the Program Chair, as well as an associated EAS board meeting *November 11-13*
- Participated in a board meeting and a long-term program planning meeting for the Eastern Analytical Symposium (EAS) in Plainsboro, NJ *May 17, 2019*

RUTLEDGE, CLAIRE E.

- Led a Wasp Watcher training for citizen-scientists participating in biosurveillance for emerald ash borer and other non-native buprestids in Westbrook and Orange (10 adults) *July 5 & 6, 2018*
- Participated in and presented a talk entitled “Trapping the Bronze Birch Borer” at the conference “Preparing Europe for Invasion by the Emerald Ash Borer and the Bronze Birch Borer” sponsored by the Organization for Economic Cooperation and Development (OECD) and held at the Austrian Research Centre for Forests (BFW) in Vienna, Austria (50 attendees) *October 1-4*

- Participated as an “expert” in the “14th Meeting of the Working Group on EU Priority Pests – EKE on *Agrilus anxius* and *Agrilus planipennis*” in Vienna, Austria (8 adult attendees) *October 5-6*
- Taught the lecture and laboratory sections on “Insect Pests of Trees” for Arboriculture 101 held at the Connecticut Tree Protective Association in Wallingford (45 adults) *October 17*
- Taught the lecture and laboratory sections on “Insect Pests of Trees” for Arboriculture 101 held at the Connecticut Tree Protective Association in Wallingford (45 adults) *October 24*
- Presented “Dr. Rutledge’s Insectorium and Petting Zoo” at the Ghouls & Gourds Festival at the Brooklyn Botanic Garden (approx. 500 youths) *October 27*
- Presented a talk entitled “Emerald Ash Borer” at the 2018 Annual Conference of the New England Chapter of the International Society of Arboriculture in Mystic (80 adult attendees) *November 6*
- Spoke to forestry students from Nonnewaug High School in Woodbury about invasive insects in Ansonia (30 youths) *December 7*
- Taught “Insects That Attack Trees and Shrubs” for the CTPA Arboriculture 101 course held in Wallingford (45 adults) *February 6, 2019*
- Participated in the first Board Meeting of the Connecticut Tree Protective Association as Treasurer in Wallingford (12 adults) *February 19*
- Taught “Tree Conditions Laboratory” for the CTPA Arboriculture 101 course held in Wallingford (45 adults) *February 27*
- Presented a talk entitled “Ash and Oak, and Southern Pine Beetles, Oh My!” at the Forest Health Monitoring Workshop held in Jones Auditorium (65 attendees) *March 5*
- Organized, moderated, and presented a talk entitled “How Did We Get Here? Emerald Ash Borer in Connecticut” at the workshop “Oak-calypse and Ash-mageddon: Connecticut Trees in Trouble” held in Jones Auditorium (100 attendees) *March 25*
- Presented a talk entitled “Bio-Surveillance: Using a Native Wasp to Find an Invasive Beetle” to Master Gardeners in Haddam (65 adults) *April 9*
- Presented a talk entitled “Bio-Surveillance: Using a Native Wasp to Find an Invasive Beetle” to Master Gardeners in Bethel (40 adults) *April 11*
- Was interviewed for a segment on the emerald ash borer, which aired on Fox 61 <https://www.youtube.com/watch?v=cpLvCCY7bNg&feature=youtu.be> *April 16*
- Presented a talk entitled “The Tempestry Project” at a panel discussion on “Craft Objects and Data,” which was sponsored by SCOPA and held at Yale University’s Sterling Memorial Library, in New Haven (25 adults) *April 24*
- Presented a talk entitled “New Insects in Connecticut” to Master Gardeners in Norwich (15 adults) *April 25*
- Participated in “Parent University” at North Haven Middle School and spoke about becoming an entomologist and what she does in her job (95 youths) *June 7*

SCHULTES, NEIL P.

- Presented a poster entitled “Nucleobase Transport in *Erwinia amylovora*” at the International Congress of Plant Pathology held in Boston, MA (over 250 attendees at the poster sessions) *July 29-August 3, 2018*
- Presented a poster entitled “Nucleobase Transport in *Erwinia amylovora*” at the Sussex Plant Biology Symposium held in Jones Auditorium (70 attendees) *September 14*
- Gave a seminar entitled “Disease Management Efficacy Test at Lockwood Farm, CT” at the 80th Annual New England, New York and Canadian Fruit Pest Management Workshop held in Burlington, VT *October 23-24*
- Gave two lectures entitled “Genetically Modified Plants in Agriculture” to Science Course Sci 031 at Yale University (30 participants) *November 16*

- Gave a lecture entitled “Genetically Modified Plants in Agriculture” to Science Course Sci 031 at Yale University (10 adults) *December 7*
- Co-organized and served as a judge for fifty-four student research posters at the Northeast Regional Student Research Conference held at Quinnipiac University in Hamden *April 26, 2019*
- Presented a poster entitled “Nucleobase Transport in Fire Blight Pathogen and Host” at the 2nd Annual International Symposium on Fire Blight of Rosaceous Plants held in Traverse City, MI (65 adults) *June 17-21*

SHEPARD, JOHN J.

- Spoke about the state Mosquito Trapping and Testing Program to attendees of the Center of Sustainable Nanotechnology meeting held in Jones Auditorium (approx. 40 attendees) *September 21, 2018*
- Gave two invited talks entitled “Arbovirus Activity in Connecticut, 2018” and “Entomologist Challenge – *Aedes cinereus*” at the 64th Annual Meeting of the Northeastern Mosquito Control Association held in Nashua, NH (approx. 150 attendees) *December 3-5*
- Gave two seminars entitled “Arbovirus Surveillance in Connecticut” and “Mosquitoes of Connecticut – Life Cycles and Habitats” in Jones Auditorium as part of a training workshop to prepare attendees for their Commercial Supervisory Certification Exams for Mosquito and Biting Fly Control (71 attendees) *January 15, 2019*
- Presented a talk entitled “Biology, Ecology, and Feeding Behavior of Mosquitoes in Connecticut” at a Symposium on Mosquito-Borne Diseases in Connecticut held in Jones Auditorium (50 attendees) *April 11*
- Attended the Town of Milford’s Mosquito control kick off media event and was interviewed by WFSB Channel 3, WTNH Channel 8, WTIC-Fox 61, WVIT 30, News 12, and Hearst Media about the state Mosquito and Arbovirus Surveillance Program *April 23*
- Spoke to two groups of high school students about the State Mosquito Trapping and Arbovirus Surveillance Program at the 2019 State Agriscience Fair held in Jones Auditorium (46 students) *May 2*
- Gave a seminar entitled “Taxonomic Identification of Adult Female Mosquitoes” as part of a Vector Biology Boot Camp sponsored by the Northeast Regional Center for Excellence in Vector-Borne Diseases held at the Louis Calder Center in Armonk, NY (20 students) *May 16*

SHIDORE, TEJA

- Gave an oral presentation entitled “Impact of Toxin-Antitoxin Systems on Persistence and Fitness of the Fire Blight Pathogen *Erwinia amylovora*” at the Sussex Plant Biology Symposium held in Jones Auditorium (70 attendees) *September 14, 2018*

SMITH, VICTORIA L.

- Presented a talk entitled “Nursery and Forest Health Inspection” to the 2018 class of CAES interns, with Dr. Lindsay Triplett, at the Station (15 participants) *July 18, 2018*
- Participated in the CT Nursery & Landscape Association Summer Field Day held at Lockwood Farm in Hamden (275 participants) *July 25*
- Participated in the National Meeting of the National Plant Board held in Cleveland, OH (150 participants) *August 12-16*
- With Ms. Tia Blevins, met with USDA-APHIS-Export Services personnel and representatives from three European Union Plant Protection Organizations for an audit of operations at CT Daylily, in Wallingford, which is considered by the EU as a Pest Free Place of Production; standard operating procedures, testing records, pest surveys, inspection reports, and export records were examined in detail *September 19*
- Participated in a meeting of the US Forest Service Cooperators, held at Portsmouth Public Library in Portsmouth, NH (30 participants) *November 7-8*

- Participated in the Fall meeting of the CT Cooperative Agricultural Pest Survey (CAPS) held in Jones Auditorium (10 participants) *November 20*
- Participated in the Winter Symposium of the CT Nursery and Landscape Association, with a presentation entitled “Experiment Station Update,” held at the Aqua Turf in Southington (200 participants) *January 23-24, 2019*
- Participated in a meeting of the Systems Approach to Nursery Certification (SANC) Working Group held at the Airport Holiday Inn in Phoenix, AZ (approx. 100 participants) *February 11-14*
- Participated in the National Certified Investigator/Inspector Training, Basic program, sponsored by the Council on Licensure, Enforcement, and Regulation (CLEAR), held at the Holiday Inn Riverwalk in San Antonio, TX (approx. 120 participants) *February 25-March 1*
- Organized and participated in the annual Forest Health Monitoring Workshop held in Jones Auditorium (presentations may be viewed at <https://portal.ct.gov/CAES/Publications/Publications/Forest-Health-Monitoring-Workshop-2019>) (65 participants) *March 5*
- Participated in the 94th meeting of the Eastern Plant Board, held at the Holiday Inn by the Bay in Portland, ME, with discussions on hemp regulation, invasive species, funding issues, and other topics (100 participants) *April 8-11*
- Was interviewed about Gypsy moths by Channel 3 WFSB News *May 9*

STAFFORD, KIRBY C. III

- Was interviewed about ticks, mosquitoes, and associated diseases by Louis Carta, community health educator at the Middletown Health Department, on WIHS 1933 Radio *July 5, 2018*
- Was interviewed about the lone star tick by Alexia Farrell, News 12 CT *July 17*
- Participated in the CT Nursery & Landscape Association Summer Field Day held at Lockwood Farm in Hamden (275 attendees) *July 25*
- Presented a talk on the historical and cultural aspects of ticks at the Northampton Historical Society & Museum in Northampton, MA (24 attendees) *July 31*
- Was interviewed about the new exotic longhorned tick by Katrina Koerting, Danbury News-Times *August 10*
- Was interviewed about fall tick activity and the new Asian longhorned tick by Ed Stannard, New Haven Register *August 22*
- Was interviewed about the role of bees or wasps in a stinging incident in the news by John Burgeson, Connecticut Post *August 24*
- Participated in a meeting of the IACUC Administrators Network Group at UConn Health in Farmington (26 participants) *August 27*
- With Dr. Scott Williams, presented a webinar on tick IPM through the Northeast Regional Center for Excellence in Vector-Borne Diseases (110 attendees) *August 30*
- Was interviewed about the prevalence (spread) of invasive species of insects and the impact on Connecticut’s tree population by Kaitlyn McGrath, NBC Connecticut *September 5*
- Presented two posters, one on lone star ticks in Connecticut and the other on overwintering survival of ticks in Connecticut and Maine at the International Conference for Lyme Borreliosis and Other Tick-Borne Diseases held at the Centers for Disease Control and Prevention in Atlanta, GA *September 11-14*
- Participated in a visit by Beverly Samuel, National Program Leader at USDA-NIFA *September 19*
- Participated in a visit by Drs. Jian Sun and Jocelyn Mullins from the CT Department of Public Health *September 25*
- Was interviewed about the Asian longhorned tick by Azubuike Ejiochi, Fox 61 News *October 1*
- Presented a tick update at a meeting of the Ledge Light Health District Lyme Disease Prevention Task Force (8 attendees) *October 11*

- Spoke on ticks and tick-borne diseases at the Vernon Garden Club in Vernon (30 attendees) *October 15*
- With Dr. Gale Ridge, spoke on “Entomology and Death” at the State Police Academy in Meriden (38 attendees) *October 16*
- Was interviewed about spotted lanternfly by John Silva, WTIC Radio *October 24*
- Was visited by Isabell MacInnes, a health protection and screening nurse specialist from NHS Western Isles, Scotland *October 24*
- With Dr. Gale Ridge, presented two talks on ticks, bed bugs, and forensic entomology to the students of Alice Bray, Central Connecticut State University (14 attendees) *October 25*
- Was interviewed about the spotted lanternfly by John Burgeson, Connecticut Post *October 29*
- Presented a talk entitled “Tick Winter Survival and Establishment of *Amblyomma americanum* in New England” while attending the Entomological Society of America, Entomological Society of Canada, and Entomological Society of British Columbia Joint Annual Meeting held in Vancouver, BC, Canada (70 attendees) *November 11-14*
- Participated in a meeting of the CT Cooperative Agricultural Pest Survey (CAPS) committee held in Jones Auditorium (10 participants) *November 20*
- Was interviewed about rodent targeted vaccines by Angus Chen for Scientific American *December 20*
- Participated and presented talks entitled “Surveillance for *Amblyomma americanum* in NY and CT” and “Integrated Tick Management – A Connecticut Update” at the Northeast Regional Center for Excellence in Vector-Borne Diseases annual conference held in Jones Auditorium (94 attendees) *January 24-25, 2019*
- Presented a CAES Seminar entitled “CAES History Part 2: 109 Years of “Field Day” at Lockwood Farm” (approx. 60 attendees) *February 20*
- Organized a workshop entitled “Fighting the Bite: Management of Ticks and Risk of Tick-Borne Disease” in cooperation with Erica Fearn, CT Environmental Council, and gave three presentations on tick biology, integrated tick management, and a review of product efficacy in controlling ticks (114 registered attendees) *February 21*
- Spoke on ticks and tick-borne diseases to the Simsbury Garden Club in Simsbury (43 attendees) *February 25*
- Spoke about “Managing the Exploding Expansion of Tick and Vector-borne Disease Risks” at the 2019 Connecticut Groundskeepers Turf and Landscape Conference held in Cromwell (>100 attendees) *February 27*
- Presented a talk entitled “New and Scary Ticks!” at the Forest Health Monitoring Workshop held in Jones Auditorium (65 attendees) *March 5*
- Spoke about the gypsy moth, emerald ash borer, and tree mortality at the Farmington Garden Club in Farmington (40 attendees) *March 11*
- Presented a talk on ticks, tick-borne diseases, and tick control at the Cherry Brook Garden Club in Canton (40 attendees) *March 12*
- Spoke on gypsy moth at the Connecticut Trees in Trouble workshop held in Jones Auditorium (80 attendees) *March 25*
- Gave welcoming remarks to the Landscape Design School in Jones Auditorium *March 26*
- Presented a talk on ticks and tick-borne diseases in Trumbull, for videotaping for the health department’s Healthy Town series *March 27*
- Presented a seminar entitled “Ticks: It’s More Than Just Lyme Disease” at the Department of Pathobiology at the University of Connecticut (40 attendees) *April 4*
- Presented a talk on tick-borne diseases and tick management at Hollandia Nursery in Bethel (38 attendees) *April 12*
- Presented a webinar talk on “Tick Biology, Behavior and Control: Addressing the Public Health Threat” for the PCT Public Health Virtual Conference *April 17*

- Was interviewed about the active surveillance program by Charity Scott, Wall Street Journal *April 23*
- Presented two talks entitled “Habitat and Winter Survival of *Ixodes scapularis* and *Amblyomma americanum* and Establishment of the Lone Star Tick in Connecticut” and “Management of Ticks in Landscapes: Mechanical and Chemical Management, Deer Exclusion, and Other Research” at the UMass Extension Ticks and Tick-Associated Diseases Conference held in Milford, MA (93 attendees) *April 24*
- Was interviewed about gypsy moth defoliation and impact on trees in eastern Connecticut by Gregg Monte, NBC Connecticut *May 3*
- Participated in the NEVBD Center of Excellence “Boot Camp” for public health personnel and provided training on tick identification and tick management at the Louis Calder Center, Fordham University, Armonk, NY *May 13-16*
- Spoke on ticks and tick management at the Rogers Corporation in Rogers (40 attendees) *June 5*
- Spoke on ticks and tick management at the Lyme Public Library (38 attendees) *June 6*
- With Dr. Gale E. Ridge, presented a talk on forensic entomology to the States Attorneys and staff in Hartford (20 attendees) *June 12*
- With a panel organized by the Westport Weston Health District, taped a presentation on ticks and tick-borne diseases in Westport *June 13*
- Participated and presented on tick management in a conference call organized by the Midwest Center for Excellence in Vector-Borne Diseases *June 18*
- Presented a talk on ticks and tick management at the Willow Tree Community Center in Waterbury (16 attendees) *June 25*

STEBBINS, SUMMER E.

- Presented an online mapping tool and spoke about the new infestation of Hydrilla in the Connecticut River at a water chestnut cooperators meeting at the U.S. Fish and Wildlife Service Northeast Region in Hadley, MA (approx. 30 attendees) *April 24, 2019*

STEVEN, BLAIRE T.

- With Dr. Doug Brackney, hosted the 7th Annual Symbiosis Symposium held in Jones Auditorium (54 attendees) *October 4, 2018*
- Gave an invited lecture entitled “Desert Biological Soil Crusts as a Model for Soil Carbon Cycling” at Eastern Connecticut State University, Department of Biology (10 faculty and 30 student attendees) *October 9*
- Gave an invited talk entitled “Biological Soil Crusts as a Model for Soil Carbon Cycling” in the Department of Molecular and Cellular Biology at the University of Connecticut in Storrs (15 faculty and 45 student attendees) *December 4*
- Gave a talk entitled “Bacteria Are Everywhere, So Go Anywhere to Study Them” at Westfield State University, Westfield, MA for their scientific career development course (20 student attendees) *February 22, 2019*
- Gave a talk entitled “Biological Soil Crusts as a Model for Soil Carbon Cycling” at the 10th annual Gobabeb/Namib Desert Symposium and Field Expedition held in Gobabeb, Namibia (approx. 60 attendees; 30 students) *April 22*

STONER, KIMBERLY A.

- Was co-leader of a tour of Native Plant Meadows and Pollinator Habitat in South-Central Connecticut (along with Kathy Connolly, landscape designer), visiting sites in Westbrook, Killingworth, Chester, and Old Saybrook (2 sites); and presented information on crop pollination, bee diversity, life cycles of native bees, and diverse plants providing floral resources to pollinators over the growing season (43 adult attendees) *July 28, 2018*
- Was interviewed about the value of goldenrod to bees by Kathy Connolly for an article, which ran in

the New London Day and Zip06 newspapers, reaching 185,000 households in southeastern Connecticut *August 9*

- Organized and co-led an on-farm workshop entitled “Pollinator Habitat at Blueberry Hill Organic Farm” with Virginia Keith (farmer) and Bill Purcell (Natural Resources Conservation Service, CT) in Danielson (17 attendees, including 5 incoming Yale students) *August 20*
- Was interviewed about the decline of pollinators and other flying insects worldwide by Douglas Hawes-Davis of Blue Sky Pictures, LLC, for a documentary *August 29*
- Presented a talk entitled “Planting for the Bees’ Needs” at the Mitchell Branch of the New Haven Public Library (19 attendees) *September 4*
- Presented a talk entitled “Planting for the Bees’ Needs” to the New Roxbury Land Trust at Roseland Park in Woodstock (22 attendees) *September 23*
- Spoke about “Planting for the Bees’ Needs” and led a walk around the garden to talk about the bees we observed at the Yale Marsh Botanical Garden in New Haven (35 attendees) *October 4*
- Led a meeting of the Connecticut Native Plants for Pollinators and Wildlife Working Group at Highstead Arboretum in Redding (12 attendees) *October 15*
- Gave a presentation entitled “Planting for the Bees’ Needs” at the annual meeting of the Clinton Land Trust at the public library in Clinton (50 attendees) *October 15*
- Presented a talk entitled “Pumpkin (*Cucurbita* spp.) Pollination on Organic, IPM, and Experimental Farms in Connecticut” as a part of a symposium, “Insect Ecology, Evolution, and Economics in the Plant Family Cucurbitaceae: Opportunities, Insights, and Challenges Presented by Insects (and Their Microbiomes)” (45 attendees) *November 13*
- Presented a poster entitled “Tracking pesticide residues in pollen trapped from honey bees (*Apis mellifera* L.)” as part of a symposium, “Understanding and Mitigating the Risks of Pesticide Exposure for Pollinators and Other Beneficial Insects” at the Entomological Society of America, Entomological Society of Canada, and Entomological Society of British Columbia Joint Annual held in Vancouver, BC, Canada (67 attendees) *November 14*
- Participated in a Vegetable Grower Listening Session, organized by Shuresh Ghimire, Vegetable IPM Coordinator, UConn Cooperative Extension, at the Litchfield County Extension Center in Torrington (15 attendees) *February 7, 2019*
- Gave a talk entitled “Pollinator Protection Strategies” at the workshop “Fighting the Bite: Management of Ticks and the Risk of Tick-Borne Disease” held in Jones Auditorium (105 attendees) *February 21*
- Gave a talk entitled “Pollinator Habitats: What Can Science Tell Us?” at “OrganiConn,” the winter conference of CT NOFA held at Housatonic Community College in Bridgeport (45 attendees) *February 23*
- Presented a Keynote speech entitled “Pollinator Pathways: What Science Can Tell Us?” at the All-Town Meeting for Pollinator Pathways held at Grace Farms in New Canaan (85 attendees) *March 5*
- Was featured as a guest on the Organic Farmstead radio program, WPKN, 89.5 FM *March 7*
- Spoke to a meeting of 350 CT on “Bee Health and the Threats They Face” at the Agora in New Haven (12 attendees) *March 10*
- Organized, led, and gave a talk entitled “Pollinator Habitat: What Can Science Tell Us?” at the 4th Annual Pollinator Habitat Conference held in Jones Auditorium (90 attendees) *March 14*
- With Mary Ellen Lemay, presented a workshop entitled “Planting for the Bees’ Needs: Providing Habitat for Honey Bees and Wild Bees” at the 2019 Connecticut Land Conservation Conference held at Wesleyan University in Middletown (65 attendees) *March 23*
- Presented a talk entitled “Keep Your Garden Buzzing” at the Greenwich Botanical Center (18 attendees) *March 26*
- Presented a talk entitled “The Pollinator Pathway: ‘Bee’ On It” to the Elm City Parks Conservancy at Edge of the Woods in New Haven (9 attendees) *March 27*
- Presented a keynote lecture entitled “How Integrated Pest Management Helps Pollinators in

Agriculture” to the annual Envirothon at Sessions Woods Environmental Center in Burlington (130 attendees, of whom about 100 were high school students) *March 30*

- Gave a talk entitled “Planting for the Bees’ Needs” to the Spring Glen Garden Club at the Lockwood Farm Cottage in Hamden (23 attendees) *April 8*
- Gave a talk entitled “The Bees’ Needs” as the keynote speaker at the annual dinner of the Simsbury Land Trust held at The Riverview in Simsbury (150 attendees) *April 9*
- Was interviewed about pollinator pathways by Bob Miller of the Danbury News-Times *April 17*
- Spoke on “Planting for the Bees’ Needs” at Wakeman Town Farm in Westport (50 attendees, of whom 25 were high school students) *April 22*
- Was interviewed about Pollinator Pathways and gardening for pollinators by Pem McNerney of Shore Publishing and Zip06 *April 29*
- Was interviewed about Pollinator Pathways by Theresa Barger Sullivan of Connecticut Magazine *May 8*
- Was interviewed about Pollinator Pathways by Bob Miller of the Danbury News-Times *May 21*
- Was interviewed about CT Department of Transportation efforts to create pollinator habitat along state highways by Greg Hladky of the Hartford Courant *May 22*

TRIPLETT, LINDSAY R.

- Presented a workshop on data entry and analysis to the 2018 Plant Health Fellows program, in which students analyzed chrysanthemum height data (10 students) *July 18, 2018*
- Organized and presented at a lunchtime mini-symposium highlighting the contributions of nine CAES scientists to the 2018 International Congress of Plant Pathology (40 attendees) *July 26*
- Chaired a meeting of the Annual Phytopathological Society’s Committee on Bacteriology as Chairperson (62 attendees) *July 30*
- Participated in a meeting of the APHIS Widely Prevalent Bacterial Diseases Committee as the representative for CT, MA, NH, and RI (5 attendees) *July 31*
- Co-authored five formal research presentations entitled “Exception to the Norm: Inactive TAL Effectors Trigger an Atypical Resistance Mechanism in Rice,” “Automated Primer Design for DNA-based Detection of the Emerging Potato Pathogen *Dickeya dianthicola*,” “Characterization of a Bacterial Leaf Streak of Rice Resistance Locus Aided by Nanopore Sequencing,” “*hok-sok* Toxin-Antitoxin System Plays Important Roles in Morphological Plasticity, Bacterial Persistence, and Catalase Activity in *Erwinia amylovora*,” and “Type II Toxin-Antitoxin Systems are Essential for the Survival of *Erwinia amylovora* Under Lethal Stress Conditions,” which were presented at the International Congress of Plant Pathology held in Boston, MA *July 29-August 3*
- Organized the 2018 Plant Health Fellows program and “wrapped up” the Plant Science Day presentation of their field plot “Nanoparticle Effects on Chrysanthemum Wilt” (assisted by Dr. Lindsay Triplett) (25 visitors) *August 8*
- Co-organized the noontime seminar presentations of their mentored laboratory projects (40 attendees) *August 9*
- Presented a class lecture entitled “Host-Pathogen Coevolution, Resistance, and Host Range” to a Yale undergraduate class EVST251: Parasites, Pests, and Pathogens (36 students) *February 11, 2019*
- Presented a tour of her laboratory to leadership from the FFA national organization (5 attendees) *February 19*
- Organized and conducted a meeting of Plant Health Fellows mentors to discuss the upcoming summer internship program (12 attendees) *May 23*
-

VOSSBRINCK, CHARLES R.

- Presented informal talks on propagation and growth of figs at the Food and Fig Festival in West Haven (Mayor Nancy Rossi and approx. 100 other attendees) *September 29, 2018*
- Held a fig workshop at Lockwood Farm demonstrating rooting and pruning techniques (25 attendees) *March 9, 2019*

WARD, JEFFREY S.

- Spoke on “Independent Effects of Invasive Shrubs and Deer Herbivory on Plant Community Dynamics and Forest Management Implications” for a CT DEEP-sponsored teacher’s workshop held at the Connecticut Forest & Park Association in Middlefield (25 attendees) *July 10, 2018*
- With Dr. Mark Ashton (Yale), gave invited co-lectures on “Silvics of Individual Species and Stand Dynamics” and “Silvicultural Systems and Practices” at the Northeast Silviculture Institute for Foresters Mixed Oak-Hickory Symposium held in Sturbridge, MA (53 attendees) *July 12*
- Co-presented a field workshop on oak management and ecology for the Northeast Silviculture Institute for Foresters Mixed Oak-Hickory Symposium held in Union (45 attendees) *July 13*
- Was interviewed about the risks of dead and dying trees along Connecticut’s roadsides by Gregory Hladky, Hartford Courant *August 20*
- Was interviewed about the risks of dead and dying trees along Connecticut’s roadsides by Toni Terzi, Fox 61 News *August 22*
- Was interviewed about using herbicides to control invasives by Ken Dixon, Connecticut Post *August 30*
- Was interviewed about fall colors by Alyssa Taglia, WTNH News Channel 8 *September 17*
- Spoke on “Safety Concerns When Treating Invasive Species” at the Connecticut Invasive Plant Symposium held in Storrs (136 attendees) *October 4*
- Was interviewed about the status of ash in Connecticut’s forest by John Burgeson of the Connecticut Post *October 15*
- Presented a workshop entitled “An Introduction to Tree Identification” for the Institute for Learning in Retirement held at Albertus Magnus College in New Haven (37 attendees) *October 19*
- Spoke on “The Biodiversity Crises” at the Greenwich Grown luncheon (54 attendees) *October 20*
- Gave instruction on invasive plant control at Partners 4 Plants Weed Wrangle at Babcock Park in Greenwich (7 attendees) *October 20*
- Spoke on “The Ever Changing Connecticut Forest” at the Cheshire Public Library (18 attendees) *October 22*
- Was interviewed about acorns and weather by Robert Miller of the Danbury News-Times *October 30*
- Spoke on “The Biodiversity Crises - Invasive Plants” to the Audubon Connecticut Science Committee in Stratford (21 attendees) *November 27*
- Hosted a New England Society of American Foresters Executive Committee quarterly meeting *December 19*
- Was interviewed about ice storm damage by Bob Miller of the Danbury News-Times *December 19*
- Was interviewed about climate effects of tree species migration by Miranda Weiss of American Forests Magazine *January 30, 2019*
- Presented a webinar entitled “Rehabilitation of Degraded Hardwood Stands” for the University of Vermont’s Managing Our Changing Forests webinar series (55 attendees) *February 21*
- Spoke on the relationship between deer density and oak regeneration at the Forest Health Monitoring Workshop held in Jones Auditorium (43 attendees) *March 5*
- Gave a keynote talk entitled “Gypsy Moths and Oak Forests - Past, Present, and Future” at the Looking Forward--Recovering from Oak Loss on Rhode Island’s Private Woodlands workshop held in Coventry, RI (150 attendees) *March 16*
- Spoke on “Invasive Species and Urban Forests” at the Invasive Plant Species workshop hosted by the Bristol Public Works Department and the Environmental Learning Centers of CT *March 20*

- Presented an invited lecture entitled “Want Oak? Clearcut and Hunt” at the New England Society of American Foresters annual meeting held in Burlington, VT (87 attendees) *March 27-29*
- Spoke on “STORMWISE: Integrating Arboriculture and Silviculture to Create Storm Resilient Roadside Forests” at the Northeast Natural History Conference held in Springfield, MA (23 attendees) *April 13*
- Was an invited participant in the Forest Action Plan 2020 Roundtable held in Waterbury *June 13*
- Was interviewed about the impact of sycamore anthracnose on tree growth and survival by Bob Miller, Danbury News-Times *June 18*
- Was interviewed about the extent of barberry in Connecticut by Ted Goerner, Hartford Courant *June 18*
- Gave an invited lecture entitled “Tending Oak Stands for Stocking, Growth and Quality” at the University of New Hampshire’s Red Oak...the Book and Beyond: The Ecology and Management of Northern Red Oak (68 attendees) *June 28*

WHITE, JASON C.

- Was interviewed about the release of *Technical Bulletin 19*, which describes our pesticide and arsenic surveillance of the Connecticut food supply, by Ed Stannard, New Haven Register *July 30, 2018*
- Attended and gave a platform presentation entitled “Engineered Nanomaterials Suppress Fungal and Viral Crop Disease” at the 2018 International Conference on the Environmental Effects of Nanoparticles and Nanomaterials (ICEENN) held at Duke University in Durham, NC (100 attendees) *September 5-7*
- Gave a presentation entitled “Use of Engineered Nanomaterials to Suppress Plant Disease” at the Sussex Plant Biology Symposium, sponsored by Yale University, held in Jones Auditorium (40 attendees) *September 14*
- With Drs. Brian Eitzer, Walter Krol, Christina Robb, Nubia Zuverza-Mena, and Roberto De La Torre-Roche, met with Beverly Samuel of USDA NIFA regarding Department Programs *September 19*
- With Dr. Wade Elmer, hosted the semi-annual All-Hands meeting of the Center for Sustainable Nanotechnology and gave a presentation entitled “Nano-Enabled Agriculture: What Are the Important Chemistry-Driven, Mechanistic Questions Relevant to Nanoparticle Interactions/Uptake/Transport in Plants?” in Jones Auditorium (70 attendees) *September 21-22*
- Attended the 15th International Phytotechnologies Conference in Novi Sad, Serbia, and gave a presentation entitled “Use of Engineered Nanomaterials to Suppress Crop Disease in Plants,” chaired a technical session entitled “Plant-Nanoparticle Interactions,” and chaired a meeting of the Editorial Board of the International Journal of Phytoremediation *October 1-5*
- Chaired a technical session at the “2nd Quantifying Exposure to Engineered Nanomaterials from Manufactured Products (QEEN II)” Workshop held at the US Department of Labor in Washington, DC and gave a presentation entitled “Exposure to Nanomaterials in Agroecosystems and Agricultural Production” (140 attendees) *October 9-10*
- Gave a lecture entitled “Engineered Nanomaterials for the Control of Plant Pathogens” at Zhejiang University in Hangzhou, China (100 attendees) *October 17*
- Gave a lecture entitled “Engineered Nanomaterials for the Control of Plant Pathogens” at the Research Institute for Subtropical Forestry of the Chinese Academy of Forestry in Hangzhou, China (20 attendees) *October 18*
- Was interviewed about his views on what the scientific community has learned about nanotechnology over the last 15 years by Ms. Mallory Hinks (AAAS Fellow) of the National Nanotechnology Initiative Program Office *October 25*
- Gave a talk entitled “Engineered Nanomaterials for the Suppression of Fungal and Viral Crop Disease” while attending the 2018 Sustainable Nanotechnology Organization (SNO) annual meeting held in Arlington, VA (35 attendees) *November 5-9*
- Met with Dr. Lloyd Whitman, who is Principal Assistant Director of Physical Sciences and Engineering

of the White House Office of Science and Technology (OSTP), Dr. Charles R. Santerre, who is Senior Policy Advisor at the OSTP, and Dr. Lisa Friedersdorf, who is Director of the National Nanotechnology Coordination Office (NNCO) in the Eisenhower Executive Office Building, and provided an update on CAES nanotechnology programs *November 7*

- Met with Sarah Shapiro of Senator Chris Murphy’s Washington, DC office and provided a briefing on CAES programs and research *November 8*
- Hosted Dr. Michael Rickenbach of the State of CT - Department of Emergency Services & Public Protection Division of Scientific Services for the CAES Seminar Series *December 5*
- Gave a lecture entitled “Nanotechnology in Agriculture: Assessing the Balance Between Applications and Implications” at the University of Pittsburgh School of Public Health (30 attendees) *February 18-20, 2019*
- Attended the BILAT USA 4.0 Workshop entitled “Fostering EU-US Cooperation in Nanosafety” at Harvard University and presented a lecture entitled “Nanomaterials in Agri-Food Systems: Potential Environmental Health Implications” (30 attendees) *March 4-6*
- Attended the Connecticut Conference on Natural Resources at the University of Connecticut and gave a presentation entitled “Nanotechnology and Agriculture: A Path to Global Food Security?” (40 attendees) *March 18*
- Was interviewed by Mico Tatolovic of The Guardian newspaper over the use of nanomaterials in food for a story that will run in mid-April *March 27*
- Gave a presentation entitled “Nanotechnology in Agriculture: Assessing the Balance Between Implications and Applications” at the University of Connecticut Department of Nutritional Science (20 attendees) *March 27*
- Co-chaired a session entitled “Nanotechnology at the Water-Agriculture-Energy Nexus” and gave a presentation entitled “Engineered Nanomaterials for the Suppression of Fungal and Viral Crop Disease” at the 2019 American Chemical Society Meeting held in Orlando, FL (25 attendees) *March 30-31*
- Recorded a podcast on the 15th Anniversary of the National Nanotechnology Initiative (NNI) with Dr. Lisa Friedersdorf of the National Nanotechnology Coordination Office *April 16*
- Gave a lecture entitled “Nanotechnology in Agriculture: Assessing the Balance Between Applications and Implications” at the University of Massachusetts Stockbridge School of Agriculture *April 23*
- Attended the USDA NIFA Nanotechnology Annual Program Review at Vanderbilt University in Nashville, TN and gave a presentation entitled “Nanoscale Elements Suppress Plant Disease, Enhance Micronutrient Use Efficiency, and Increase Crop Yield” (40 attendees) *May 19-21*
- Presented an invited lecture at the Nanjing University School of the Environment entitled “Nanotechnology in Agriculture: Assessing the Balance Between Applications and Implications” and met with students and faculty to discuss ongoing and future collaborative research *May 27-30*
- Was interviewed in a ZOOM call by three graduate students from the University of Arkansas-Fayetteville as part of the National Science Foundation I-Corp; the students asked questions about sustainable agriculture and food production *June 10*
- Presented an invited lecture entitled “Engineered Nanomaterials for the Suppression of Fungal and Viral Crop Disease in Agriculture” at the 2019 TechConnect World Innovation Conference and Expo held in Boston, MA (35 attendees) *June 17-19*
- Presented an invited lecture entitled “Engineered Nanomaterials for the Suppression of Fungal and Viral Crop Disease in Agriculture” at the 3rd Annual Symposium of the Nanyang Technological University-Harvard University TH Chan School of Public Health Initiative for Sustainable Nanotechnology (NTU-Harvard SusNano), which was held in conjunction with the 10th International Conference on Materials for Advanced Technologies (ICMAT 2019) in Singapore (35 attendees) *June 24-26*

WILLIAMS, SCOTT C.

- Spoke about “Tick-Borne Disease Ecology: Concerns for Forest and Public Health Alike” for a CT DEEP-sponsored teacher’s workshop held in New Haven (50 attendees) *July 11, 2018*
- Gave an invited lecture with DEEP Wildlife Division Biologist Michael Gregonis entitled “Acorn Abundance Patterns and Their Implication for Wildlife” at the Northeast Silviculture Institute for Foresters Mixed Oak-Hickory Symposium held in Sturbridge, MA (53 attendees) *July 12*
- Presented an invited lecture about the positive relationship between blacklegged ticks and invasive plants at the Annual Meeting of the CT Tree Protective Association held in Farmington (350 attendees) *July 19*
- With Dr. Megan Linske and Mr. Michael R. Short, gave a field demonstration of rodent trapping and tick-borne disease research to South Central Connecticut Regional Water Authority interns in North Branford (15 students) *July 27*
- Gave an invited lecture entitled “Less-Toxic Integrated Control and Host Reservoir Dilution of *Ixodes scapularis* in Residential Settings” at the Integrated Management of Ticks and Mosquitoes, New York State Integrated Pest Management Conference held in White Plains, NY (100 attendees) *August 7*
- With Dr. Kirby Stafford, gave a Northeast Regional Center for Excellence in Vector-Borne Diseases-sponsored webinar entitled “Integrated Tick Management” (150 attendees) *August 30*
- Attended the 15th International Conference on Lyme Borreliosis and Other Tick-Borne Diseases and presented an invited lecture entitled “Less Toxic Integrated Control of Juvenile *Ixodes scapularis* in Residential Southwestern Connecticut” at the Centers for Disease Control and Prevention in Atlanta, GA *September 11-14*
- With Mr. Michael R. Short, conducted a small mammal trapping demonstration to students in the Wildlife Management Techniques class in the Department of Natural Resources and the Environment at the University of Connecticut (18 students, 1 professor) *September 17*
- Attended the National Wildlife Society Conference in Cleveland, OH and as President-Elect, participated in the NETWS Fall Executive Committee meeting, the Wildlife Society Sections and Chapters Collaboration Meeting, and the meeting of the Editorial Advisory Board for the Wildlife Professional in Cleveland, OH *October 6-11*
- Gave an invited lecture about environmental employment opportunities at Middlesex Community College in Middletown (20 students, 1 teacher) *October 24*
- Hosted Scotland resident Isabell MacInnes during her Churchill Fellowship by providing a tour of CAES and a demonstration of tick sampling methodology in Lyme *October 24-25*
- With Mr. Joseph P. Barsky, Mr. Michael R. Short, and Dr. Megan Linske (Entomology), hosted the FFA Forestry Career Development Event held at Lockwood Farm (48 students, 12 teachers) *November 30*
- Presented a short talk entitled “Hydraulic vs. Backpack Sprayers for Tick Control: A Comparison” at the Northeast Regional Center for Excellence in Vector-Borne Diseases annual conference held in Jones Auditorium (94 attendees) *January 24-25, 2019*
- Presented an invited lecture entitled “Use of Commercial Repellents for Averting Deer and Rabbit Damage” at the Eastern New York Fruit and Vegetable Conference held in Albany, NY *February 19*
- Presented an invited lecture entitled “What the Research Shows” at the workshop “Fighting the Bite: Management of Ticks and Risk of Tick-Borne Disease” held in Jones Auditorium (105 attendees) *February 21*
- Gave a talk entitled “Putting Science to Work for Society: Linking Forest and Public Health” at the Forest Health Monitoring Workshop held in Jones Auditorium *March 5*
- Participated in Connecticut Public Radio’s “The Whole Story” program on “Managing the Deer Population” <http://www.wshu.org/post/managing-deer-population#stream/0> *March 5*
- Hosted Lyman Hall High School students and discussed professional opportunities in the sciences (16 students, 1 teacher) *March 11*
- Presided over the annual members meeting of The Northeast Section of the Wildlife Society held in Groton *April 15*

- Moderated a symposium titled “Persistent and Emerging Ectoparasites Affecting Wildlife and Public Health Alike” at the NEAFWA conference held in Groton *April 16*
- Gave an invited lecture entitled “Discovery of an Established Population of Lone Star Ticks in Southwestern Connecticut” at the NEAFWA conference held in Groton *April 16*
- Presented an invited lecture entitled “Discovery of an Established Population of Lone Star Ticks in Southwestern Connecticut” at the International Urban Wildlife Conference held in Portland, OR (76 attendees) *June 2-5*
- Gave an invited lecture entitled “Ticked Off! Invasive Plants, Ticks, Deer and Lyme Disease—A Surprising Connection” in New Canaan at a lecture series jointly run by the Town Conservation Commission and New Canaan Land Trust (110 attendees) *June 12*

ZENG, QUAN

- Attended and co-organized a workshop “Effector Detector Plants” (21 attendees) and led a field trip to the Arnold Arboretum of Harvard University (105 attendees) at the International Congress of Plant Pathology (ICPP2018) held in Boston, MA *July 27-August 2, 2018*
- Gave an oral presentation entitled “Fire Blight: History, Management, and New Challenges” on Plant Science Day held at Lockwood Farm in Hamden (200 attendees) *August 8*
- Was interviewed about recent research updates on fire blight by Mr. John Burgeson, Connecticut Post *August 8*
- Gave an oral presentation entitled “Fire Blight Diagnosis and Management” at the Nursery and Landscape Research Tour held at the Valley Laboratory in Windsor (20 adults) *September 13*
- Gave an oral presentation entitled “Microbiome Associated with Apple Flowers and Its Impact on Fire Blight Infection” at the Sussex Plant Biology Symposium (organized by Yale University) held in Jones Auditorium (70 adults) *September 14*
- Met with Beverly Samuel, the National Program Leader of USDA NIFA, and discussed his research program *September 19*
- Gave a tour and introduction about his research program for visitors from the Center for Sustainable Nanotechnology (40 adults) *September 21*
- Gave two research presentations entitled “Apple Flower Microbiome and Its Impact on Fire Blight Infection” and “Understanding the Role of Water in Blossom Blight Infection” at the 80th Annual New England, New York and Canadian Fruit Pest Management Workshop held in Burlington, VT (50 adults) *October 23-24*
- Taught a guest lecture entitled “Bacterial Plant Pathogens and Diseases” and lab “Diagnosis of Bacterial Plant Diseases and Isolation of Bacterial Pathogens” at the University of Connecticut (17 students) *November 28*
- Judged the NE Regional Sigma Xi Student Research Conference held at Quinnipiac University in Hamden *April 24, 2019*
- Taught “Apple Stories” to a preschool class at the Cheshire Nursery School in Cheshire (16 children, 5 adults) *May 24*
- Gave a presentation entitled “Management of Bacterial Plant Diseases, Using Fire Blight as an Example” to a group of visiting undergraduate students from Quinnipiac University (10 adults) *June 12*
- Gave an invited presentation entitled “New Insights from *Erwinia amylovora* Genomics and How That Influences Disease Management” (65 adults) and an oral presentation entitled “Microbiome Associated with Apple Flowers and Its Impact on Fire Blight Infection” (65 adults) at the 2nd International Symposium on Fire Blight of Rosaceous Plants held in Traverse City, MI *June 17-21*

ZUVERZA-MENA, NUBIA

- Presented a “flash talk” of her presentation to be given at the International Congress of Plant Pathology

- at the CAES ICPP 2018 Preview Symposium held in Jones Auditorium (35 attendees) *July 26, 2018*
- Attended the International Congress of Plant Pathology (ICPP) 2018: Plant Health in a Global Economy in Boston, MA and presented our work within the session “The First Line of Defense Against Plant Disease in the Developing World: Mineral Nutrition.” The oral presentation was entitled “Can Nanoparticles Enhance Disease Resistance Through Mineral Nutrition?” (180 attendees) *August 1*
 - With Mr. Mark Creighton, staffed the CAES booth at The Big E in West Springfield, MA *September 18*
 - Participated as a tour guide for attendees of the Center for Sustainable Nanotechnology (CSN) annual meeting held at the Station *September 21*
 - Gave a presentation entitled “Emerging Contaminants: Per- and Polyfluoroalkyl Substances” at the University of Texas at El Paso (15 attendees) *October 29*
 - Presented a guest lecture entitled “Nanomaterials and the Food Supply: Applications and Implications” for the course “Biomedical Issues in Pathobiology - Diseases in the World: A One Health Approach” at the University of Connecticut (25 attendees) *November 5*
 - Toured and presented the work of the Department of Analytical Chemistry to a group of students and faculty from Quinnipiac University (~10 visitors) *June 12, 2019*
 - Presented “Cerium Oxide Nanoparticle (nCeO₂) Interactions with the Short Chain Perfluoroalkyl Substance PFBS on Radish Plants” at the Nanotech 2019 Conference and Expo held in Boston, MA (~20 attendees) *June 17-19*

ADVANCES IN KNOWLEDGE

DEPARTMENT OF ANALYTICAL CHEMISTRY

Service, research, and outreach activities in the Department are conducted within the focus areas of **Food Safety** and **Environmental Monitoring/Remediation**. Activities within each area are often complimentary. A breakdown of samples based on submitting agency is shown below.

Source of Sample	Numbers of samples analyzed
Department of Agriculture	75
Department of Consumer Protection	257
Department of Energy and Environmental Protection	78
FDA, Health Depts., Cities/Towns, Misc. Foundations	213
Proficiency Test Samples	51
University Research Collaborators	600
CAES Departments	1950
Grand Total	3,224

I. SERVICE ACTIVITIES

Analyses in the Department of Analytical Chemistry are conducted on a wide range of sample types submitted by other state and federal agencies, municipalities, law enforcement, non-profit groups, businesses, university collaborators, and other Departments at the Connecticut Agricultural Experiment Station (CAES). This list is not intended to be all-inclusive.

1. ANALYSES ON BEHALF OF CONNECTICUT DEPARTMENT OF AGRICULTURE

The Department of Analytical Chemistry has three long-standing programs with the CT Department of Agriculture (DoAg) involving the chemical analysis of commercial feed and fertilizer products.

a. Animal Feeds:

- **Analysts:** John Ranciato, Nubia Zuverza-Mena, Brian Eitzer.
- **Goal:** To assure products are in compliance with stated label guarantees and that levels of aflatoxins, if present, are below regulatory limits.
- **Summary:** This was one of the primary analyses of the Station in the late 1890s. Products for household pets and commercial agricultural operations are collected by inspectors from DoAg. Analytical results are reported to DoAg, who in turn report findings to the product dealer and/or manufacturer and conduct regulatory response as required. In addition, data are reported to the FDA through an online data exchange platform called eLEXNET.

- **Results:** From July 1, 2018 to June 30, 2019, we received no feed samples for analysis of protein, fat, moisture, fiber, or select micronutrients. Joint funding with the DoAg has been acquired from the FDA to facilitate inclusion in the Animal Feed Regulatory Program Standards (AFRPS); this 5-year cooperative agreement has enabled the Department to bring aflatoxin analysis in animal feeds by liquid chromatography high resolution mass spectroscopy (LC-HRMS) under the scope of ISO accreditation effective February 2018. This reporting period, 35 samples were analyzed by methods for aflatoxin extraction and quantitation

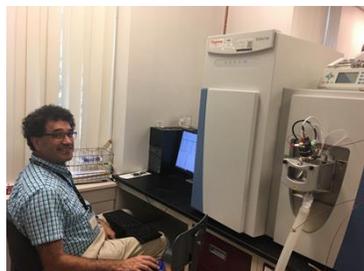


(by LC-HRMS) in corn-based feed as part of the AFRPS. All but two samples were officially logged out with no aflatoxins detected; the final two samples had Aflatoxin B1 at 4.10 and 1.40 $\mu\text{g}/\text{Kg}$ (below the tolerance of 20 $\mu\text{g}/\text{Kg}$ total aflatoxin).



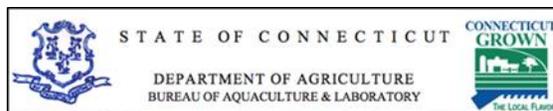
b. Fertilizers:

- **Analyst:** John Ranciato.
- **Goal:** To assure products are in compliance with stated label guarantees.
- **Summary:** This was one of the primary analyses of the Station in 1875. Products from residential and commercial agricultural operations are collected by DoAg inspectors. Analytical results are reported to DoAg, who in turn reports findings to the product dealer and product manufacturer and takes regulatory response as needed.
- **Results:** From July 1, 2018 to June 30, 2019, we received and completed analysis of 44 samples for macronutrients, such as nitrogen, available phosphoric acid, and potash, and for micronutrients, including but not limited to boron, sulfur, cobalt, magnesium, and iron. Samples deficient in one or more analytes (determined according to the investigational allowances outlined in the Official Publication of the Association of American Plant Food Control Officials) numbered 22 (50%). Analytical findings are turned over to the CT Department of Agriculture for regulatory action.



c. Analysis of seaweed samples:

- **Analysts:** Terri Arsenault, Craig Musante, Michael Ammirata, Brian Eitzer.
- **Goal:** To assess potential contamination of seaweed prior to release for sale.
- **Summary:** A newer program with the CT DoAg Bureau of Aquaculture involves the chemical and microbial analysis of seaweed being grown commercially in CT for sale to restaurants. The CAES Department of Analytical Chemistry conducts the chemical analysis; the microbial analysis happens at the Department of Public Health (DPH) Laboratory Environmental Microbiology Section. During the current reporting period, 18 samples were received for analysis of moisture content, pesticides by both liquid and gas chromatography with mass spectrometry (LC-MS; GC-MS), as well as polychlorinated biphenyls (PCBs) by GC with electron capture detection (GC-ECD), and select heavy metals by inductively coupled plasma mass spectrometry (ICP-MS). Results are reported to DoAg Aquaculture staff for a decision on regulatory action. All samples analyzed were judged suitable for sale on the basis of chemical analysis results.



2. ANALYSES ON BEHALF OF CONNECTICUT DEPARTMENT OF CONSUMER PROTECTION, FOOD AND STANDARDS DIVISION

Analyses conducted on food and consumer product samples submitted by the CT Department of Consumer Protection (DCP) are important to public safety. The results of these analyses are reported quickly and can lead to the recall of products that have levels of chemical residues, heavy metals, fungi/mold, or fecal contamination that are deemed unacceptable by DCP. If products are imported into CT from other states or countries, the US Food and Drug Administration leads the regulatory response.

a. Pesticide residues in food:

- **Analysts:** Walter Krol, Brian Eitzer, Michael Ammirata, Terri Arsenault, and Kitty Prapayotin-Riveros.

- **Summary:** As part of the Manufactured Food Regulatory Program Standards (MFRPS), we determine concentrations of pesticides and total arsenic in fresh and processed foods from local, domestic, and imported sources offered for sale in CT and assure compliance with established tolerances. MFRPS surveillance samples are collected by DCP inspectors and results are published in periodic Station Bulletins available by mail and at www.ct.gov/caes. From July 1, 2018 through June 30, 2019, a total of 121 samples of food were analyzed for pesticide residues. Of the 121 samples analyzed, 59 (48.8%) contained a total of 144 residues. Of these 59 samples, there were 3 samples that contained 5 violative residues. An organic cinnamon sample contained bifenthrin, which was both a no tolerance and a National Organic Program violation. A sample of thyme contained 3 no tolerance residues, and an artichoke sample was found to contain residues of dimethomorph that was a no tolerance violation within method uncertainty. There were 51 different pesticide active ingredients found at an average concentration of 0.222 µg/Kg, and the average number of pesticide residues per sample containing residues was 2.4. During the same time frame, there were 21 fresh and processed food samples analyzed for total arsenic; none of these were found to be violative.

- With US FDA funding and support, the Department has received and expanded ISO/IEC 17025 Accreditation from the American Association for Laboratory Accreditation (A2LA) for this program.

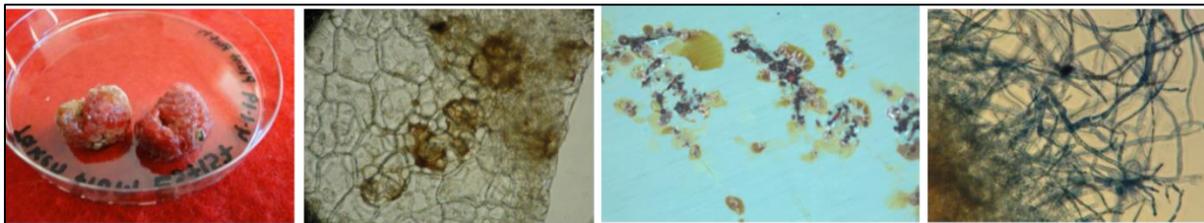
Impact: The Department's MFRPS serves as the sole surveillance and monitoring effort in the state, assuring that the food supply within CT is safe and free from chemical and heavy metal contamination.



b. Miscellaneous samples:

- **Analysts:** John Ranciato, Brian Eitzer.

- **Summary:** From July 1, 2018 to June 30, 2019, 93 consumer complaint samples were submitted



by CT DCP for analysis, including foreign material identification, fecal content determination, product adulteration or tampering, and off taste. For some samples, we rely on the expertise in other CAES Departments, including Plant Pathology and Ecology, Entomology, and Forestry and Horticulture. Samples during the current reporting period included infant formula allegedly containing worm species and a large shipment of barley grain that contained rice weevils and mites.

3. ANALYSES ON BEHALF OF DEPARTMENT OF CONSUMER PROTECTION, LIQUOR CONTROL DIVISION

a. Beverages/products for ethanol content:

- **Analyst:** Terri Arsenault.
- **Goal:** To provide percent ethanol content for label registration and taxation purposes.
- **Summary:** We analyzed 2 products (wines) for ethanol content. Results were submitted to DCP in support of product label registration.



b. Beverage authenticity:

- **Analysts:** Terri Arsenault, Brian Eitzer.
- **Goal:** To determine if products offered to customers at CT establishments are authentic as to brand.
- **Summary:** Fourteen alcoholic products were examined for authenticity; 8 were part of an investigation concerning a local winery allegedly mixing various over the counter ingredients (orange soda, grape juice, brandy, moscato and triple sec) and labeling the product as a local wine. In this case, sample results were inconclusive. Two separate samples were products marketed as non-alcoholic that actually contained violative levels of ethanol. Lastly, four samples were part of an investigation related to discount vodka being substituted for premium vodka. In this case, submitted samples were found to be authentic. In all cases, results are returned to the DCP Division of Liquor Control, who determine appropriate regulatory action. A conductivity meter that was supplied to Liquor Control inspectors for field determination of vodka authenticity continues to be successfully used. Elemental profile as determined by inductively coupled plasma with mass spectrometry (ICP-MS) or optical emission spectroscopy (ICP-OES) is now also used during adulteration investigations.



4. ANALYSES ON BEHALF OF DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION (DEEP), WASTE MANAGEMENT BUREAU

a. Analysis of PCBs (polychlorinated biphenyls):

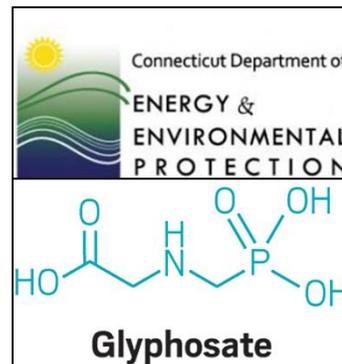
- **Analysts:** Michael Ammirata, Terri Arsenault.
- **Goals:** To determine the extent of polychlorinated biphenyl (PCB) contamination in submitted samples, with matrices including soil, water, oil, sediments, and surface wipes.
- **Summary:** From July 1, 2018 to June 30, 2019, 36 samples were analyzed from pre-existing sites or new locations in CT. Sample collection is performed by the DEEP PCB Enforcement Unit as part of mandatory long-term monitoring of these areas. The findings are reported to DEEP for assessment of continued regulatory compliance or to establish remediation criteria. In addition, a proficiency test was completed as part of this program.



b. Analysis of pesticides:

- **Analysts:** Brian Eitzer, Terri Arsenault, Walter Krol, Christina Robb.
- **Goals:** To ascertain pesticide concentration associated with misapplication or drift in support of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Additional samples are analyzed in support of DEEP surface and groundwater monitoring programs. Submitted sample matrices include soil, water, oil, sediments, tank mixes, and surface wipes.
- **Summary:** From July 1, 2018 to June 30, 2019, 32 samples were analyzed under this program.

Impact: The analysis of samples collected from surveillance programs for soil, surface/groundwater and sediments, as well as those that are part of active misapplication investigations, enable DEEP to enforce current state and federal regulations on pesticides and to promote overall environmental and public health.



5. ANALYSES ON BEHALF OF MUNICIPAL AND FEDERAL AGENCIES

a. Analysis of samples for FDA Food Emergency Response Network (FERN):

- **Analysts:** Craig Musante, Terri Arsenault, Brian Eitzer, Christina Robb, Walter Krol, Kitty P.-Riveros, John Ranciato, Jason C. White.

- **Summary:** The Department of Analytical Chemistry continues its work with the FDA as part of the Food Emergency Response Network Chemistry Cooperative Agreement Program (FERN cCAP). This program enables research and analyses on contaminants in food such as pesticides, poisons, toxins, and heavy metals. Staff participated in an FDA surveillance assignment involving the analysis of 100 samples of rice-based baby foods within CT; five separate analytical platforms were used to screen food for poisons, toxins, pesticides, heavy metals, and inorganic arsenic species. Ongoing surveillance includes juices and juice powders. The Department participated in several FDA and USDA FSIS proficiency tests and challenge exercises. Dr. Christina Robb has continued to investigate methods related to the detection of the plant toxins ricin and abrin by novel LC-HRMS techniques. Lastly, Brian Eitzer and Ms. Terri Arsenault both served as instructors for FDA courses on LC-MS and GC-MS FERN methods, respectively; these training courses are open to FDA staff and other state laboratories.



Impact: The Department's participation in FERN has resulted in the acquisition of highly sensitive analytical equipment and significant funding to support staff, including post-doctoral researchers. In addition to being used for FDA work, these resources are also applied to our state programs in a manner that directly benefits the public health of CT residents.

b. Analysis of samples for municipalities, law enforcement and other groups:

- **Analysts:** Terri Arsenault, Brian Eitzer, Walter Krol, Craig Musante, John Ranciato.

• **Summary:** From July 1, 2018 through June 30, 2019, Department staff analyzed several dozen samples for municipalities or other groups. We analyzed foods and other products for heavy metals at the request of the New Haven Health Department and the City of Stratford. In one lead poisoning investigation involving a child, submitted samples of kitty litter were found to have 19 ppm lead. In another investigation for the New Haven Police Department, samples of water and plant food were analyzed for potential adulteration; the results were inconclusive.



Impact: The findings of high lead levels in kitty litter assisted city inspectors in their investigation, particularly with regard to inhalation of litter dust, and highlights the importance of FERN equipment and funding to the health of citizens in the state.

6. ANALYSES ON BEHALF OF OTHER STATION DEPARTMENTS

a. *Elemental and Molecular Analysis - Department of Plant Pathology and Ecology:*

• **Analysts:** Chuanxin Ma, Craig Musante, Roberto De La Torre Roche, Nubia Zuverza-Mena, Jason C. White.

• **Summary:** In conjunction with scientists in the Department of Plant Pathology and Ecology, elemental and molecular analyses of several hundred samples of various crops grown in the presence or absence of nanoscale micronutrient amendments was again conducted. This work is being done under a USDA AFRI NIFA grant focused on this topic; the \$480,000 grant began March 1, 2016, and includes co-investigators at the International Fertilizer Development Center in Muscle Shoals, AL and the University of Texas El Paso. Additional details on this project can be found in the Department of Plant Pathology and Ecology section of this document.



7. ANALYSIS OF CHECK SAMPLES

• **Analysts:** Walter Krol, Terri Arsenault, Brian Eitzer, Craig Musante, Michael Ammirata, Nubia Zuverza-Mena

• **Summary:** Thirty samples were analyzed during the reporting period as part of annual proficiency testing related to our FDA FERN work, FDA ISO Accreditation program (MFRPs), Animal Feed Regulatory Program (AFRPs), as well as performance evaluation samples for our polychlorinated biphenyl (PCB) regulatory program. All of these testing regimes serve to ensure accurate and reliable laboratory results.

II. RESEARCH ACTIVITIES

Research projects in the Department of Analytical Chemistry include applied and fundamental investigations. Research is often stimulated by our service work and in turn, research results often impact service activities.

1. FOOD SAFETY

Project 1: *Improvement of analytical methods for determination of pesticide residues and heavy metals in food:*

• **Investigators:** Brian Eitzer, Terri Arsenault, Walter Krol, Christina Robb, Michael Ammirata, Craig Musante, John Ranciato, Jason C. White.

- **Summary:** We continue to participate in or lead several FDA coordinated research projects. This includes the use of high resolution LC-MS and LC-MS/MS platforms for the screening of pesticides, toxins (fungal, plant) and poisons. We are currently involved in the analysis of juice and juice powders for a range of contaminants, and will be using newly acquired XRF instrumentation for some of these analyses. We have achieved ISO Accreditation for two separate FDA programs; one focused on human food (MFRPS) and a second focused on animal feed (AFRPS). The analysis of abrin is being investigated by LC-MS as a means to improve the speed of detecting this highly toxic plant toxin. This work is being performed in conjunction with the FDA Forensic Chemistry Center. The overall goal of these projects is to develop robust and accurate methods that the FDA (and state of CT) could deploy as part of large-scale surveillance programs.

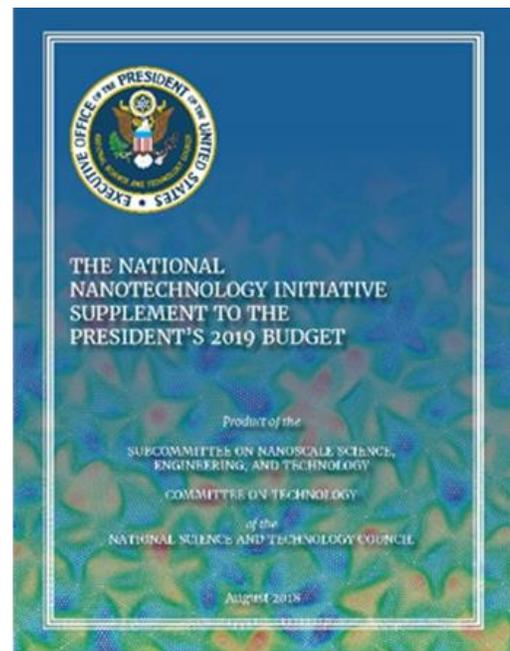
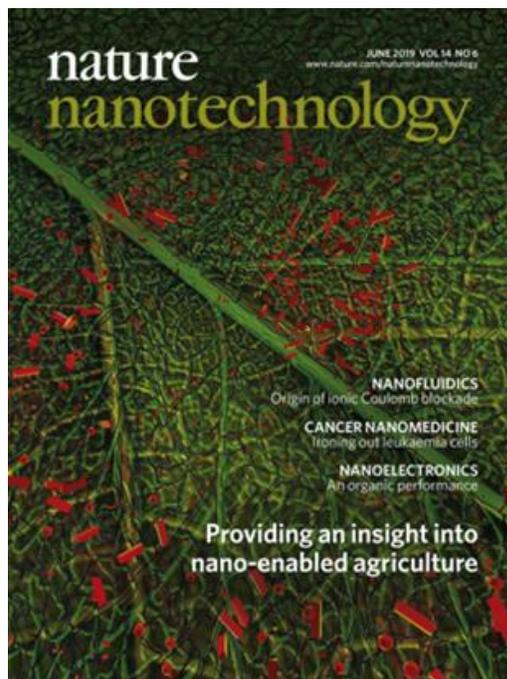


Impact: The development and validation of new more sensitive equipment and analytical techniques will enhance food safety surveillance activities in the state and serve to better protect the public against incidental or intentional adulteration.

Project 2: Nanoparticles in agricultural systems:

- **Investigators:** Roberto De La Torre-Roche, Chuanxin Ma, Nubia Zuverza-Mena, Craig Musante, Yu Shen, Ishaq Adisa, Jason C. White.

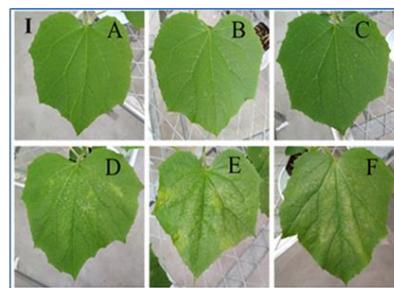
- **Summary:** Nanomaterials (NM) have at least one dimension less than 100 nm (one billionth of a meter), and possess unique physical and chemical properties not observed at the bulk scale. Nanotechnology, which takes advantage of these useful nanoscale properties, has become widely used in numerous sectors, including electronics, health-care, cosmetics, pharmaceuticals, food processing, and agriculture. Our work in this area is focused on two separate but related topics; the implications of nanomaterial presence (by accident or design) in agricultural systems and the use of nanoscale nutrients as agricultural amendments to suppress plant disease and increase yield.



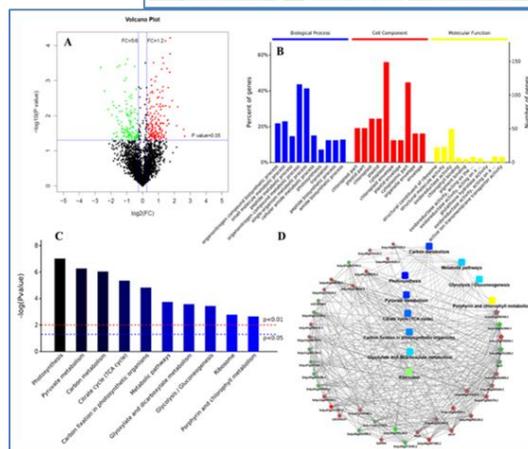
3. Progress towards 1°C RRE Goals



• The first project is focused on the fate of nanomaterials in agricultural systems. Although nanomaterial use has been widespread and is increasing rapidly, the consensus among the scientific community is that understanding of the fate and effects of nanomaterials in the environment is still inadequate. Research in our laboratory has been focusing on defining the impact (physiological and molecular toxicity, accumulation) of NMs on food crops, with a focus on understanding the mechanisms of plant response.



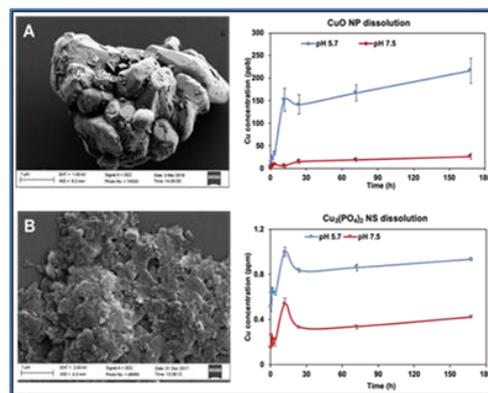
Recent collaborative work with investigators in Italy (University of Parma) and China (Nanjing University) has focused on characterizing the response of crop species exposed to cadmium sulfide quantum dots and nanoparticle silver. Additional collaborators on this project include colleagues at the University of Massachusetts, Texas A & M University, the University of Texas El Paso, the US National Institute of Standards and Technology, Hasselt University in Belgium, Peking University in China, The Ocean University of China, Zhejiang University, China Agricultural University, Jiangnan University, Nanjing Agricultural University, and the Chinese Academy of Sciences.



The second project is focused on the use of nanoscale micronutrients to sustainably suppress crop disease and increase yield. In one set of experiments funded by USDA NIFA, we have shown that amendment with select nanoscale micronutrients not only promotes crop health but also stimulates tolerance to stress from both pathogens and drought. A second set of projects is occurring as part of our inclusion in The Center for Sustainable Nanotechnology, which is a NSF Center for Chemical Innovation (CCI). Here, we continue to investigate how the underlying chemistry of nanoscale micronutrients such as copper, silica, and sulfur control the time dependence of particle activity, include nutrient uptake and disease response. Last, a new project is part of the Nanyang Technological University (NTU; Singapore) and Harvard University TH School of Public Health Initiative for Sustainable Nanotechnology (SusNano); here, we will begin to investigate the use of nanoscale nature-derived materials (cellulose, chitosan) as carriers for various agrochemicals.



Impact: Our research has demonstrated that the toxicity of nanomaterials to crops can be significantly different from that of the corresponding bulk material. Current investigations are focused on understanding the mechanisms of plant response so as to enable safe design and use of these important materials. For example, when used appropriately, nanoscale versions of select micronutrients can suppress crop disease and increase yield. Such techniques may be critical to sustainably increasing food production so as to achieve and maintain global food security in the coming decades.



2. ENVIRONMENTAL MONITORING/REMEDIATION

Project 1: *Protecting pollinators with economically feasible and environmentally sound ornamental horticulture.*

- **Investigators:** Brian Eitzer, Kimberly Stoner (Department of Entomology), Richard Cowles (Valley Laboratory), Cristi Palmer (Rutgers University).

Summary: We are participating in a multi-year and multi-institution study to examine pesticide use in ornamental horticulture. One part of this study is to understand the translocation of pesticides into the pollen and nectar of plants. Plants were treated with known amounts of five different pesticides and then we analyzed the pollen and nectar from the plants for those pesticides over the next couple of years. Sampling of those plant matrices is very laborious so that only very small amounts of sample are collected. These small sample amounts then require instrumental methods with great sensitivity. Liquid chromatography coupled to mass spectrometry provides this sensitivity. We are continuing to analyze the pollen and nectar of the treated plants so that we can understand how long the concentrations in these compartments remain elevated following the pesticide treatment.



Impact: Knowledge of the translocation of pesticides to pollen and nectar can be used to guide farmers in the proper use of pesticides so as to insure not only crop pollination but also protection from pests and pathogens.

Project 2: *Determining the effects of pesticide exposure on bumble bee microcolonies*

- **Investigators:** Brian Eitzer, Kimberly Stoner (Department of Entomology), David Lehman (EPA), Robert Koethe (EPA).

• **Summary:** While much has been learned about the effects of pesticides on honey bees, much less is known about their effects on bumble bees. This project is aimed at understanding some of those effects. Pollen was collected at ornamental nurseries and pesticide levels were determined using liquid chromatography/mass spectrometry (LC/MS). After characterization of pesticide content, acetamiprid, a neonicotinoid pesticide was added to the pollen at various dosage levels and the pollen was fed to bumble bee microcolonies. The colonies were then monitored for deleterious effects. After a set time period, the colonies were sacrificed and various compartments of the colony were analyzed for the acetamiprid. In the sample spiked at the highest dose the acetamiprid and two of its metabolites were observed in hive materials. The highest concentrations were seen in the nests, intermediate amounts in the nectar, fecal matter and eggs, with lesser amounts in the bees, larvae, and pupae. These data will then help us to understand how the pesticide has impacted these bumble bees.

Impact: Knowledge of the effects of pesticides on bumble bees can help us to protect these important native pollinators.

PUBLIC OUTREACH

Telephone/Internet Inquiries: We receive approximately 100 calls and emails from the public each year requesting information on issues such as pesticides in food and the environment, as well as heavy metals in food, soils, and consumer products. In some instances, we refer the caller to a more appropriate CAES department or state agency.

Station Bulletins and Fact Sheets: Station Bulletins are periodically published by our Department. These bulletins are available in printed form and on the CAES website (www.ct.gov/CAES). Fact sheets are articles written for the general public regarding topics of timely and widespread interest. These are also available on our website and in printed form.

DEPARTMENT OF ENTOMOLOGY

The Department of Entomology is involved in a variety of service, research, pest surveillance, and plant regulatory activities. The primary service activities are provided through the Insect Information Office (IIO). Staff in this office answer insect-related questions and identify insects and related arthropods for the public, government agencies, growers, and business organizations. All scientists provide information to citizens of Connecticut by answering telephone inquiries, making farm visits, participating in meetings of growers and other groups, and speaking on their research. Most of the research in the Department has a major applied aspect, addressing the integrated management of ticks, pests of field crops, nurseries, and orchards, wood-boring insects, invasive insects, and honey bees and other bee pollinators.

The Office of the State Entomologist at the Connecticut Agricultural Experiment Station, created by the Connecticut General Assembly in 1901, is part of the Department of Entomology with responsibility, in part, to ensure our nursery industry is free of plant pests and certify their products for shipment to other states and outside the United States. The Connecticut Green Industry (i.e., nursery, greenhouse, floriculture, sod, Christmas trees) is the largest agricultural business in Connecticut. The industry estimates that environmental horticulture generates \$1.022 billion gross income supporting 48,000 full- and part-time jobs in Connecticut. In conjunction with regulatory activities, Department staff conducts a surveillance program in Connecticut for a variety of established pests and for exotic plant pests, some of regulatory concern, that represent a threat to our green industry, forests, and urban ornamental trees and shrubs. Surveillance for plant pests is performed in partnership with the United States Department of Agriculture (USDA) through the Cooperative Agricultural Pest Survey (CAPS) program, Plant Protection Act surveys, and the U.S. Forest Service. For plant diseases of regulatory concern, we work closely with the Plant Disease Diagnostic Laboratory in the Department of Plant Pathology and Ecology. We also conduct forest health surveys and a statewide aerial survey for gypsy moth defoliation (and any defoliation by other insects) and a gypsy moth egg mass survey. The results of our plant and forest surveys for 2018-2019 may be found later in the Department's research activities along with summaries of our regulatory activities. The Office of the State Entomologist and the Apiary Inspector also oversee registration of beekeepers and inspection of honey bee colonies for pests and disease.



The Insect Information Office.

The staff of the Department of Entomology also take a lead in providing extensive outreach activities for the Experiment Station by providing information to both children and adults about the Experiment Station's research at public events and at health and agricultural fairs, such as the Eastern States Exposition (Big E) in Springfield, MA, Celebrating Agriculture in Woodstock, CT, the Garden Expo in Fairfield, CT, Norwalk-Wilton Tree Festival, and the Connecticut Flower and Garden Show. The Insect Information Office is located in the renovated Jenkins-Waggoner Laboratory and has a laboratory, office, public reception, and a climate-controlled collections room.

Service Activities

Insect Information Office

Dr. Gale E. Ridge works in the New Haven Insect Information Office. Insect identification services date back to nearly the inception of the institution (1875) starting with the first Annual Report of The Connecticut Agricultural Experiment Station published in 1877. The Station announced that it was offering to “identify useful or injurious insects....and to give useful information on the various subjects of Agricultural Science for the use and advantage of the citizens of Connecticut.”

Since 2000, there has been a trend away from traditional communication such as mail and visitors to cell phone and internet. Phone calls remain a primary citizen contact followed by emails.

Impact of the IIO is public education to reduce pesticide use and promote non-chemical management of nuisance arthropods, protection of public health, conservation of natural

habitat and species, protection of agriculture, and protection of urban structures and buildings. The office directly serves private citizens, pest management professionals, the real estate industry, nurseries, land care businesses, arborists, health departments, other medical professionals, charities, manufacturing, the hospitality industry, schools, colleges, and universities, housing authorities, museums, municipalities, libraries, law enforcement, state government, and the media. Between July 1, 2018 and June 30, 2019, the IIO handled 11,369 requests for information. Of these, 52% were natural resources, 45% man and medical issues, 2% food-related, and 1% undetermined.

But for scattered hot spots, Gypsy moth, *Lymantria dispar* populations collapsed in 2019. The outbreak was brought under control by the entomopathogenic fungus *Entomophaga maimaiga*. Successive cold wet springs in 2018 and 2019 assisted fungal inoculation of the caterpillars, further suppressing populations.

There were 725 categories of inquiries including insects, arachnids, animals, pesticides, insect damage, general entomology, and horticulture. Delusory Parasitosis (DP) cases continued to rise from 189 in 2016, 243 in 2017, 300 in 2018, and 357 in 2019. These are time-consuming psychological cases that encompass multiple phone calls, emails, and visits, which often involve medical professionals.

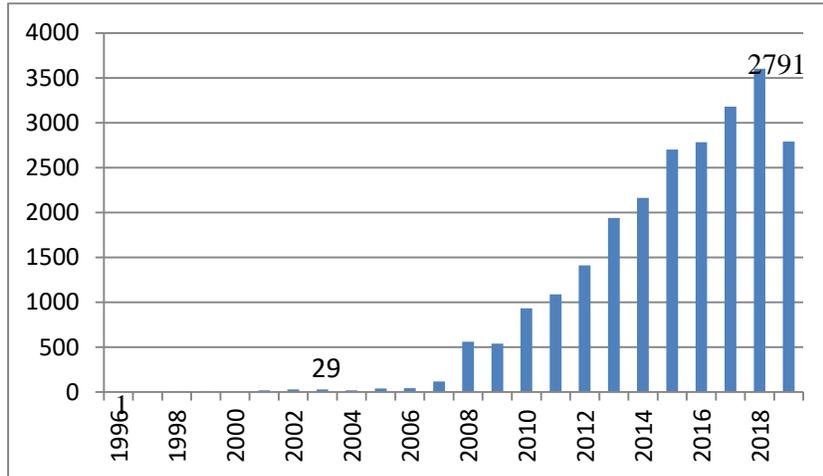


Table 1. Number of bed bug inquiries from FY 1996 to 2019.

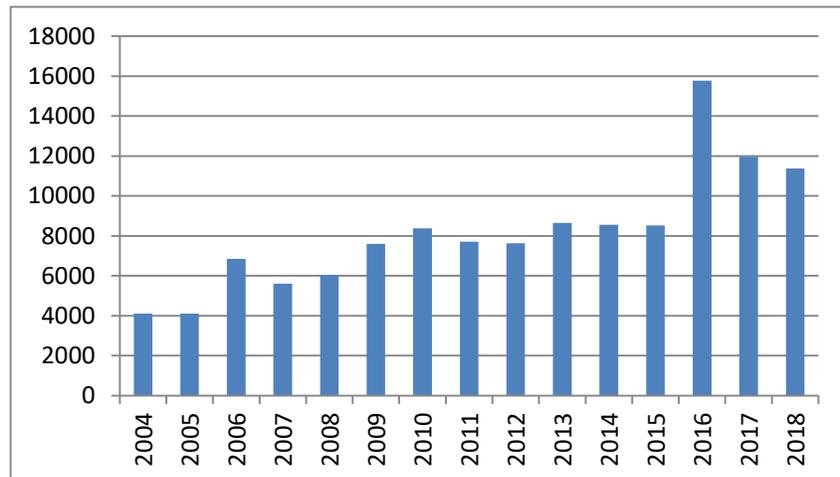


Table 2. Number of inquiries from FY 2004/2005 to FY* 2018/2019.

After a second mild winter followed by a cool wet spring, tick populations, especially American dog ticks, *Dermacentor variabilis* were high. Black-legged tick, *Ixodes scapularis* populations were also high with the Insect Information Office responding to numerous calls and visits during early spring of 2019. Many tick submissions for Lyme disease testing passed through the Insect Information Office. Additionally, mistaken tick identifications from the public were forwarded to the office for a correction of identification. Two-lined chestnut borer, *Agrilus bineatus* populations in the eastern half of Connecticut were elevated, because oak trees stressed by both Gypsy moth activity and summer droughts (2016 and 2017) were weakened to attack. Fall webworm *Hyphantria cunea* populations were very high this year and emerged earlier than normal in late June. Lower Fairfield County was hardest hit by the outbreak. The state also experienced an outbreak of the oak shothole leafminer, *Japanagromyza viridula* synonym *Agromyza viridula*. Reports from Massachusetts and Rhode Island corroborated this in their states.



Oak shothole leafminer samples illustrating bilateral ovipositor puncture damage by female fly.

The highest inquiry was human feeding bed bugs (2791) followed in order by pesticides (1247), DP (357), carpenter ant (148), carpet beetle (134), and scabies concerns (117). Scabies mites were not submitted to the IIO. The only explanation for scabies inquiries may be medical professional issues and/or population-wide concerns.

Due to the climate change crisis, inquiries remained high and were more varied. For example, citizens reported either population increases in mosquitoes and lightning bugs due to the wet weather or population losses in pollinators and butterflies such as the monarchs. Additionally, there were reports by pest management professionals of unusually shaped bald-face hornet *Dolichovespula maculate* nests with long tube-like entrances in the Huntington-Shelton area. The office continued to lead in public outreach building collaborative relationships and projects with local, state, and federal agencies, particularly health departments to better serve the needs of Connecticut citizens.

CAPS Survey and Outreach Programs: The Cooperative Agricultural Pest Survey and Plant Protection Act (formerly the Farm Bill), supported by the USDA-APHIS-PPQ and overseen by State Survey Coordinator Katherine Dugas and Deputy State Entomologist Dr. Victoria L. Smith, are two programs that provide support for pest survey and educational outreach on the identification and risks posed by a number of potential invasive insects and plant diseases. With worldwide trade and travel increasing, we are at an increased risk of foreign plant species, plant diseases, and insect pests being introduced in the U.S. In Connecticut, the CAPS program has largely conducted surveys in nurseries, Christmas tree farms, state parks, and conservation and public lands. In 2019, CAPS is surveying for a number of hardwood and coniferous insect pests in nurseries and Christmas tree farms. Additional vineyard surveys are supported by funding from the Plant Protection Act, as well as the continued funding of the Forest and Agricultural Pest Outreach Program. This program's main objective is using outreach and education to increase public understanding of the costs associated with invasive pests such as spotted lanternfly and emerald ash borer. The program also provides guidance on the management and control of detected invasive pests. By raising

awareness of invasive pests, we hope to increase public awareness of pest management options and early reporting of potential new pest sightings to federal or state authorities.

Bird & Butterfly Garden: The Bird & Butterfly Garden is a partnership of the Federated Garden Club of Connecticut, the Spring Glen Garden Club of Hamden, and The Connecticut Agricultural Experiment Station. Most maintenance and improvements to the garden are done by farm manager Richard Cecarelli and his staff. The garden is open to the public Monday-Friday 8:30 a.m.-4:00 p.m., it is closed on the weekends and state holidays. The garden creates several favorable habitats for our native birds, butterflies, and pollinating insects and helps us determine which plants may work best in southern Connecticut gardens. Plants are labeled for easy identification. The Bird & Butterfly Garden at Lockwood Farm is listed in the *Nature Conservancy Open Days Directory for New England*.

Jeffrey Fengler observed 10 different butterfly species, 7 species of birds, and 4 other species around the garden at Plant Science Day held on August 8, 2018.

<i>Butterflies & Moths</i>	<i>Birds</i>	<i>Other</i>
Monarch	American Goldfinch	European Honeybee
Eastern Tiger Swallowtail	American Robin	Green Frog
Spicebush Swallowtail	Common Grackle	Bumblebee spp.
Cabbage White	House Sparrow	Large Milkweed Bug
Black Swallowtail	Red-tailed Hawk	
Peck's Skipper	Bluejay	
Common Sulphur	Turkey Vulture	
Tawny-edged Skipper		
Grey Hairstreak		
Silver-spotted Skipper		

Dr. Claire Rutledge hosted several interns and students:

- Jill Tate – Intern through the Plant Health Fellows program (a collaboration of Southern Connecticut State University and CAES sponsored by the Education and Literacy Initiative of the USDA National Institute of Food and Agriculture). In addition to regular field duties, she examined the strong correlation between defoliation by gypsy moths and the proportion of a buprestid beetle, the twolined chestnut borer collected by *Cerceris fumipennis*. Twolined chestnut borer attacks weakened oaks and were much more prevalent in the areas of the state that had suffered gypsy moth outbreaks. *June – August, 2018*
- Mona Elamin – Student at Gateway Community College. Spent time in the laboratory and the field learning about her program and assisting with collection curation and field research site location. *April 2019*
- Niklas Lowe – Masters of Science student at Central Connecticut State University under Dr. Alicia Brays. Starting his masters' project on Southern pine beetles in Connecticut. Dr. Rutledge is currently on his committee.
- India Wolterstorff – Junior at New Haven Academy. She worked in the laboratory for 3 weeks in May. Among other projects, she assisted in search for parasitoids of Emerald ash borers, by peeling trees in the field, and sifted and examined bark peeled from ash trees to find egg parasitoids of Emerald ash borer. *May 2018*

RESEARCH ACTIVITIES

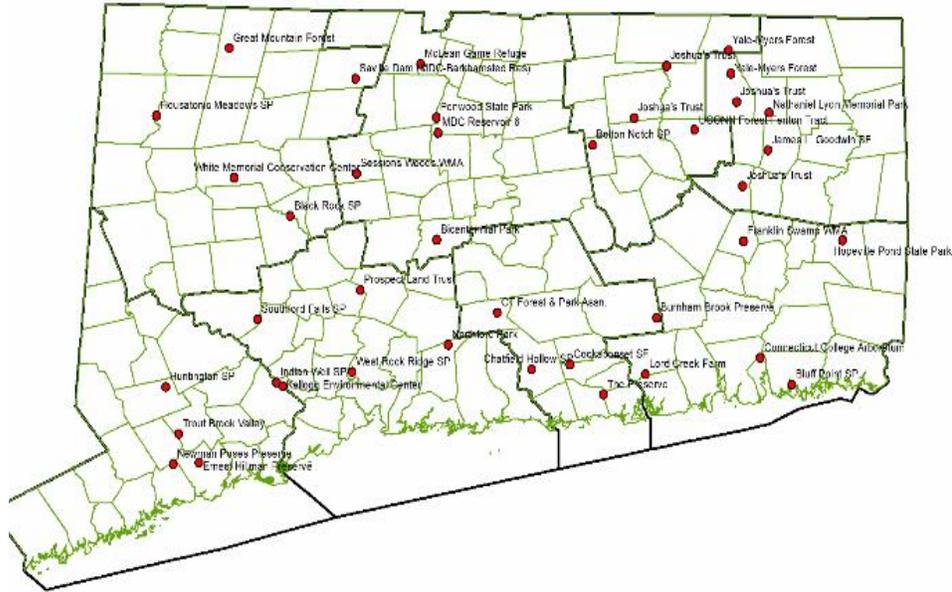
The statewide tick active surveillance program, a lone star tick control project, and an integrated tick management program involve scientists and staff from the Departments of Entomology, Environmental Science, and Forestry and Horticulture under the umbrella of the Experiment Station's **Center for Vector Biology and Zoonotic Diseases**.

Tick Active Surveillance Program

A new statewide active tick surveillance program was initiated in 2019 that will provide critical information on the distribution and abundance of ticks and the prevalence of current and newly emerging agents of human disease. The blacklegged tick, *Ixodes scapularis* Say, is the primary vector for at least seven pathogens that cause human disease; *Borrelia burgdorferi*, the agent of Lyme disease, *Babesia microti* (babesiosis), *Anaplasma phagocytophilum* (anaplasmosis), *B. miyamotoi* (a relapsing fever *Borrelia*), *B. mayoni* (a new Lyme *Borrelia* spp.), the *Ehrlichia muris*-like agent, now *E. muris* subsp. *eaucلائrens* (ehrlichiosis) (known only from upper mid-west so far), and Powassan virus. The program is funded in part by a grant from the Centers for Disease Control and Prevention (CDC) through the Epidemiology and Laboratory Capacity (ELC) program for Infectious Disease at the Connecticut Department of Public Health. The field program is run by Dr. Scott C. Williams (Forestry and Horticulture), Dr. Megan A. Linske, and Dr. Kirby C. Stafford (Entomology) with seasonal assistants Jamie Cantoni and Sarah Hemstock. All the tick testing is conducted by Dr. Douglas E. Brackney and Duncan W. Cozens (Environmental Sciences).

Ticks are collected at 40 paired publically-accessible active tick surveillance sampling locations throughout CT's eight counties (see map) from April through October with a focus on the blacklegged tick, *Ixodes scapularis*. Over 1,000 adult and 700 nymphal *I. scapularis* have been collected. Sampling is conducted by Sarah Hemstock and Jamie Cantoni. Other tick species that are being found and tabulated include American dog ticks, *Dermacentor variabilis*, the vector of Rocky Mountain spotted fever, and the lone star tick, *Amblyomma americanum*, an aggressive southern species that is becoming established in Connecticut and parts of coastal New England. One nymph of the newly discovered invasive, exotic Asian longhorned tick, *Haemaphysalis longicornis*, that was first detected in New Jersey in 2017 and is locally abundant in parts of Westchester County and Staten Island, New York, was detected as part of the program in Fairfield County.

The multiplexed RT-qPCR assay for *Ixodes scapularis* can detect *Borrelia burgdorferi* s.l., *Babesia microti*, *Anaplasma phagocytophilum*, *Borrelia miyamotoi*, and Powassan virus lineage II. Work on a differential diagnostics follow-up assay to help differentiate *Borrelia burgdorferi* s.s. from other strains has been implemented. The *Amblyomma* multiplexed RT-qPCR has been validated for bourbon virus and Heartland virus and assays for *Rickettsia* spp., *Ehrlichia chaffeensis*, and *E. ewingii* are pending. Testing of 531 of the adult ticks by Dr. Douglas E. Brackney and Duncan W. Cozens revealed that 50% were infected with *Borrelia burgdorferi*, 15% with *Babesia microti*, 9% with *Anaplasma phagocytophilum*, 2% *Borrelia miyamotoi*, and 1% with Powassan virus. Comparatively these rates are greater than those reported in by the passive tick surveillance program; however, the significance of this is unclear at this time. We have also been collecting and testing *I. scapularis* nymphs. We have tested 288 with prevalence rates for *Borrelia burgdorferi*, *Babesia microti*, *Anaplasma phagocytophilum*, *Borrelia miyamotoi*, and Powassan virus being 18%, 6%, 6%, 1% and 0%, respectively.



Lone Star Tick Control Project

The presence of an established lone star tick population in Norwalk first came to light as a result of a June, 2017, report from a South Norwalk resident about a deer that was acting strange. When a Connecticut Department of Energy and Environmental Protection (DEEP) Environmental Conservation (EnCon) arrived on scene at Manresa Island, the animal was deceased. Dr. Kirby Stafford, Dr. Scott Williams, and Dr. Megan Linske continued a 4-poster study in 2019 for the control of the lone star tick population on the island in cooperation with staff from the Wildlife Division, CT DEEP. Four 4-posters were re-activated June 1, 2019 with the 4-poster feeding stations recharged with corn and permethrin weekly. Ticks are also sampled weekly at established transects. Wildlife biologists again tranquilized a few deer at the Manresa Island site and documented an apparent reduction of ticks on the ears of the animals. The host-seeking population of *A. americanum* in 2019 is down roughly 80% from 2018.



Adult female *A. americanum* (CDC) and lone star ticks feeding on the ear of a deer on Manresa Island prior to impact from the treatment with permethrin via the 4-poster (courtesy DEEP).

Lone Star Tick Overwintering Study



Overwintering survival of *I. scapularis* and *A. americanum* were investigated under varying conditions of leaf litter and snow cover by Dr. Megan A. Linske, Dr. Kirby C. Stafford, and Dr. Scott C. Williams and with the assistance of Heidi Stuber and Michael Short at CAES and Charles Lubelczyk and Margaret Welch at the Maine Medical Research Center Institute (MMRCI) over three winter seasons for each species, supported by the Northeast IPM Center. This project was continued for a fourth year for *A. americanum* with support from

Tick pot without leaf cover (left) and without snow cover (right).

the Northeast Center of Excellence for Vector Biology in the winter of 2018-2019. The three-year study with *I. scapularis* was completed the previous year. Snow and leaf litter can moderate temperatures and provide moisture. This study examined survival with no cover, leaf litter cover, snow cover, or both leaf litter and snow cover. Nymphal and adult lone star ticks were placed in special “tick pots” buried in the ground with temperature and humidity data loggers. For the winter of 2018-2019, CAES retrieved 432 adult and 720 nymphal *A. americanum* and 27 temperature and relative humidity loggers in this final year of the overwintering study. Very few nymphs survived the winter; excess moisture seemed to play a role in their demise. Leaf litter presence/absence and snow presence/absence had no apparent effect on adult survival. A total of 68% of females and 53% of males survived the Connecticut 2018-2019 winter while just 9% of males survived in Maine (the state did not permit the import of both sexes for research purposes). As *A. americanum* continue to survive the winter in these studies, this suggests further establishment in New England coastal areas is not only possible, but likely.

Integrated Tick Management (ITM)

Lyme disease (LD) continues to be the most commonly reported vector-borne disease in the United States. According to the Centers for Disease Control and Prevention, it affected over 360,000 people in 2016. The blacklegged tick, *Ixodes scapularis*, is the vector for *Borrelia burgdorferi*, the causal agent for Lyme



The 4-poster utilized by white-tailed deer (left), a fipronil bait box (center), Michael Short applying Met52 (right).

disease, and at least six other human pathogens. An integrated tick management project was initiated by Dr. Kirby C. Stafford, Dr. Scott C. Williams, and Dr. Megan Linske, with the assistance of technicians Heidi Stuber and Michael Short in 2016-2017 in a cooperative agreement with Dr. Andrew Li at the USDA-Agricultural Research Service, which is funding the study. Seven neighborhoods were selected throughout Guilford based on their layout and proximity to large (> 200 acres) pieces of Town- or Land Trust-owned open spaces, and 91 properties (21%) agreed to participate with good distribution among all seven neighborhoods. The treatments in this ITM study consist of different combinations of untreated controls and homes treated with various combinations of spray applications of the entomopathogenic fungus *Metarhizium anisopliae* (Met52® EC), the fipronil-based rodent bait box (Select TCS®) and the 4-poster passive acaricide application station for the treatment of white-tailed deer (*Odocoileus virginianus*). Twelve '4-posters' (1 per 50 acres) were initially deployed in October 2017. Bait boxes and Met52 were first deployed or applied in June 2018. For 2018-2019, twelve 4-posters were re-deployed and maintained through the adult *I. scapularis* active season in the fall and spring. Again, a total of 540 fipronil-based rodent-targeted bait boxes were deployed at 54 residences and 36 of those residences were treated with Met52 (*Metarhizium anisopliae*) spray application. Dragging for questing nymphs began in mid-May by Heidi Stuber with seasonal assistants Bailey Willett and Meagan DeNicolo and live-trapping of white-footed mice by Dr. Scott C. Williams and Dr. Megan A. Linske with the assistance of Michael Short. Each captured mouse is sedated, marked with a unique ear tag, processed for ticks, and a blood sample was taken for serological analysis. Full analysis of the data for the first two years of treatment in comparison to the base-line year and the controls is pending. However, initial summary of the data for 2018 shows reductions in host-seeking ticks and ticks feeding on mice for all the treatment combinations in comparison to the control sites the first full year of implementation of the integrated interventions.

Using Color Sorting and Palynology to Track Pesticide Residues in Trapped Pollen to a Plant Genus
(Dr. Kimberly Stoner, Dr. Richard Cowles, Dr. Brian Eitzer with Andrea Nurse of the University of Maine)

Because of consumer concern about the use of neonicotinoid insecticides on ornamental plants, and the possibility that neonicotinoid residues in nectar and pollen would be hazardous to pollinators, the Connecticut Department of Energy and Environmental Protection funded a CAES project trapping pollen from honey bee colonies at three ornamental plant nurseries and analyzing the pollen for pesticides. At two of the nurseries we found concentrations of pesticides generally below those known to cause negative effects on honey bee colonies. Mean concentrations for the neonicotinoid clothianidin at the two nurseries were 2.9 and 3.9 ppb and for were thiamethoxam below the limit of detection and 2.9 ppb. However, at the third nursery we found a few samples with extraordinarily high levels of acute pesticide toxicity to bees. One sample had 305 ppb thiamethoxam, 31 ppb clothianidin, 94 ppb of acephate, and 15 ppb of methamidophos. By sorting two of the pollen samples by color, testing each of the color components again for pesticides, and analyzing the color components using palynology, we were able to associate the high pesticide levels with pollen from the plant genus *Spiraea*. The nursery confirmed applications of thiamethoxam and acephate to this crop in the nursery. (Clothianidin is a metabolite of thiamethoxam and methamidophos is a metabolite of acephate.)



Impact: This is the first time that pesticide residues in a pollen sample from a honey bee colony have been traced to a specific plant

genus. This technique maybe useful in other studies to determine how honey bees are exposed to hazardous levels of pesticides through the pollen they collect and feed to their larvae.

The Bee Fauna of an Atlantic Coastal Plain Tidal Marsh Community in Southern New England, USA

(Tracy A. Zarrillo and Dr. Kimberly A. Stoner)

With growing evidence of changes in local abundance, geographical range, and species diversity of wild bees, it is imperative to document wild bee communities in representative habitats throughout North America. The Connecticut shoreline has historically been subject to many natural and anthropogenic disturbances, and there is a lack of baseline data regarding bee biodiversity in Connecticut's maritime habitats. In this study, we characterized the wild bee fauna of a discrete maritime habitat in Connecticut, USA, and examined salt-marsh, beach dune, and coastal scrub bee communities adjacent to Long Island Sound. We conducted biweekly surveys at Grass Island (Guilford, CT) over a two-year period (2011–2012) using pan traps and effort-based (timed) net collecting from flowers. We collected 3928 individual bees, representing five families, 18 genera and at least 80 species. Floral records for 374 individuals resulted in associations of 35 bee species with 19 species of plants. Seventy percent of the bees captured in the net survey were visiting alien plants, with the exotic *Rosa rugosa* Thunb. having the highest level of bee diversity and relative abundance. The total number of bee species collected in this survey represents approximately 23% of the known Connecticut fauna, including four specialists associated with coastal and wetland habitats. The abundance and diversity of bees visiting alien plants on Grass Island, as well as the occurrence of these sand specialists, may prove to be of conservation concern as the Connecticut shoreline continues to be altered.



Impact: This survey assembled a wild bee species list that will serve as baseline data for future studies of bee diversity in coastal communities, as well as augmenting the museum holdings in the insect collection of the Connecticut Agricultural Experiment Station. Information from this study is readily accessible to the public through use of an open-source journal, and collection data for each species collected has been data-based into the American Museum of Natural History, Division of Invertebrate Zoology Database and mapped online at the biodiversity portal www.discoverlife.org.

Detection of Bronze Birch Borer

This multi partner project, headed by Forest Research UK, is focused on understanding how Europe can best prepare for, and manage if necessary, the risks and impacts of emerald ash borer (*Agrilus planipennis*) and bronze birch borer (*Agrilus anxius*). The group funded research in my laboratory into adapting monitoring tools used for emerald ash borer for the detection of bronze birch borer. The bronze birch borer is native to North America, and non-North American species of birch have little-to-no resistance to the beetle. If bronze birch borer were to become established in Europe, it could have a devastating impact. We looked at the efficacy of purple prism traps and green multi-funnel traps, both commonly used in EAB surveys, for detecting BBB. Since BBB feeds on declining trees, we also compared trap catches on trees that had been girdled, with trees that were intact. In 2017 our results showed us that BBB prefers traps hanging in girdled trees to those hanging in intact trees. The results from the second year confirmed this, as well as showing us that girdled birch trees are still more attractive than intact trees after a year of being girdled. A second season of experiments was begun in 2018 and continued in 2019, in collaboration with Dr. Peter Silk of Canada Forestry looking at the impact of lures with plant volatiles and a putative BBB pheromone on trap efficacy.



Jill Tate examines a purple prism trap hung on a birch tree at Tunxis State Forest in Hartland with Dr. Claire Rutledge.

Preparing Europe for Invasion of Emerald Ash Borer and Bronze Birch Borer

In October 2018, Dr. Claire Rutledge represented The Connecticut Agricultural Experiment Station at a conference in Vienna, Austria on the European response to these two potential borers. There were delegates from 28 countries, and research on a wide range of related topics was discussed. A special issue of the journal Forestry will be devoted to the research presented at the conference.



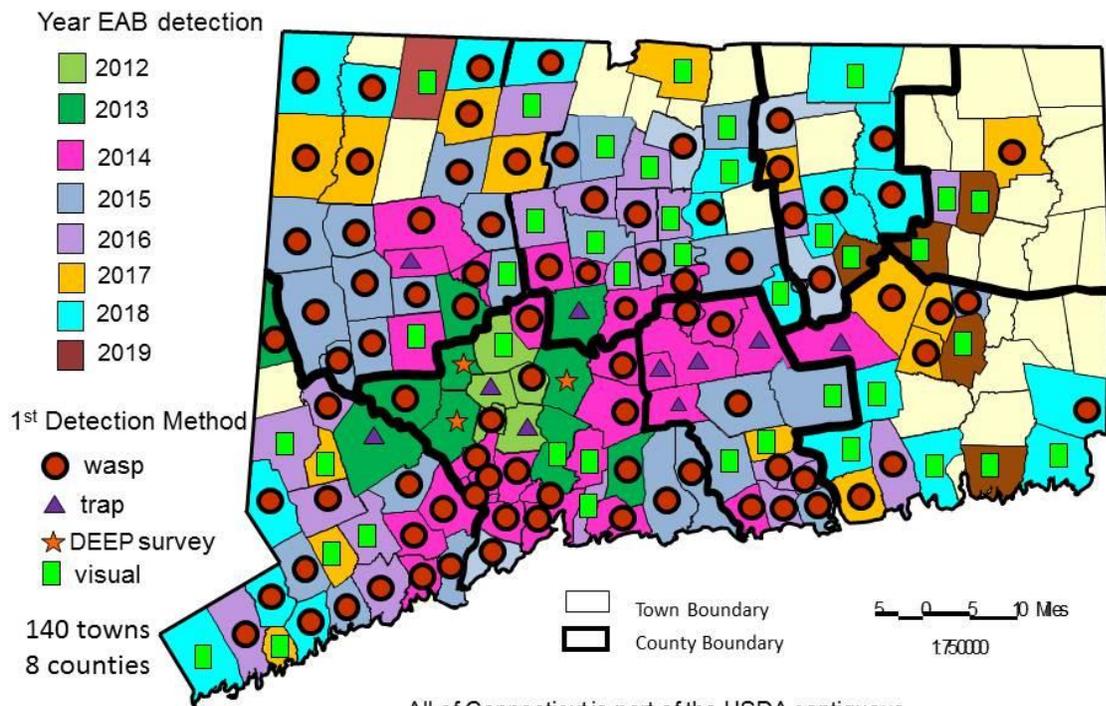
Delegates from the conference outside of the Austrian Research Centre for Forests in Vienna Austria. (Bundesforschungszentrum für Wald)

Biosurveillance for Exotic Buprestidae and the Wasp Watcher Program

The wasp watcher program was begun in the spring of 2010. *Cerceris fumipennis* is a native digging wasp that provisions its nest with adult Buprestidae, including emerald ash borer. It is used as a tool for detecting and monitoring emerald ash borer and other invasive buprestid species by intercepting its prey as female wasps return to their nest.



The wasp was responsible for the first detection of EAB in Connecticut, and remains our main tool for detecting and monitoring EAB in the state. We are in the tenth year of our Wasp Watcher program. Over the course of the program we have trained 203 watchers. In 2019, 31 watchers from previous years are signed-on, as well as 15 new watchers. Since 2010, Watchers have collected over 8,000 beetles and detected EAB in 42 new towns. We have also used this system to examine the native buprestid fauna of Connecticut, and have detected over 70 species of beetles with this tool. Of these, 21 are new state records.



All of Connecticut is part of the USDA contiguous quarantine for the emerald ash borer. EAB detections by town, year, and method shown.



June 30 2019

Classical Biological Control of Emerald Ash Borer



Larvae of the endoparasitoid *Tetrastichus planipennisi* and the remains of an EAB larvae. CT.

Following the detection of EAB in Connecticut, the determination was made to join the USDA APHIS/ PPQ biological control program for EAB. In May 2013, Dr. Claire Rutledge began releases of the gregarious endoparasitoid, *Tetrastichus planipennisi* and the egg parasitoid *Oobius agrili* in Middlebury and Prospect, CT. In 2016 we were able to add another species of parasitoid to the releases, *Spathius galinae*. This parasitoid is a gregarious ectoparasitoid of EAB, and has a much longer ovipositor than *T. planipennisi*. This means that they can parasitize larvae that are feeding in areas of the tree with much thicker bark. The parasitoids are shipped from the USDA APHIS emerald ash borer mass-rearing facility in Brighton Michigan. Releases have been made in 14 towns in Connecticut altogether, the others being Hamden, Sherman, Cromwell, Litchfield, Plymouth, Simsbury, East Haddam, Weston, Kent, Coventry, Lebanon and East Windsor. Each release site receives parasitoids for 2 years. We have been fortunate in finding in-state collaborators to aid in releases. DEEP has been generous in allowing us to release parasitoids in Connecticut Wildlife Management Areas and State Parks. In 2016, we partnered with the Connecticut office of The Nature

Conservancy, and they aided in releases at three sites along the Connecticut River and its tributaries. In 2017, we were given permission by the Aspetuck Land Trust to do releases at Trout Brook Preserve. In the spring of 2018, we entered a partnership with a large private farm in Kent to do releases there.

After releases, the next step is to determine if the parasitoids have established in the environment. All three species have been recovered at least a full year after the last release. *Tetrastichus planipennisi* has been recovered at 7 sites, and *Spathius galinae*, which we just began releasing in 2016, has been recovered at 2 sites. Parasitism rates of the *S. galinae* in particular are very promising, with wasps attacking up to 45% of available EAB larvae. *Oobius agrili*, the egg parasitoid is a tiny wasp, and very difficult to recover. In spring 2019 we were able to detect it at 4 of its release sites.

Beyond detection at release sites, we want to know how well the parasitoids are spreading in the environment. By peeling ash trees at various distances from the release sites, we can see how well the larval parasitoids are moving. In spring 2019, we peeled trees in Cromwell and Plymouth at distances from 0.8 km to 4 km. We detected *S. galinae* at 4 km from its release site in Plymouth, and both *S. galinae* and *T. planipennisi* 3 km from the release site in Cromwell. Previous surveys found *T. planipennisi* had spread as far as 3 km from Prospect.

Longhorned Beetles of Connecticut

The larvae of most longhorned beetles, or Cerambycidae, bore into dead or dying trees and shrubs. The few pest species generally feed upon living trees or herbaceous plants or upon firewood and wooden construction material. Dr. Maier, assisted by Morgan Lowry and Tracy Zarrillo, has been examining the biology of these borers to increase our understanding of species diversity, distribution, and larval hosts, and floral hosts of adults. To obtain new data, they capture adult beetles in traps baited with sex pheromones and host volatiles, rear adults from wood infested by larvae, collect adults on flowers, attract adults to light-traps, capture adults in flight interception and fermenting bait traps, and record data on labeled specimens in museums.

In 2019, Dr. Maier and his team completed a multi-year study of hosts of northeastern longhorned beetles in the subfamily Lamiinae, which includes most of the species with larvae that damage live plants. They reared 39 species from dead wood or from galls in live branches collected in Connecticut and nearby states.

New hosts were discovered for 27 (69.2% of total) of the species. In all, 1,854 adults were reared to document 191 host associations, including 108 (56.5% of total) new ones. *Astylopsis macula* (Say) had the broadest host range with 28 hosts, followed by *Urgleptes querci* (Fitch) with 26 hosts and *Hyperplatys aspersa* (Say) with 13 hosts; the remaining 36 species developed in 10 or fewer hosts. Lamiine adults emerged from 71 woody species in 39 genera distributed in 24 plant families.

During their entire 21-year investigation of larval hosts of Cerambycidae in six different subfamilies, Dr. Maier and his assistants have reared 3,746 adults from the wood of trees and shrubs. These specimens represented 97 species or approximately one-half of the species known from Connecticut. The rearing project established 361 host associations, including 195 (54% of total) new ones. Based upon the number of new hosts discovered, Dr. Maier concluded that the host range of larvae of northeastern longhorned beetles is poorly known.

Over the past 12 years, Dr. Maier and his assistants have developed a database on Cerambycidae in Connecticut. This database now has over 19,000 entries, representing more than 25,000 specimens of longhorned beetles encountered during their studies or housed in museums. Biological information compiled in this database includes plant hosts of larvae, floral hosts of adults, activity periods of adults, distribution of species, and methods of sampling. These data should assist in developing management plans for destructive species of longhorned beetles and possibly for species of conservation concern. The ultimate goal of their long-term project is to produce an annotated checklist of the longhorned beetles of Connecticut.



Urgleptes querci, a small beetle that infests at least 26 plants. (Photo courtesy of M. Thomas)

NURSERY AND PLANT INSPECTION ACTIVITIES

Plant inspection and regulatory services are coordinated and conducted through the Office of the State Entomologist, whose members are State Entomologist Dr. Kirby Stafford, Deputy State Entomologist Dr. Victoria Smith, Plant Inspectors Jeffrey Fengler and Tia Blevins, Apiary Inspector Mark Creighton, and State Survey Coordinator Katherine Dugas.

Nursery Inspection and Certification. Two hundred one nurseries were certified to conduct intra- and interstate business. There were 178 nursery inspections during the growing season.

Nursery Insects and Diseases. The most important pests found in nurseries (in order of prevalence) were aphids on various trees and shrubs, thrips, red headed flea beetle, gypsy moth caterpillar, fall webworm, viburnum leaf beetle, dogwood sawflies, and imported willow leaf beetle. The most important diseases found in nurseries (in order of prevalence) were various powdery mildews, cedar apple rust, *Miscanthus* blight, and various rusts on perennials. Boxwood blight was detected at seven production nurseries.

Nursery Dealer Permits. Nursery dealer permits were issued to 92 firms.

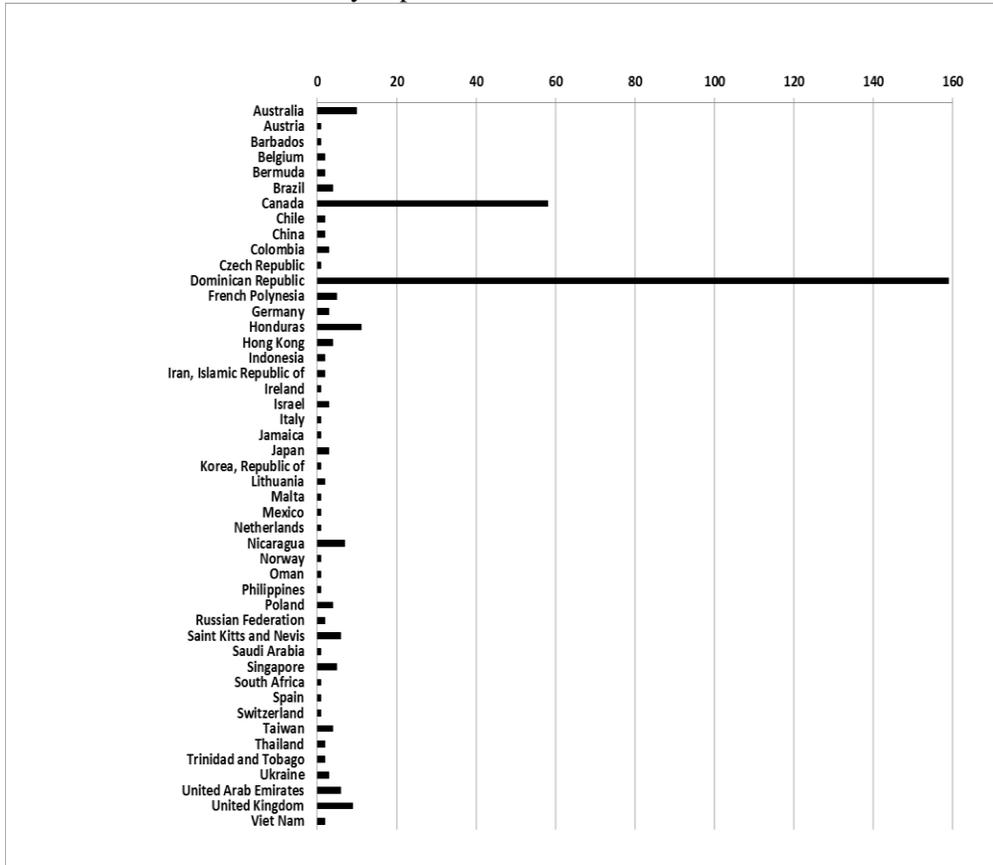
Phytosanitary Certificates. Three hundred forty-six phytosanitary inspection certificates were issued covering the shipment of the following plant materials to 47 destinations outside the United States. One hundred fifty-nine consignments were bound for the Dominican Republic (tobacco), 58 to Canada (ornamental plants), 11 to Honduras (tobacco), and 10 to Australia (ground products).

<u>Product</u>	<u>Quantity</u>
Apple fruit (cartons)	3,000
Apricot shells (ground, drums)	8
Apricot shells (ground, pounds)	2
Apricot/vegetable ivory, mixed (ground, bags)	18
Apricot/vegetable ivory, mixed (ground, drums)	27
Ash bark and wood shavings (package)	1
Buckeyes (box)	1
Bulbs & Tubers (<i>Dahlia</i> & <i>Gladiolas</i>) (bags)	216
Bulbs & Tubers (<i>Dahlia</i> & <i>Gladiolas</i>) (kilos)	7
Chinese Tree Peony (plants)	36
Corn cobs (ground, pounds)	1,000
Greenhouse plants	102
Nursery stock	
Plants (containers)	25,989
Orchids (plants)	2,404
Perennials	
Bare root plants	77
Cuttings	1,164
Seeds (bags)	568
Seeds (cartons)	1
Seeds (kilos)	34
Tobacco	
Bales	102,376
Bundles	48,842
Cartons	2,032
Pounds	1,161
Vegetable ivory (ground, drums)	20
Walnut shells (ground, bags)	22
Walnut shells (ground, drums)	592
Walnut shells (ground, kilograms)	165
Walnut shells (ground, pounds)	200

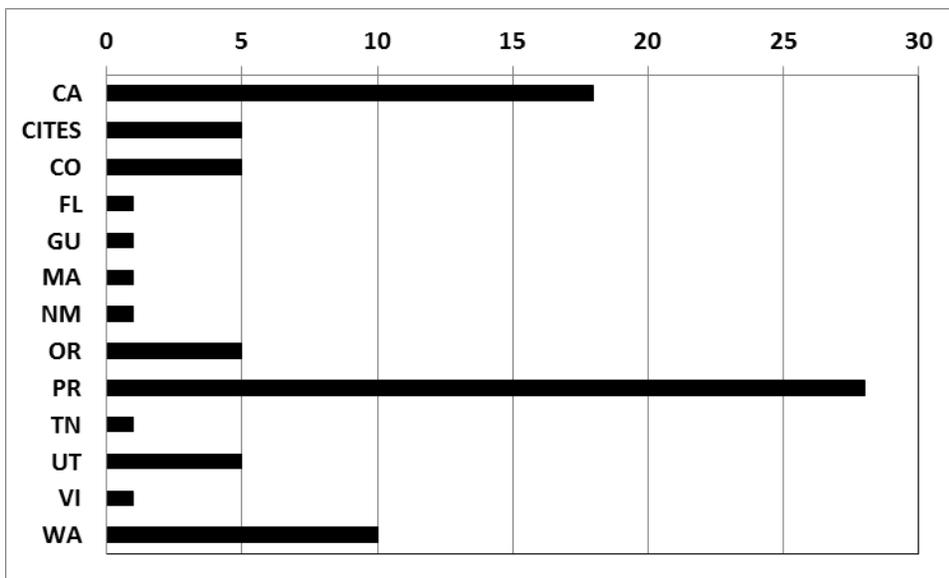
Eighty-two inspections were made to assist nurseries moving the following plants interstate, either to destinations in other states or to US Territories and Puerto Rico (13 listed destinations). Twenty-eight consignments were bound for Puerto Rico, 18 to California, and 10 to Washington.

<u>Product</u>	<u>Quantity</u>
Cuttings	100
Nursery stock (containers)	810
(bare root plants)	1,077
Greenhouse plants	1,304
Orchids (plants)	407
Seed (bags)	88

Destinations for out of country exports from CT are as follows.



Destinations for out of state export from CT, including US Territories and Puerto Rico.



Special Inspections. One inspection was conducted for 3 individual plants to assist a homeowner moving out of state.

Permits to move live plant pests, noxious weeds, and soil. In 2018, there were sixty-nine PPQ 526 Permits (Permit to move live plant pests, noxious weeds, and soil) approved in CT. There were two Controlled Import Permits issued. There were two Permits to Receive Soil issued. There was one Post Entry Quarantine permit issued.

Boxwood Blight compliance agreements for shipment to Pennsylvania. Four nurseries met requirements for shipment of boxwood nursery stock to Pennsylvania.

Hemlock Woolly Adelgid and Elongate Hemlock Scale. These pests have been present in CT for many years, and continue to cause patchy damage and decline among the remaining population of hemlocks. Statewide in 2018, 2,841 acres were affected by HWA, and 79 acres were affected by EHS. Scale insects, such as elongate hemlock scale and circular scale, are increasing in some areas, and may be more of a factor in tree damage and mortality than HWA.

Tornado Damage. A tornado outbreak on the afternoon of May 15, 2018 caused considerable damage in New Haven and Litchfield counties. About 2,000 acres of residential, state park, and town park areas were flattened by storm winds. In total, 3,280 acres were affected by tornado or wind damage statewide.

Emerald Ash Borer. Emerald ash borer has been detected in all eight counties; the quarantine for this insect was extended statewide to encompass all of Connecticut. Detections and outreach efforts included monitoring of *Cerceris* colonies; trapping was suspended when the state became fully quarantined. During aerial survey, we mapped 19,915 acres defoliated by EAB, and expect acreage and mortality to increase in the coming years.

Southern Pine Beetle. This insect was recently detected in CT, and damage estimates are still in the preliminary stage. The infestation appears to be widespread, however.

Cynipid Gall Wasp. Cynipid gall wasp was detected on the Bluff Point Coastal Reserve in New London County and adjoining areas in the town of Stonington in late 2014. The infestation has not been delimited.

White Pine Needle Decline. We recorded 105 acres affected by white pine needle decline.

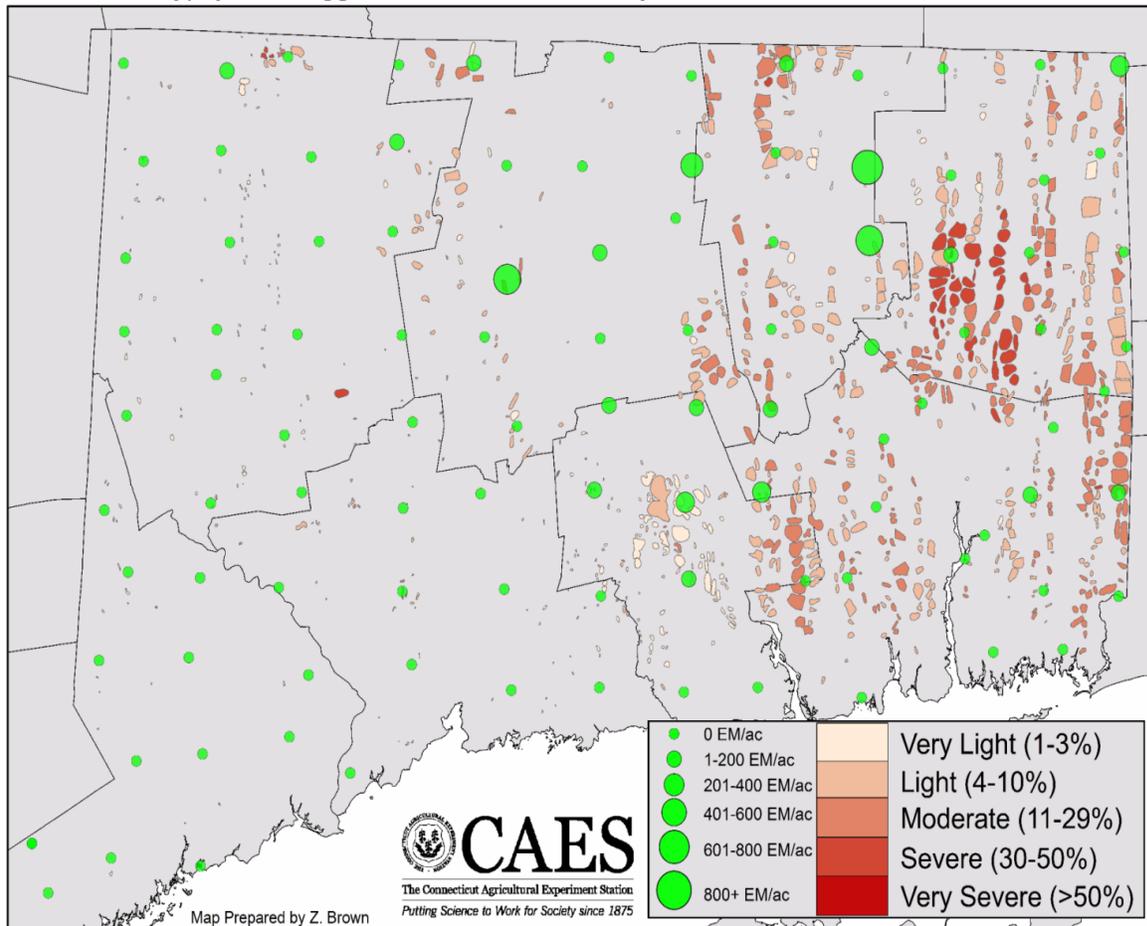
Apiary Inspection. In 2018, Connecticut had over 642 registered beekeepers maintaining over 5,000 hives. During the 2018 season, one thousand two hundred fifty-seven hives were inspected at 233 apiaries. Unofficial estimates indicate that over 5,400 packages of honey bees were imported into Connecticut for new beekeepers and to replace losses. Varroa mite infestation and the viral complex associated with varroa mite infestation was the primary reason for colony mortality. Connecticut beekeepers continue to lose colonies over winter in high numbers. The Bee Informed Annual Loss report for CT in 2018 was 64.98%, an 11.09% increase from 2017; the winter loss was 54.29%; the summer loss was 21.9%. An educational program, Biology and Management of the Varroa mite in the Honey Bee, will be presented to CT beekeepers this year in an attempt to increase honey bee survivability. Despite these challenges, beekeeping interest is still strong with over 457 new beekeepers being trained earlier this year. Six certificates were issued for export of honey bees out of Connecticut and over one hundred and twenty certificates for interstate movement of honey bees.

Forest Survey Plots. During summer 2015, we established 40 permanent forest plots on state, Nature Conservancy, and municipal water company properties. In this short-term (5 year) survey, we will examine the death/replacement of trees due to Emerald ash borer. Within each plot, 20 trees were tagged and will be

evaluated for signs of EAB infestation, including branch and tip dieback, woodpecker activity, and bark loss. We will measure the trees at Diameter at Breast Height (DBH) as a way to monitor their health. Plots were established in all counties of CT. Many of the ash trees in the plots are already dead, and most of the others are declining, due to EAB. In general, the forests are suffering from successive years of drought stress and gypsy moth defoliation, and are under threat due to development pressure, and ash mortality due to Emerald ash borer infestation is increasing.

Gypsy Moth. Damage due to gypsy moth defoliation was severe in 2017, with 1,175,000 acres defoliated. However, the fungus, *Entomophaga maimaiga*, which usually keeps gypsy moth larvae in check “kicked in” later in the spring and early summer, resulting in death of larvae and reduced adult populations. In 2018, we recorded 287,013 acres of defoliation, primarily in the eastern half of the state. Approximately 10% of these acres, or about 28,000, were dead, due to successive years of defoliation and drought stress. In December 2018 through March 2019, a gypsy moth egg mass survey was conducted in 80-95% favorable host sites on a 7-mile grid (102 sites) throughout Connecticut. Egg mass counts were low in most locations, indicating a low potential for a severe outbreak in 2019. The fungus also hit the caterpillars in June 2019, largely bringing the multi-year outbreak of the gypsy moth to an end.

2018-2019 Gypsy Moth Egg Mass 7-Mile Grid Survey Results



Aerial survey map of Connecticut showing areas defoliated by the gypsy moth in 2018 (287,013 acres) overlaid with the results of the 2018-2019 CAES egg mass 7-mile grid ground survey.

DEPARTMENT OF ENVIRONMENTAL SCIENCES

Environmental Chemistry

(Dr. Joseph Pignatello and Dr. Sara Nason)

The Environmental Chemistry program has been involved in research topics dealing with the interactions of pollutants with environmental particles, the bioavailability of pollutants in environmental solids, pollution prevention and remediation, chemicals in reclaimed wastewater reused for agricultural irrigation, and natural chemical processes in the environment. It covers many types of pollutants, including industrial solvents and chemicals, fumigants, insecticides, herbicides, pharmaceutical compounds, personal care products, perfluorinated alkyl substances, engineered nanomaterials, and greenhouse gases.

A. Interactions of Contaminants with Environmental Particles

1. Effects of air oxidation during and after pyrolysis on the chemical and physical structures of biomass chars and their adsorptive properties towards organic compounds.

(Joseph Pignatello, Feng Xiao, and collaborators from Brandeis University, University of North Dakota, and Old Dominion University)

Biomass chars are deposited in soil from wild fires and controlled outdoor burning activities such as land clearing and crop residue burning. Chars intentionally made from biomass waste, known as biochars, have found uses in agriculture and soil remediation. The surface chemistry and pore characteristics of chars essential to their functions are affected by the biomass precursor materials and, more importantly, the conditions (temperature–time heating profile) under which they are formed, produced, or weathered. Oxygen is present during formation of natural chars but usually absent during pyrolysis of biomass materials to make biochar. The underlying chemical changes induced by the concentration of oxygen present during pyrolysis are not well understood. Solid-state nuclear magnetic resonance (NMR) spectroscopy was used to characterize the chemical changes induced by including air during pyrolysis. Post-pyrolysis air oxidation (PPAO) was applied to anoxically-prepared maple wood and pecan shell chars at PPAO temperatures ranging from 300 to 600 °C for up to 40 min. The ¹³C NMR spectra showed that PPAO treatment introduces oxygen functional group into aromatic rings, primarily C-O and C=O, but also carboxyl groups (COO) identified after spectral editing. The concentration of COO was relatively low (<3% of all C), consistent with potentiometric titration, and reached a discernable maximum at 300 °C. The COO enhancement from PPAO was lower than that observed after wet-chemical oxidation with HNO₃ or ammonium persulfate. Concentrations of the C-O and C=O groups reach a maximum at PPAO temperatures between 350 and 400 °C and increase with PPAO time. Insight into the types and concentrations of oxygen functional groups induced by exposure of biomass chars to hot air has implications for an understanding of the interaction of char with nutrients, natural organic matter, pollutants, and microbes, as well as electron transfer processes in soil. This work is reported by Cao et al., 2019, in *Carbon*.

PPAO treatment of chars is accompanied by substantial changes in the surface area and pore size distribution. After PPAO chars made anoxically at 600 and 700 °C showed significant increases in surface area (up to 700 times), porosity below 6 nm (up to 95 times), and adsorption of neutral organic compounds, including two triazine herbicides and one natural estrogen (up to 120 times). Partially carbonized char made at lower temperatures (300 or 400 °C) showed moderate increases in these properties after PPAO. Chars produced by including air in the carbonization step had low surface area and underdeveloped pore structure. Adsorption of the test organic compounds on BC generally trended with surface area when it was less than 300 m²/g, but was poorly predictive of adsorption when it was greater than 300 m²/g. Overall, the results indicate that thermal reactions between molecular oxygen and char, a) increase surface oxygen functional group content, although more effectively for low-temperature than for high-temperature char samples; b) increase surface area and porosity (below 6 nm), especially for high-temperature char samples; and c) create

new adsorption sites and/or relieve steric restriction of organic molecules to micropores, thereby increasing the adsorptivity of char. These results will prove useful for understanding the fate of chars in the environment and also for improving the performance of engineered chars (i.e., biochar). This work is reported by Xiao et al., 2018, in *Science of the Total Environment*.

B. Pollution Characterization, Prevention, and Remediation

1. Oxidation of amino acids in water by peroxymonosulfate without activation.

(Joseph J. Pignatello, Yi Yang, and collaborators from the University of Wisconsin, Madison)

Peroxymonosulfate (HSO_5^- , PMS) is an optional bulk oxidant used in advanced oxidation processes (AOPs) for treating water contaminated with organic compounds. Normally, PMS is activated by the input of energy (heat or light) or reducing agents to generate sulfate and/or hydroxyl radicals, which are highly reactive towards most organic compounds. We reported in the previous Record of the Year, however, that PMS reacts directly without explicit activation with a variety of organic compounds. Contaminated water can also contain peptidic and proteinaceous toxins. Peroxymonosulfate may thus hold promise for deactivation of proteinaceous contaminants. We studied the oxidation of 19 of the 20 standard proteinogenic amino acids (all except cysteine) by PMS alone without explicit activation. Reaction half-lives at pH 7 ranged from milliseconds to hours. Amino acids possessing sulfur-containing, heteroaromatic, or substituted aromatic side chains were the most susceptible to oxidation by PMS, with rates decreasing in the order methionine > tryptophan > tyrosine > histidine. The rate of tryptophan oxidation did not decrease in the presence of an aquatic natural organic matter. Singlet oxygen resulting from peroxymonosulfate self-decomposition, while detected by electron paramagnetic resonance spectroscopy, was unlikely to be the principal reactive species. Our results demonstrate that peroxymonosulfate is capable of oxidizing amino acids without explicit activation, and that methionine and tryptophan are likely initial targets of oxidation in peptides and proteins.

2. Design of carbonaceous catalysts for environmental remediation.

(Joseph Pignatello, Zhengyang Wang, Xiangyu Bi, Sara Nason, and other collaborators in China)

We have initiated projects on surface modification of carbonaceous materials such as chars and activated carbon for trapping or trapping and degrading environmental contaminants. Because such materials are inherently strong adsorbents, they serve to gather in and concentrate contaminants out of water or soil making at reactive sites. For example, we have modified carbons to increase their anion exchange capacity. The AEC-modified carbons bind phosphate, perfluorinated carboxylic and sulfonic acids, and nitrate, all of which are anionic at ordinary pH, much more strongly than the unmodified counterparts. Other carbons have been modified to bind reagents that chemically react with adsorbed contaminants, thereby accelerating contaminant degradation. We have prepared novel carbons that contain N and O atoms incorporated into their structures. These carbons greatly accelerate the oxidation of organic compounds by a peroxide (peroxymonosulfate), without the need for light, heat, or transition metal co-catalysts.

3. Phytoremediation of PFAS at the former Loring Air Force Base

(Sara Nason, Nubia Zuverza-Mena, and collaborators)

The use of Aqueous Film-Forming Foams (AFFFs) has caused widespread contamination with per- and polyfluoroalkyl substances (PFAS) in areas that have been used for fire-fighter training. Such is the case at the Burn House site of the former Loring Air Force Base in northern Maine, USA (pictured), where the land now belongs to the Aroostook band of the Micmac nation. PFAS are have been dubbed “forever chemicals” as they are extremely persistent in the environment, and exposure to PFAS has been linked to cancer and other diseases.



A group of concerned citizens is attempting phytoremediation at the Burn House site in an attempt to reduce the contamination levels, and we are assisting them with assessing the effectiveness of their efforts. We are developing methods to evaluate levels of AFFF related PFAS in soil and plant tissue using liquid chromatography coupled with quadrupole-orbitrap mass spectrometry. This tandem, high resolution mass spectrometry method has the advantage that we can both screen for a wide range of compounds and develop sensitive quantification methods for a more limited number of contaminants. Our preliminary results tentatively identified 41 PFAS in soil from the Burn House site, including both cationic and anionic compounds.

4. Assessing the impacts of reclaimed wastewater reuse for agricultural irrigation (Sara Nason and collaborators)

Water scarcity is a problem throughout the modern world and is expected to increase as human population expands and climate change intensifies. Wastewater reuse for agricultural irrigation is an important strategy to reduce demand from surface and ground water sources and is gaining momentum as obtaining freshwater from other sources becomes more difficult. While an important strategy for combating water scarcity, wastewater reuse for agriculture is not without risks. Wastewater can contain higher levels of bacteria, heavy metals, salts, and other contaminants than conventional water sources. Specifically, there is increasing concern over organic microcontaminants (OMCs) such as pharmaceuticals, pesticides, and endocrine disrupting compounds that may be taken up into irrigated crop plants. Designing methods to detect new and emerging OMCs will be increasingly important as water recycling continues to expand.

High Resolution Mass Spectrometry (HRMS), often coupled with liquid chromatography, is an emerging technology that can be used to detect OMCs in water, soil, and food crops without a predetermined list of analytes or extensive use of chemical standards. HRMS data can be used for suspect screening, which searches databases of past measurements to find matches for chemicals present in new samples, and for non-targeted analysis (NTA) which identifies features in the data without necessarily matching them to known chemicals. The USFDA and USEPA do not yet have standardized methods for suspect screening and NTA, but use of these types of data analysis could greatly improve recognition of new and unexpected OMCs in food and in the environment.

We are working to develop sample preparation, instrumental analysis, and data analysis methods that will allow us to conduct NTA on reclaimed wastewater, soil, and plant samples. This will allow us to conduct future experiments on identifying OMCs that plants take up from contaminated soil and irrigation water. Additionally, we have developed a relationship with the Greater New Haven Water Pollution Control Authority (treatment plant pictured), who has agreed to supply effluent water for use in our projects. We anticipate growing plants and beginning sample analysis within the next year.



C. Chemistry of the Environment

1. Charge-assisted hydrogen bonding as a cohesive force in soil organic matter. (Joseph Pignatello and Jinzhi Ni)

Naturally-occurring organic matter (OM) is a heterogeneous mixture of molecules derived from the degradation of lignin, cellulose, lipids, proteins and other biological polymers. These molecules have different masses, charges, properties, and reactivities. Because OM is ubiquitous in aquatic and terrestrial systems, it plays critical roles in the biogeochemical cycling of carbon, carbon storage, the physical and chemical properties of soil, soil microbial activity, soil structure, mineral weathering, nutrient availability to plants, and the fate and transport of anthropogenic compounds. Solid and adsorbed forms of OM (“SOM”) strongly influence soil formation and structure, biological activity, mineral dissolution, metal-ion sequestration, redox reactions, and pH buffering, which are all related to soil health.

Weak bonds between molecular segments and between separate molecules of natural organic matter (OM) govern its solubility, adsorption, supramolecular association in solution, and complexation with metal ions and oxides. We tested the hypothesis that especially strong hydrogen bonds, known as (negative) charge-assisted hydrogen bonds, (-)CAHB, contribute significantly to OM cohesion. The (-)CAHB is exemplified by structures such as $(-\text{CO}_2\cdots\text{H}\cdots\text{O}_2\text{C}-)^-$ and $(-\text{CO}_2\cdots\text{H}\cdots\text{O}-)^-$. It may form between weak acids with similar proton affinity, and is shorter, more covalent, and much stronger than ordinary hydrogen bonds. Using a high-organic reference soil, we show that (-)CAHBs within the solid OM phase (intra-OM) are disrupted by solutions of simple aliphatic and aromatic acids, resulting in increased solubility of OM. The aromatic acids included naturally occurring plant exudate compounds. At constant pH and ionic strength, OM solubility increased with added organic acid concentration and molecular weight. Polar compounds incapable of forming (-)CAHBs, such as alkanols, acetonitrile, and dimethyl sulfoxide, were ineffective. Solubility enhancement showed behavior consistent with (-)CAHB theory and previous experiments—namely, *i*) that formate is more effective than acetate due to its tendency to form stronger (-)CAHBs; *ii*) that solubility enhancement peaks at pH ~5-6, where the product of the concentrations of reactive pairs (carboxylic acid, carboxylate ion) reaches a maximum; and *iii*) that elution of acetate or formate through soil columns releases hydroxide ion, consistent with formation of (-)CAHBs between added acid and free weak acid groups on the solid OM. The results support the hypothesis that the (-)CAHB contributes to the cohesion of OM in the solid state. This work is reported by Pignatello and Ni, 2018, in *Environ. Sci.: Processes and Impacts*.

Mosquito Program

A. Mosquito Trapping and Testing Program

(Philip M. Armstrong, John Shepard, Tanya Petruff, Michael Misencik, Angela Bransfield)

Mosquito-borne viral diseases constitute an annual threat to human health in Connecticut. A comprehensive surveillance program complemented by science-based controls and timely public outreach are the most effective ways of protecting the public and reducing the risk of human disease. Experiment Station scientists and technicians monitor mosquitoes and eastern equine encephalitis (EEE) and West Nile virus (WNV) activity at 91 locations throughout Connecticut from June-October. The objectives of the surveillance program are to provide: 1) early evidence of local virus activity; 2) information on the abundance, distribution, identity and infection rates of potential mosquito vectors and; 3) information that is used to assess the threat of WN virus and EEE to



warn the public and guide the implementation of disease prevention and control measures. The CAES is responsible for conducting all mosquito trapping and testing activities.



In 2018, statewide mosquito trapping was conducted from June 4 through October 18. Approximately one-third of the sites were located in densely populated residential locales along an urban/suburban corridor in the coastal southwestern corner of the state extending up through the Connecticut River Valley. Trap sites typically included parks, greenways, golf courses, undeveloped wood lots, sewage treatment plants, dumping stations, and temporary wetlands associated with waterways. Trapping locations in the other regions of the state were established in more sparsely populated rural settings that included permanent fresh-water swamps (red maple/white cedar) and bogs, coastal salt marshes, horse stables, and swamp-forest border environs.

Mosquito trapping was conducted with CO₂ (dry ice)-baited CDC miniature light traps equipped with aluminum domes, and gravid mosquito traps baited with a lactalbumin-yeast-hay infusion. Traps were placed in the field in the afternoon, operated overnight, and retrieved the following morning. Trapping frequency was minimally made once every ten days at each trap site over the course of the entire season. Adult mosquitoes were transported alive to the laboratory each morning in an ice chest lined with cool packs. Mosquitoes were immobilized with dry ice and transferred to chill tables where they were identified to species with the aid of a stereo microscope (90X) based on morphological characters. Female mosquitoes were pooled in groups of 50 or fewer by species, collection date, trap type, and collection site and stored at -80°C until processed for virus.

Aliquots of each mosquito pool were inoculated into Vero cell cultures for detection of West Nile virus (WNV), eastern equine encephalitis (EEE), and other mosquito-borne arboviruses of public health importance. Isolated viruses were identified by Real Time (TaqMan) reverse transcriptase polymerase chain reaction (RT-PCR) or standard RT-PCR using virus-specific primers. All of the virus isolation work was conducted in a certified Bio-Safety Level 3 laboratory at the CAES.



During 2018, new high records were set for the number of mosquitoes collected, pools tested, WNV isolations made, as well as the number of locations and towns with WNV activity. Additionally, a record number of human WNV infections were reported that year. A total of 334,369 (20,196 pools), represented by 46 species, were trapped and tested for arboviruses. A total of 393 isolations of WNV were made from 13 species: *Culex pipiens* = 242, *Cx. restuans* = 70, *Culiseta melanura* = 34, *Cx. salinarius* = 24, *Aedes cinereus* = 6, *Ochlerotatus canadensis* = 5, *Coquillettidia perturbans* = 4, *Oc. japonicus* = 3, *Ae. albopictus* = 1, *Anopheles punctipennis* = 1, *Oc. taeniorhynchus* = 1, *Oc. triseriatus* = 1, and *Psorophora ferox* = 1, collected from 65 locations in 53 towns in six counties (Fairfield, Hartford, Middlesex, New Haven, New London, and Windham). The first WNV-positive mosquitoes were collected on June 18 and last on October 10. The majority of WNV activity was detected in densely populated urban and suburban regions in Fairfield, Hartford, and New Haven Counties. Twenty-three human cases of WNV-associated illness, 22 which were locally acquired (encephalitis/meningitis n=18, WNV fever = 5) were reported, with one fatality. Human WNV cases were reported in 19 towns in 5 counties (Fairfield, Hartford, Middlesex, New Haven, and Windham). Dates of onset of symptoms were from July 28 to October 22. The median age for WNV human infections was 69 (range = 8-83). Human cases were temporally and spatially consistent with WNV isolations from mosquito pools, except for a human infection reported in Thompson. Additionally, two horse cases of WNV infection were reported in Fairfield and Hartford Counties, with respective dates of onset on August 20 and August 28. There were six isolates of Eastern Equine Encephalitis virus (EEEV) made from two species: *Cs. melanura* = 4, and *Ae. cinereus* = 2, collected from 5 sites in 4 towns in 2 counties (New London and Windham). There was no EEEV activity reported from humans or horses. However, EEEV was diagnosed following the necropsy of a bald eagle, which died in Middlesex County with a date of onset of October 4. Other mosquito-borne viruses isolated included: Jamestown Canyon virus (JCV) = 48 isolates from 13 species (June 4 – August 22), La Crosse encephalitis virus = 2 isolates from 1 species (August 8 – September 13), and Flanders virus = 1 isolate from 1 species (July 18). One human case of JCV infection (meningitis) was reported with date of onset on September 4.

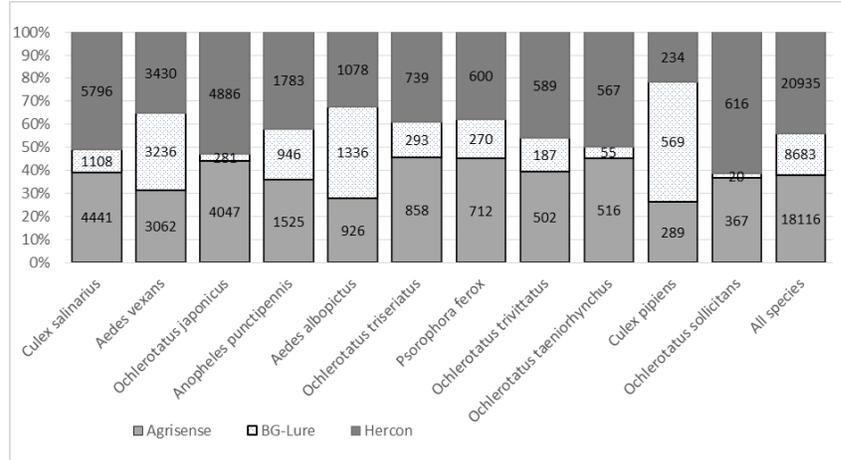
Impact: Participation in the statewide surveillance program provides timely information about levels of virus activity in the mosquito population which is used to monitor virus amplification within enzootic transmission cycles, and assess risk of human infection. This information is used to inform the public and health care providers of these risks, guide disease prevention and mosquito control efforts, and prevent disease outbreaks. In addition, this large-scale sampling effort also informs our understanding of the ecology of mosquitoes and mosquito-borne viruses. Additional studies on the role of different mosquito species to serve as vectors of viral pathogens may be used to target anti-vector interventions more effectively.

B. Population Genetics of Mosquitoes and Epidemiology of Mosquito-borne Viral Diseases

1. Evaluation of novel trapping lures for monitoring invasive *Aedes* spp. [Diptera: Culicidae] mosquitoes (Gillian Eastwood, Philip M. Armstrong, Theodore G. Andreadis, John J. Shepard, and Michael Misencik)

Multiple invasive mosquitoes pose a threat to human and animal health, including *Aedes albopictus* (Skuse) and *Aedes japonicus* (Theobald), with an ability to transmit arboviruses of concern. In addition, native container-breeding *Aedes* species, such as *Aedes triseriatus* (Coquillett), transmit agents such as La Crosse virus (LACV), negatively impacting human health. Monitoring activities for mosquito and arbovirus prevalence typically rely on a few trap types - CO₂-baited CDC-light traps, gravid traps and BG-Sentinel traps; however, these trap configurations may under-sample key mosquito vectors, and more effective tools are needed. During 2018, we tested new scent lures using BG-Sentinel traps with CO₂ in two regions of Connecticut (Stamford and Hamden), with the BG-Lure as a control. We assessed both their ability to attract target container-breeding *Aedes* species, and the overall species catch diversity. Pooled mosquitoes were

screened for arbovirus infection. A total of 47,734 mosquitoes representing 8 genera and 32 species were captured during the study, with the Stamford site deriving on average three times as many mosquitoes per trap, adjusting for effort. Fifty-seven isolates of virus (WNV, Jamestown Canyon virus, LACV) were obtained during the study, with no significant difference between trap-lure. Bedoukian Lure-A and Lure-H outperformed the BG-Lure in terms of overall numbers, diversity evenness, and the proportion of both *Ae. japonicus* and *Ae. triseriatus*. There were no significant differences among lures in capturing *Ae. albopictus*, and in terms of species richness. We highlight both novel lures as effective potential attractants for use in combination with CO₂ in mosquito surveillance.



Impact: This study shows that two novel chemical lures work effectively in BG-Sentinel traps to capture key *Aedes* spp. disease vectors. The performance of these lures generally surpasses that of the gold-standard BG-Lure in terms of diversity and numbers caught. These products should deliver more efficient mosquito monitoring for surveillance and control programs.

2. Seasonal temperatures and hydrological conditions improve the prediction of West Nile virus infection rates in *Culex* mosquitoes and human case counts in New York and Connecticut

(Philip M. Armstrong and Theodore G. Andreadis in collaboration with Alexander C. Keyel, Oliver Elison Timm, P. Bryon Backenson, Catharine Prussing, Sarah Quinones, Kathleen A. McDonough, Mathias Vuille, Jan E. Conn, and Laura D. Kramer)

West Nile virus (WNV; Flaviviridae: Flavivirus) is a widely distributed arthropod-borne virus that has negatively affected human health and animal populations. WNV infection rates of mosquitoes and human cases have been shown to be correlated with climate. However, previous studies have been conducted at a variety of spatial and temporal scales, and the scale-dependence of these relationships has been understudied. We tested the hypothesis that climate variables are important to understand these relationships at all spatial scales. We analyzed the influence of climate on WNV infection rate of mosquitoes and number of human cases in New York and Connecticut using Random Forests, a machine learning technique. During model development, 66 climate-related variables based on temperature, precipitation, and soil moisture were tested for predictive skill. We also included 20–21 non-climatic variables to account for known environmental effects (e.g., land cover and human population), surveillance related information (e.g., relative mosquito abundance), and to assess the potential explanatory power of other relevant factors (e.g., presence of wastewater treatment plants). Random forest models were used to identify the most important climate variables for explaining spatial-temporal variation in mosquito infection rates (abbreviated as MLE). The results of the cross-validation support our hypothesis that climate variables improve the predictive skill for MLE at county- and trap-scales and for human cases at the county-scale. Of the climate-related variables selected, mean minimum temperature from July–September was selected in all analyses, and soil moisture was selected for the mosquito county-scale analysis. Models demonstrated predictive skill, but still over- and underestimated WNV MLE and numbers of human cases. Models at fine spatial scales had lower absolute errors but had greater errors relative to the mean infection rates.

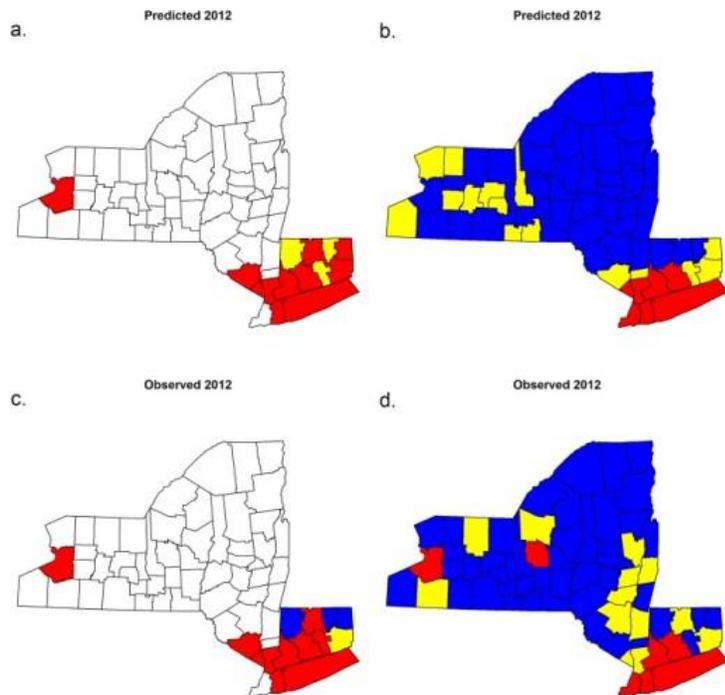


Figure. Predicted and observed WNV mosquito infection rates (panels a, c) and human cases (b, d) for 2012, a particularly widespread WNV year. For mosquito infection rates, blue corresponds to MLE < 1 mosquito per 1000, yellow corresponds to MLE 1–5 per 1000, and red to MLE > 5 per 1000. White indicates excluded counties for which we did not have mosquito surveillance data. For human cases (b, d), blue indicates no human cases, yellow indicates 1–5 cases, and red indicates more than 5 cases.

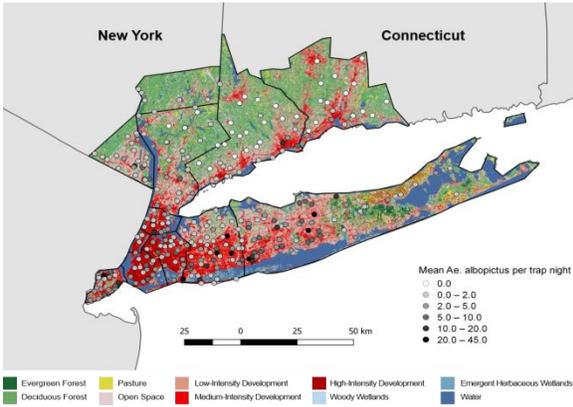
Impact: This study helps us understand the relationship of climate and landscape variables to WNV activity and human disease risk. Such information can be used to improve predictive models and understand the dynamics of WNV.

3. Environmental determinants of *Aedes albopictus* abundance at a northern limit of its range in the United States

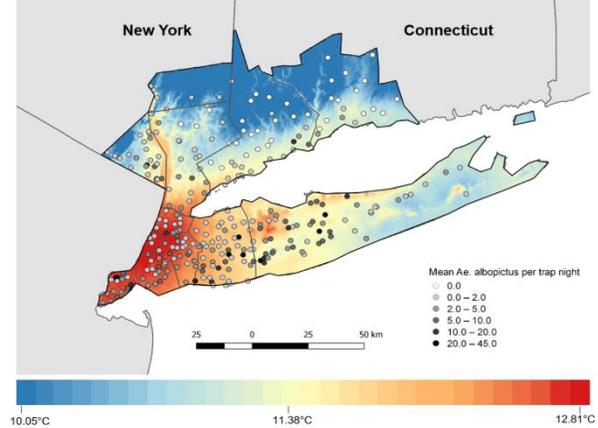
(Gillian Eastwood, Philip M. Armstrong, and Theodore G. Andreadis in collaboration with Pallavi A. Kache, Kaitlin Collins-Palmer, Marly Katz, Richard Falco, and Maria Diuk-Wasser)

Aedes albopictus is a vector of arboviruses associated with high rates of morbidity and mortality. The northern limit of *Ae. albopictus* in the northeastern United States runs through the southern New York State and Connecticut. We present a landscape-level analysis of mosquito abundance measured by daily counts of *Ae. albopictus* across 338 trap sites in 12 counties during May–September 2017. During the study period, the number of *Ae. albopictus* caught per night of trapping ranged from zero to 194 across all sites, with a mean of 3.21 mosquitoes per night of trapping. We constructed four negative binomial model generalized linear models, evaluating trapping methodology, as well as land cover classification, road density, as well as temperature and precipitation at multiple time intervals on *Ae. albopictus* abundance. BG-Sentinel traps were 2.78 times more efficient than gravid traps and 1.49 times more efficient than CDC light traps (Model 1). Greater proportions of low- and medium-intensity development and low proportions of deciduous cover around the trap site were associated with higher abundance ($p < 0.01$) (Model 3). Increases in minimum winter temperature and March precipitation were significantly associated with increased abundance ($p < 0.01$). Additionally, the cumulative precipitation within a 28-day time window prior to date of collection had a strong non-linear relationship with abundance, such that as precipitation increased beyond 69.97 mm, there was an associated decrease in abundance (Model 4). Based on these findings, we recommend that mosquito surveillance and control programs conduct regular assessments of meteorological conditions and spatial land cover patterns when placing new traps and applying control measures against *Ae. albopictus*.

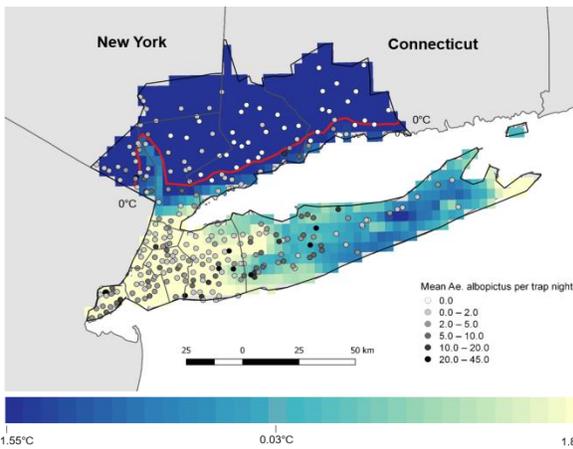
A. Trap sites in relation to land cover across study region ^a



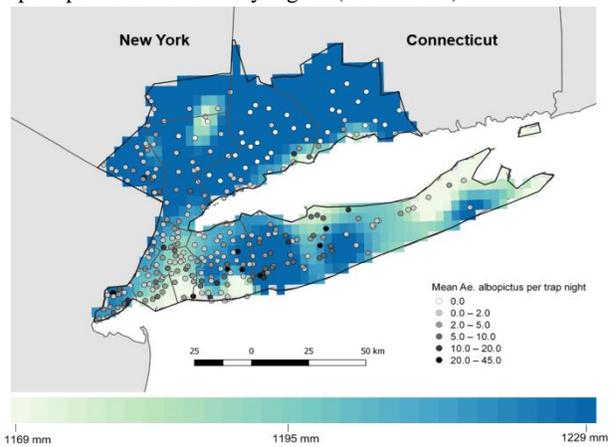
B. Trap sites in relation to mean annual temperature across study region (1981–2010) ^b



C. Trap sites in relation to mean winter temperature across study region (1981–2010) ^b



D. Trap sites in relation to mean cumulative annual precipitation across study region (1981–2010) ^b



Impact: This investigation reveals that landscape-level differences in temperature, precipitation, and land cover affect variation in *Ae. albopictus* abundance at the northern limit of the species distribution in NYS and CT. Overall, our findings can help guide decision-making for local mosquito control programs aiming to monitor and control the northward invasion of *Ae. albopictus*.

4. Vector-Host Interactions of the Asian Tiger Mosquito, *Aedes albopictus*, The Potential Vector of Zika and Other Arboviruses

(Dr. Olivia Harriott and Dr. Goudarz Molaei)

The Asian tiger mosquito, *Aedes albopictus*, garnered international attention in 2015 after the emergence and rapid spread of Zika virus in Brazil and other countries in Central and South America, the Caribbean, and in the state of Florida. This mosquito species has been expanding beyond its native boundaries in Africa and Asia into temperate zones in North America and Europe, heightening concern about possible human health implications. *Aedes albopictus* has been implicated in outbreaks of Dengue and Chikungunya viruses in several countries in Europe and Asia, prompting public health agencies in the United States to closely monitor local populations of this mosquito species. Connecticut is among 40 states where established populations of *Ae. albopictus* have been reported. As mosquito-borne disease agents are



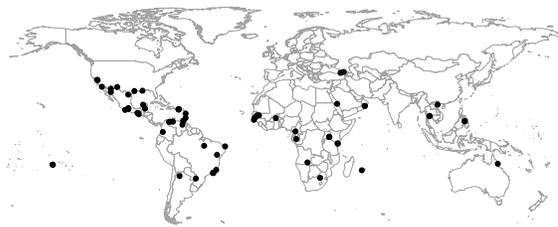
transmitted primarily during blood feeding, knowledge of vector feeding patterns and blood meal sources can aid in assessing the role of mosquitoes and their host species in disease transmission, maintenance, and amplification. We are investigating blood-feeding behavior of *Ae. albopictus* collected from mid-Atlantic regions of the U.S., using molecular methods. Of the blood meals analyzed to date, over 98% were from mammalian, and occasionally reptilian, hosts. These findings are consistent with reported feeding tendencies ascribed to this mosquito species.

Impact: Detailed knowledge of the vector-host interactions of mosquito populations in nature is essential for evaluating their vectorial capacity and for assessing the role of individual vertebrates as reservoir hosts involved in the maintenance and amplification of zoonotic agents of human diseases. Our study will clarify the host associations of *Ae. albopictus* in the mid-Atlantic region of the U.S., identify vector host preferences as the most important transmission parameter, and determine the risk of human infection with Zika and other arboviruses likely transmitted by this important mosquito species.

5. Global screen for *Wolbachia* in *Aedes aegypti* across the world

(Andrea Gloria-Soria in collaboration with Thomas Chiodo and Jeffrey R. Powell)

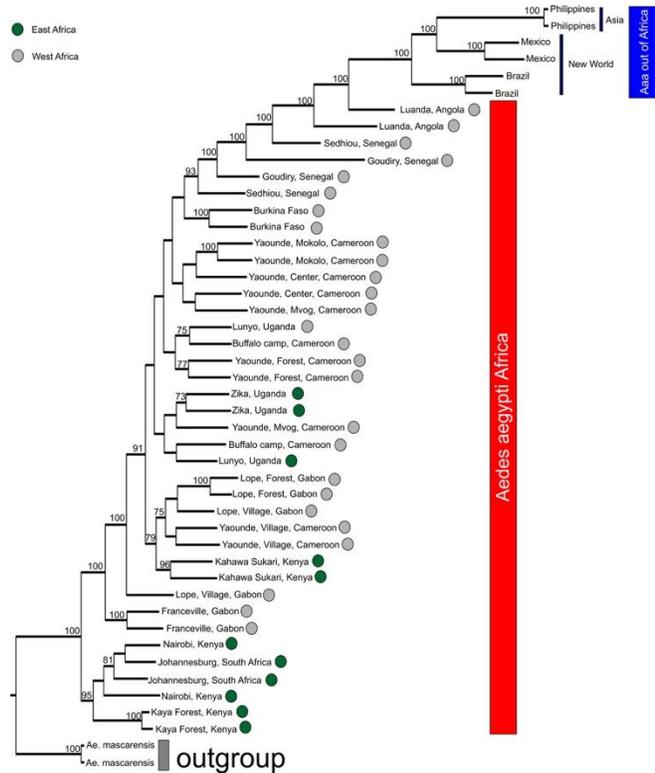
Wolbachia is a genus of endosymbiotic bacteria that infects 66% of all insect species. Its major impact on insects is in reproduction: sterility, production of one sex, and/or parthenogenesis. Another effect was discovered when the disease-transmitting mosquito, *Aedes aegypti* Linnaeus (Diptera: Culicidae), was infected with *Wolbachia* isolated from *Drosophila*: infected female mosquitoes became less capable of transmitting diseases such as dengue fever and chikungunya. This has led to releases of *Ae. aegypti* carrying *Wolbachia* in an attempt to control disease. An open question is whether there are natural *Wolbachia* infections of this mosquito. We assayed DNA from 2,663 *Ae. aegypti* from 27 countries on six continents, 230 from laboratory strains, and 72 *Aedes mascarensis* MacGregor (Diptera: Culicidae) for presence of *Wolbachia* DNA. Within the limits of our polymerase chain reaction-based assay, we found no evidence of *Wolbachia*, suggesting that natural infections of this endosymbiont are unlikely to occur throughout the worldwide distribution of *Ae. aegypti*. Had we found a *Wolbachia*-positive population of *Ae. aegypti*, it would have been interesting to explore whether the symbiotic relationship produced similar levels of refractoriness to transmission of pathogens in infected females and its impact on *Ae. aegypti* reproduction and life history traits. A naturally occurring vector-endosymbiont association, implying coadaptation, may have proved more stable than the artificial mosquito-*Drosophila* system currently being used for disease control. This work was published in Gloria-Soria et al., 2018, *J. Med. Entom.*



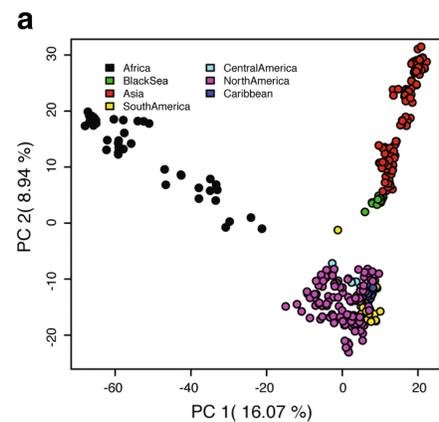
6. Global population genetics of *Aedes aegypti*

(Andrea Gloria-Soria in collaboration with Jeffrey R. Powell, Francis Schaffner, Vincent Robert, and Panagiota Kotsakiozi)

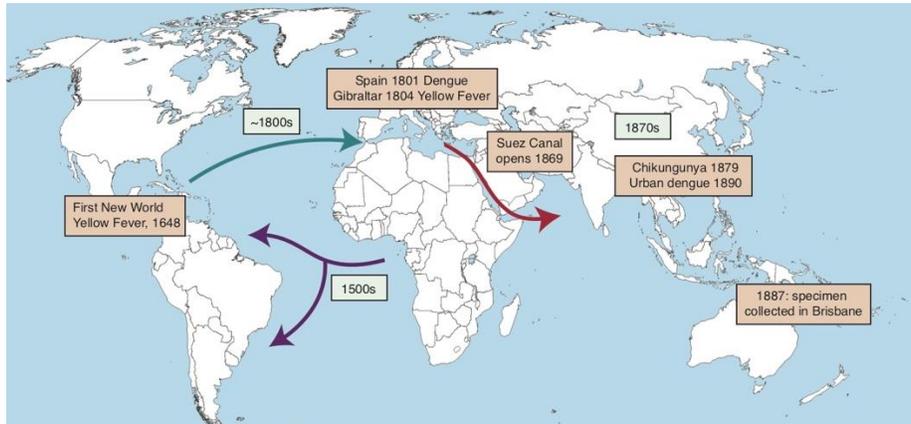
The yellow fever mosquito *Aedes aegypti* transmits viral diseases that have plagued humans for centuries. *Ae. aegypti* is the major vector of dengue, yellow fever, chikungunya, and Zika viruses, and remains of great medical and public health concern. Its ancestral home are forests of Africa and ~400–600 years ago it invaded the New World and later Europe and Asia, causing some of the largest epidemics in human history. However, little is known about the genetic structure and history of *Ae. aegypti* across Africa, as well as the possible origin(s) of the New World invasion. We used ~17,000 genome-wide single nucleotide polymorphisms (SNPs) to characterize a heretofore undocumented complex picture of this mosquito across its ancestral range in Africa. We found signatures of human-assisted migrations, connectivity across long distances in sylvan populations, and of local admixture between domestic and sylvan populations. Finally, through a phylogenetic analysis combined with the genetic structure analyses, we suggest West Africa and especially Angola as the source of the New World's invasion, a scenario that fits well with the historic record of 16th-century slave trade between Africa and Americas. The work is published in Kotsakiozi et al., 2018, *Ecol. Evol.*



Furthermore, *Ae. aegypti* was rarely detected in countries surrounding the Mediterranean Sea after the 1950s, but during the last 16 years it re-appeared in Madeira, Russia and in the eastern coast of the Black Sea. We genotyped *Ae. aegypti* populations from the Black Sea region at 12 microsatellite loci and ~19,000 genome-wide single nucleotide polymorphisms (SNPs) to investigate whether this is a recent invasion (and if so, where it came from) or a remnant of pre-eradication populations that extended across the Mediterranean. We also used the Black Sea populations together with a world reference panel of populations to shed more light into the phylogeographical history of this species. Our results confirmed that *Ae. aegypti* left Africa and arrived in the New World ~500 years ago. The lineage that returned to the Old World and gave rise to present day Asia and the Black Sea populations split from the New World approximately 100–150 years ago. Globally, the Black Sea population is genetically closer to Asia, but still highly differentiated from both New World and Asian populations. This evidence, combined with bottleneck signatures and divergence time estimates, support the hypothesis of present-day Black Sea populations being remnants of older populations, likely the now extinct Mediterranean populations that, consistent with the historic epidemiological record, likely represent the original return of *Ae. aegypti* to the Old World. The results are published in Kotsakiozi et al., 2018, *Parasites & Vectors*.



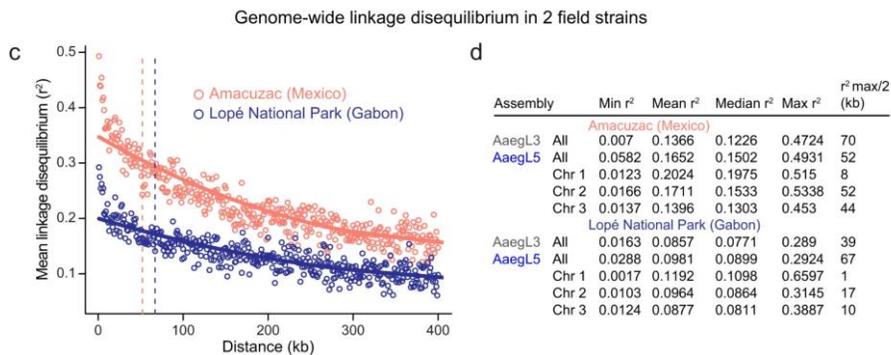
We have put together a review of all recent work on the population genetics of *Ae. aegypti* in efforts to reconstruct its recent (approximately 600 years) history and relate these findings to epidemiological records of occurrences of diseases transmitted by this species (Powell et al., 2018, *BioScience*). The two sources of information are remarkably congruent. *Ae. aegypti* was introduced to the New World 400–550 years ago from its ancestral home in West Africa via European slave trade. Ships from the New World returning to their European ports of origin introduced the species to the Mediterranean region around 1800, where it became established until about 1950. The Suez Canal opened in 1869 and *Ae. aegypti* was introduced into Asia by the 1870s, then on to Australia (1887) and the South Pacific (1904).



7. Towards a better assembly of the *Aedes aegypti* genome

(Andrea Gloria-Soria in collaboration with Ben J. Matthews, Leslie Vosshall, and members of the *Aedes aegypti* Genome Working Group (AGWG))

Female *Aedes aegypti* mosquitoes infect more than 400 million people each year with dangerous viral pathogens including dengue, yellow fever, Zika, and chikungunya. Progress in understanding the biology of mosquitoes and developing the tools to fight them has been slowed by the lack of a high-quality genome assembly. The AGWG combined diverse technologies to produce the markedly improved, fully re-annotated AaegL5 genome assembly, and demonstrate how it accelerates mosquito science (Matthews et al. 2018 *Nature*). We anchored physical and cytogenetic maps, doubled the number of known chemosensory ionotropic receptors that guide mosquitoes to human hosts and egg-laying sites, provided further insight into the size and composition of the sex-determining M locus, and revealed copy-number variation among glutathione *S*-transferase genes that are important for insecticide resistance. Using high-resolution quantitative trait locus and population genomic analyses, we mapped new candidates for dengue vector competence and insecticide resistance. AaegL5 will catalyse new biological insights and intervention strategies to fight this deadly disease vector.



C. Virus-Vector Interactions

1. Vector Competence of *Ae. albopictus* from the Northeastern US for Chikungunya, Dengue, and Zika Viruses

(Andrea Gloria-Soria, Philip Armstrong, Doug Brackney, Angela Bransfield in collaboration with Alex Ciota, Sean Bialosuknia, Anne Payne, Laura Kramer)

The Asian tiger mosquito (*Aedes albopictus*) is an invasive mosquito species that has spread to over 50 countries during the last 40 years including the U.S. The first U.S. population was discovered in Houston, TX in 1985 and it has since expanded its range in eastern U.S. with established populations as far north as NY, CT, and MA. *Aedes albopictus* has been shown to be a competent vector of 23 arboviruses in the laboratory and serves as a secondary vector of chikungunya, dengue, and Zika viruses in the tropics. Previous studies indicate that vector competence is population- and virus-dependent but there are no comprehensive vector competence studies with local *Ae. albopictus* populations from the northeastern U.S. using isolates of invasive arboviruses. Accordingly, we compared vector competence of northern *Ae. albopictus* populations for low-passage strains of chikungunya, dengue, and Zika viruses. Preliminary results show that *Ae. albopictus* from NY and CT were highly competent for chikungunya virus under environmentally relevant conditions. The LR strain from the Indian Ocean Islands had higher transmission potential than the DMR strain from the Americas. *Ae. albopictus* populations from NY were also efficient vectors for Zika virus but CT populations exhibited low infection rates and none transmitted Zika virus. We find that both mosquito population and virus strain impact vector competence in the northeastern U.S.



Impact: A clearer understanding of the vector competence of *Ae. albopictus* populations for invasive arboviruses can elucidate actual public health risk for disease outbreaks.

2. The Role of RNA Interference in Arbovirus Diversification

(Dr. Doug Brackney, Dr. Phil Armstrong)

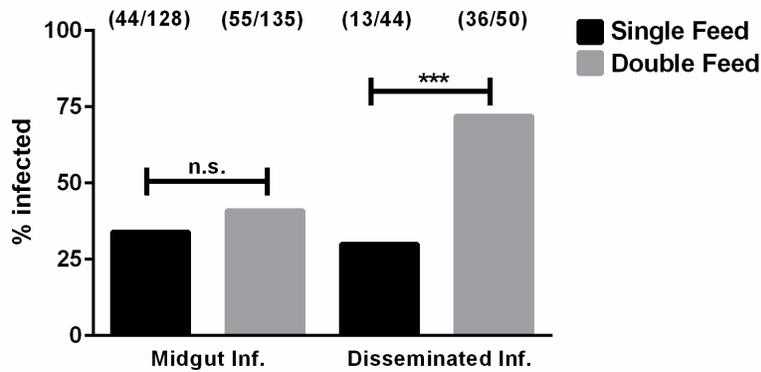
Arthropod-borne RNA viruses exist within hosts as heterogeneous populations of viral variants and, as a result, possess great genetic plasticity. Understanding the micro-evolutionary forces shaping these viruses can provide insights into how they emerge, adapt, and persist in new and changing ecological niches. Our previous studies have demonstrated that the innate immune pathway of arthropods, RNA interference (RNAi), serves as one of these micro-evolutionary forces and can directly impact the diversity of virus populations. However, because of other forces such as genetic drift and genetic bottlenecks, it is unclear the true role of RNAi in arbovirus diversification. We are currently performing a series of experiments to address this specifically. Using viruses which over-express RNAi agonists, we will be able to quantify RNAi-mediated diversification. In addition to the canonical RNAi pathway, recent work has demonstrated that arbovirus sequences can be integrated into the mosquito genome and that these sequences can serve as templates for RNAi-mediated targeting of viral genomes. Our work will be to further quantify the contributions of this non-canonical RNAi based defense mechanism in virus diversification. Ultimately this line of research will provide mechanistic insights into arbovirus evolution and epidemic potential.

3. Factors influencing vector competence

(Dr. Doug Brackney, Dr. Philip Armstrong, Ms. Angela Bransfield)

The emergence and re-emergence of arthropod-borne viruses (arboviruses) over the last 40 years constitutes

Zika virus infection of *Aedes aegypti*



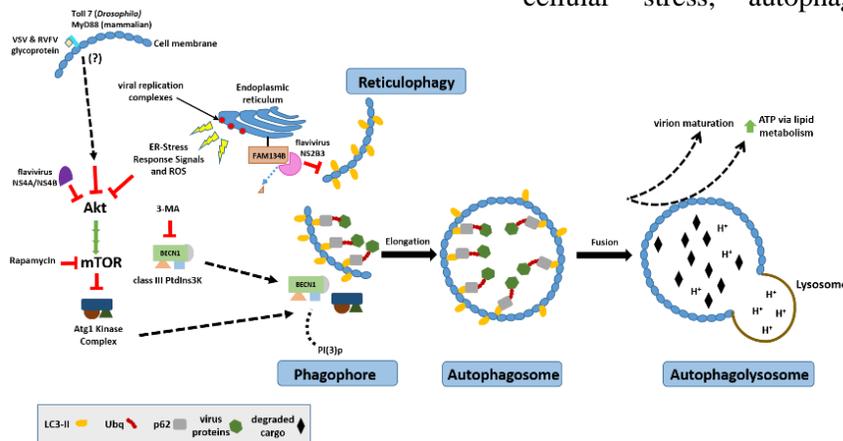
a continued and significant public health threat. Determining the relative risk for transmission is typically assessed in the laboratory by performing vector competence studies. Vector competence is the ability of an arthropod vector (e.g., mosquitoes) to become infected with a pathogen, permit replication and ultimately transmit the pathogen to a naïve vertebrate host. This can be determined by providing the local vector populations with an infectious bloodmeal containing the pathogen of interest (e.g., Zika virus).

Subsequently, individual mosquitoes are assayed at varying time points post-bloodmeal to determine if the gut became infected, if the virus was able to escape the gut and enter the hemolymph (i.e., the open circulatory system), and to determine if the pathogen is being transmitted in the saliva. This basic procedure has been utilized for the better part of a century; however, for some species such as *Aedes aegypti* mosquitoes, it doesn't take into consideration the natural habits of the mosquito. For instance, it is well documented that *Ae. aegypti* mosquitoes take a bloodmeal every two to three days in the wild. Therefore, we have recently begun studying the effects that multiple feeding episodes may have on the vector competence of *Ae. aegypti* and *Ae. albopictus* to Zika virus, dengue virus and chikungunya virus. Surprisingly, we have found that non-infectious bloodmeals provided after the initial infectious bloodmeal significantly enhanced the rates in which the virus is able to escape the gut and infect the salivary glands. These paradigm shifting findings will change how risk assessments of vector-borne disease outbreaks are determined and help explain the explosive epidemic potential of viruses transmitted by mosquitoes.

4. The Role of Autophagy During Arthropod-borne Virus Infection of Mosquitoes (Dr. Doug Brackney and Ms. Maria Correa)

Autophagy can be induced in metazoans by developmental stimuli or in response to various types of stress such as starvation, hypoxia, or microbial infection. During normal growth conditions, autophagy maintains cellular homeostasis by degrading unwanted or damaged organelles and protein aggregates. In times of cellular stress, autophagy catabolizes these cellular

components, generating a pool of energy and macromolecules that maintain essential cellular processes until normal growth conditions return. Because this is a highly complex process requiring the reorganization of intracellular membranes and numerous signaling pathways, perturbations in normal activity, at any of these stages, can drastically affect the



outcome of autophagic events. Not surprisingly, many viruses either directly modulate or indirectly alter many of these pathways and/or processes important in regulating autophagy. To date, our understanding of virus-host autophagy interactions has been limited to mammalian systems, yet arthropod-borne viruses (arboviruses) require both a vertebrate host and invertebrate vector for maintenance in nature. It is currently unknown if or how the autophagy pathway of vectors interacts with viruses. Our contribution here is expected to result in a detailed understanding of these events. The significance of these studies is that they will contribute to our understanding of virus-vector interactions. This is important because identifying cellular components/pathways essential to virus replication has the potential to be exploited for the development of novel control strategies.

Tick Management and Epidemiology of Tick-borne Diseases

A. Evaluation of Temperature-dependent Physiological Parameters Associated with Disease Transmission in Blacklegged Tick

(Dr. Goudarz Molaei, Dr. Kirby C. Stafford III)

Climate models predict that the environment will warm in the tick geographic ranges. Historical data on tick dispersal patterns has been incorporated into recently developed computer-based models to predict how this warming climate will alter the biogeography of this arthropod vector. However, conspicuously little or no empirical information is available on the potential association between increasing temperature and physiological processes that influence tick vector competence. The overall aim of this proposed project is to reduce this knowledge gap by quantifying the effect of a warming environment on a defined set of disease transmission-relevant physiological parameters in blacklegged tick (*Ixodes scapularis*). Specific aims of the project are: 1) Determine if a warming environment alters the density of endogenous symbiotic bacteria. *I. scapularis* house endogenous symbiotic bacteria that mediate several aspects of its host's physiology, including vector competence. We will determine whether a warming environment alters the dynamics of the microbial population by quantifying the relative density of endogenous symbionts present within blacklegged ticks maintained at elevated temperatures, relative to their counterparts maintained under normal insectary conditions, and 2) Determine if a warming environment alters the transmission dynamics of *B. burgdorferi* within *I. scapularis*. We will investigate whether a warming environment alters the infection dynamics of *B. burgdorferi* within blacklegged ticks. Specifically, we will expose *I. scapularis* to infectious blood meals, and then a) quantify the percentage of hosts infected, and b) the pathogen burden of infected hosts. These infection parameters will be quantified in individuals maintained at both elevated and conventional temperatures.

B. Distribution and Establishment of the Lone Star Tick, *Amblyomma americanum* (L.) (Acari: Ixodidae), in Connecticut and Implications for Range Expansion and Public Health

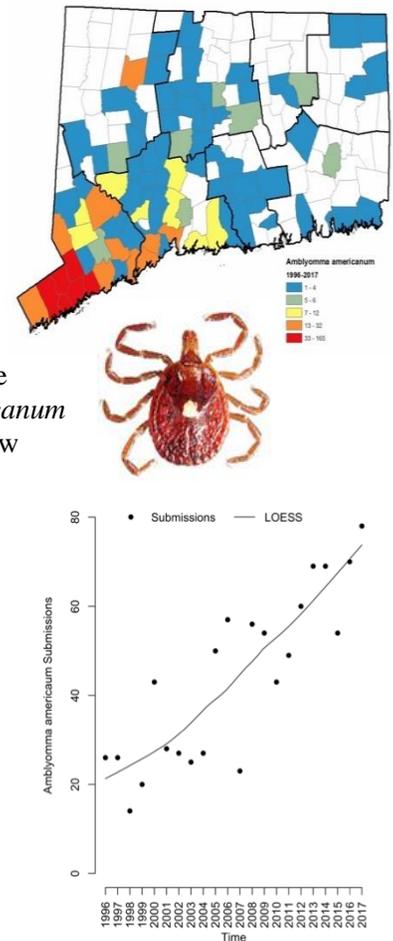
(Dr. Kirby C. Stafford III, Dr. Goudarz Molaei, Dr. Eliza A. H. Little, Dr. Christopher D. Paddock, Dr. Sandor E. Karpathy, Mr. Andrew M. Labonte)

In the United States, the lone star tick, *Amblyomma americanum* (L.), is an aggressive southeastern species whose range has reportedly been steadily expanding northward. The number of *A. americanum* specimens submitted to the Tick Testing Laboratory (TTL) at the Connecticut Agricultural Experiment Station (CAES) increased by 58% from the period of 1996-2006 (n = 488) to 2007-2017 (n = 773), mainly from Fairfield County in the southwestern corner of the state. The greatest numbers of *A. americanum* submissions to the CAES-TTL were from the City of Norwalk and a few adjacent municipalities. We also report the discovery of a large infestation of adult and nymphal lone star ticks detected on a dead male white-tailed deer, *Odocoileus virginianus* (Zimmerman), on Manresa Island, Norwalk, in June 2017, indicating a long established, undetected population. A sample of nymphal and adult host-seeking *A. americanum* collected July 2017 from Manresa Island were tested and a proportion were positive for *Ehrlichia chaffeensis*, *E. ewingii*, and *Anaplasma phagocytophilum*. The *A. americanum* tick and its associated disease pathogens are expected to become an increasing public health concern in southern New England.

Impact: As *A. americanum* expands its established range into new regions and more ticks are found on humans seasonally in areas beyond established populations, it is expected that this species and associated pathogens will become an increasing medical and veterinary concern in southern New England.

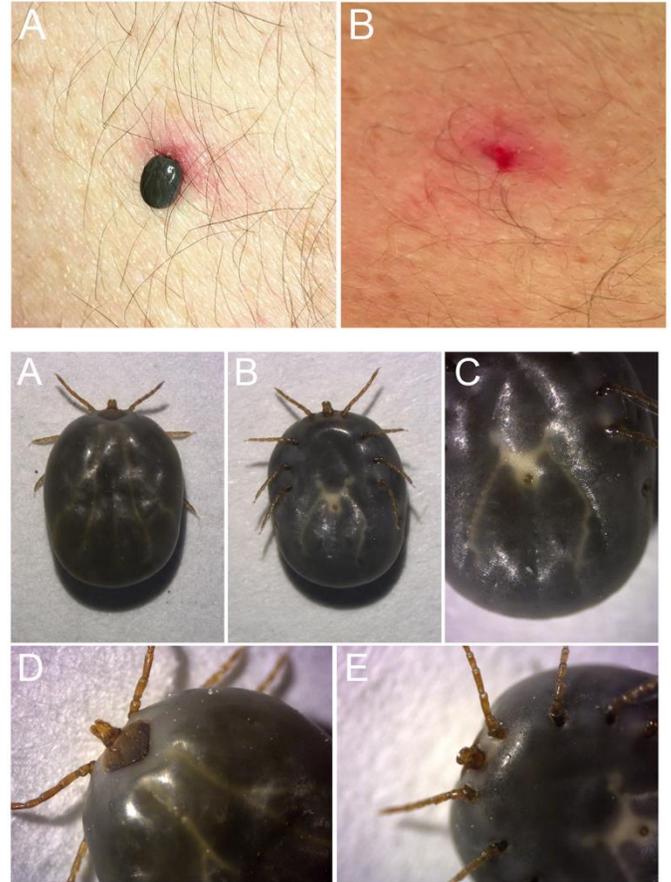
C. First Report of the Introduction of an Exotic Tick, *Amblyomma coelebs* (Acari: Ixodidae) Feeding on a Human Traveler Returning to the U.S. from Central America

(Dr. Goudarz Molaei, Dr. Sandor Karpathy, Dr. Theodore Andreadis)



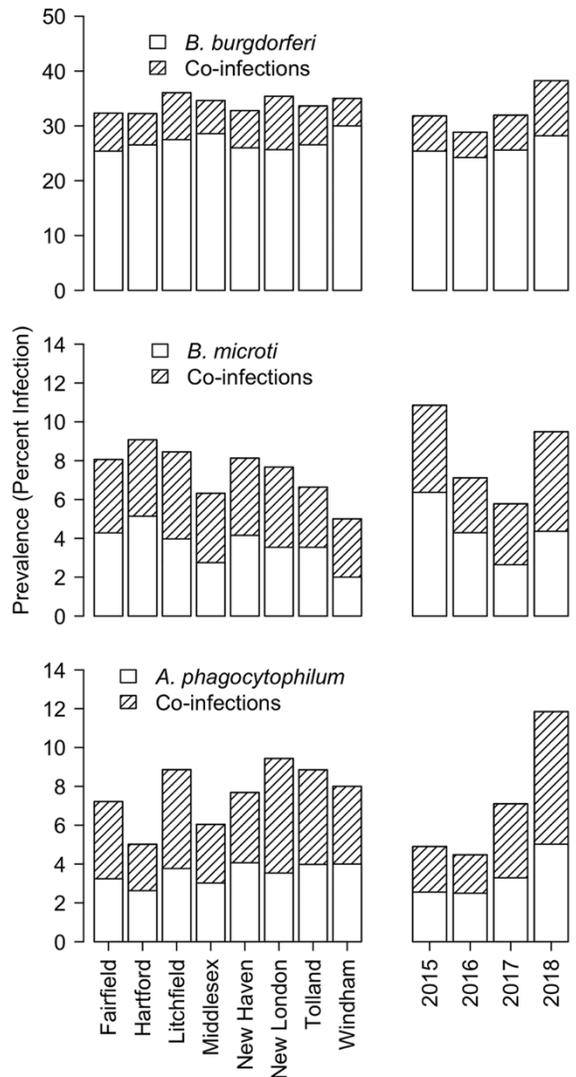
Introduction of ticks into the United States that can carry disease-causing pathogens to humans, companion animals, and wildlife has accelerated in recent years, mostly due to globalization, frequency of travel, and a rise in legal and illegal animal trades. We report for the first time, introduction of a live fully engorged *Amblyomma coelebs* feeding on a human into the United States from Central America. *Amblyomma coelebs* is geographically distributed in the Neotropical region and reaches the southern states of Mexico. This species is capable of transmitting a number of pathogens of public health and veterinary importance including, spotted fever group rickettsiae, raising concern that *A. coelebs*, if it became established in the country, might also be able to carry these pathogens.

Impact: Considering the risks of exotic ticks as vectors of numerous pathogens and their potential to establish new populations under conducive climatic and habitat conditions, rigorous inspection practices of the imported livestock and pet animals at the ports of entry are vital. It is also important for travelers and practitioners to develop a heightened awareness of the public health risks associated with the unintended importation of exotic ticks and the potential such parasites have for breaching United States biosecurity defenses.



D. Passive Tick Surveillance: Exploring Spatiotemporal Associations of *Borrelia burgdorferi*, *Babesia microti*, and *Anaplasma phagocytophilum* Infection in *Ixodes scapularis*
(Dr. Goudarz Molaei, Dr. Eliza A. H. Little)

Blacklegged (deer) tick, *Ixodes scapularis*, transmits a group of pathogens including, *Borrelia burgdorferi*, *Babesia microti*, and *Anaplasma phagocytophilum*, the causative agents for Lyme disease, babesiosis, and anaplasmosis, respectively. *Ixodes scapularis* ticks submitted by the state residents to the Connecticut Agricultural Experiment Station-Tick Testing Laboratory between 2015 and 2018 were tested using standard PCR and pathogen-specific primers. Infection and co-infection prevalence in *I. scapularis* were estimated in order to assess differences in infection status by life-stage (nymph or adult female), county, and year as well as whether infection with *B. burgdorferi* changes the likelihood of infection with either *B. microti* or *A. phagocytophilum*. Of the 11,254 *I. scapularis* acquired in Connecticut, 40.7% tested positive for at least one pathogen and the remaining 59.3% were negative. Most *I. scapularis* ticks tested positive for a single pathogen (33.6%), and only 7.2% were infected with more than one pathogen, of which 93.2% were identified with dual infection and 6.8% tested positive for all three pathogens. Adults were more likely than nymphs to be infected or co-infected with these pathogens. Furthermore, we found that ticks were 74% more likely to be infected with *B. microti* and 98% more likely to be infected with *A. phagocytophilum* if infected with *B. burgdorferi* compared to those not infected. We did not find spatial differences in infection or co-infection prevalence but between 2015 and 2018 the likelihood that a tick was co-infected increased with time.



Impact: Co-infections in humans as the result of bites by ticks carrying multiple pathogens may not only manifest with more severe symptoms but also lead to challenges in diagnosis and improper treatment. In this study we show adult and nymph *I. scapularis* ticks can be co-infected and that co-infection prevalence may be increasing over time. These findings have serious implications for the clinical diagnosis, course, severity, and treatment of human tick-borne disease cases.

E. Field Evaluation of a Novel Oral Reservoir-Targeted Vaccine Against *Borrelia burgdorferi* Utilizing an Inactivated Whole-Cell Bacterial Antigen Expression Vehicle

(Dr. Kirby Stafford III, Dr. Scott Williams, Dr. Megan Linske, Dr. Steve Zatechka, Dr. Luciana Richer, Dr. Goudarz Molaei, Dr. Chris Przybyszewski, Dr. Stephen K. Wikel)

Blacklegged ticks (*Ixodes scapularis*) are the principle vector for *Borrelia burgdorferi*, among other infectious agents, in the Northeastern, Mid-Atlantic, and upper Midwestern areas of the United States. White-footed mice (*Peromyscus leucopus*) are the primary and most competent reservoir host of *B. burgdorferi* in the Northeast. Live reservoir-targeted vaccines (RTVs) to limit enzootic transmission of *B. burgdorferi* were previously developed and successfully evaluated in laboratory and field trials. A novel, inactivated RTV was developed to minimize regulatory and market challenges facing previous RTVs based

on live bacterial or viral vehicles. Thirty-two residential properties in Redding, Connecticut participated in a field trial consisting of an oral, inactivated RTV efficacy study (2015-2016). During the two-year vaccination period, a significant decrease ($P < 0.001$) in the percentage of *B. burgdorferi*-infected *I. scapularis* larvae parasitizing *P. leucopus* was observed, as was a significant reduction ($P < 0.0001$) in the percentage of infected *P. leucopus*, based on the peptide visfatin enzyme-linked immunosorbent assay, on RTV-treated properties when compared to control properties. This novel inactivated RTV was effective in reducing the numbers of *B. burgdorferi*-infected *I. scapularis* and *B. burgdorferi*-infected *P. leucopus* on properties where it was distributed.

Impact: With the future availability of multi-antigen RTVs and other edible means to deliver pass-through acaricide or biologic feeding inhibitors, the application methods being developed for the OspA RTV are potentially transferrable to several rodent species and could provide substantial, achievable infection control. Reservoir-targeted vaccine programs for *B. burgdorferi*, and eventually other pathogens, are a promising tool in reducing the prevalence of infection in both *I. scapularis* and *P. leucopus*.

F. Range Expansion of the Lone Star Tick Another Public Health Concern in Connecticut

(Dr. Goudarz Molaei)

The lone star tick, *Amblyomma americanum*, is an aggressive southeastern United States species whose range has reportedly been steadily expanding northward. The number of *A. americanum* specimens submitted to the Connecticut Agricultural Experiment Station Tick Testing Laboratory (CAES-TTL) increased by 58% from the period of 1996-2006 (n = 488) to 2007-2017 (n = 773), mainly from Fairfield County in the southwestern corner of the state. The greatest numbers of *A. americanum* submissions to the CAES-TTL were from the City of Norwalk and a few adjacent municipalities. However, recently the number of lone star ticks submitted to the CAES-TTL has substantially increased and additionally, we have identified established populations of this species in New Haven County. We are investigating range expansion of this tick species in Connecticut and its potential for pathogen transmission.

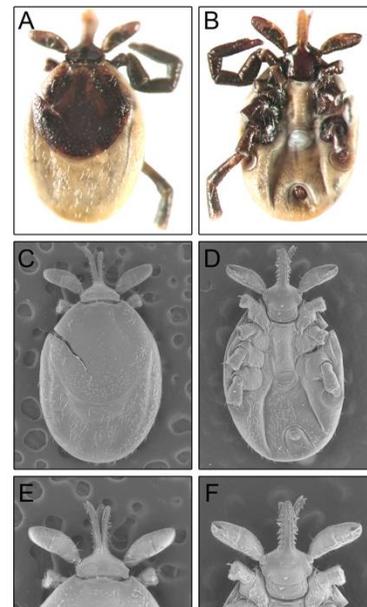


Impact: Changes in climatic conditions among other factors have substantially augmented the range expansion of non-native tick species and tick-borne pathogens of public health and veterinary importance in the United States. Understanding of the extent of distribution and prompt interception of non-native ticks and pathogens are vital to curtail geographic expansion of these ticks and prevent the spread of infection in humans and livestock.

G. Investigating Morphological Anomalies in Ixodes scapularis, Amblyomma americanum, and Dermacentor variabilis, the three Main Tick Vectors of Human Pathogens in the United States

(Dr. Goudarz Molaei)

Reports of morphological abnormalities in ticks, especially in *Ixodes scapularis*, *Amblyomma americanum*, and *Dermacentor variabilis*, as the three main vectors of human pathogens in the United States, are exceedingly rare. Only within the past few years have morphological abnormalities in *I. scapularis* ticks been documented in the upper Midwestern and Northeastern United States. While recent reports of morphological anomalies may simply reflect a new research interest, these abnormalities in ticks may also be on the rise. Studies suggests ticks with exoskeletal anomalies may have greater infections with disease agents and may also have more multiple simultaneous pathogen infections, than morphologically normal ticks. We are investigating morphological anomalies in ticks and have already identified and reported 3 cases: the first was a dwarf tick in 2015, the second a nine-legged tick reported in 2017, and the third an adult female seven-legged *I. scapularis*, which we believe is the first report of this type of morphological abnormality in this important tick species.



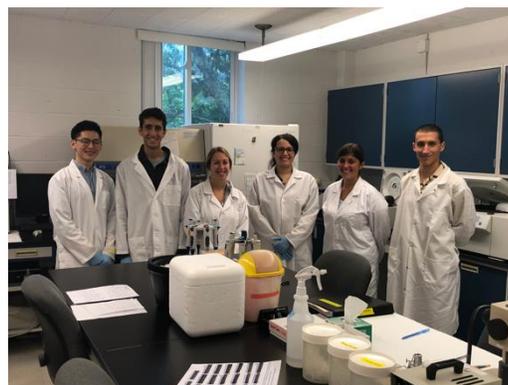
Impact: Given the difficulties in species identification of tick specimens with morphological abnormalities and potential implications in pathogen transmission, further investigations of teratologies in ticks are needed. Accurate morphological identification of tick specimens is also important for understanding of species abundance and diversity, as well as determining which specimens require examination for the evidence of infection.

H. Passive Tick Testing Program for Assessing Human Health Risk with Tick-borne Diseases

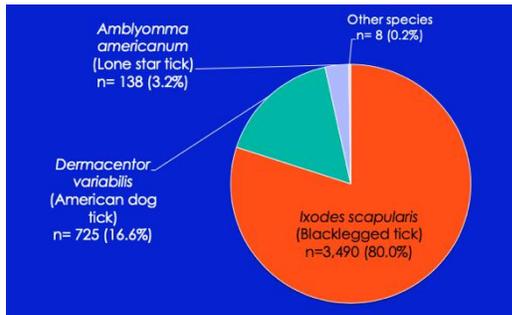
(Dr. Goudarz Molaei assisted by Alex Diaz, Alaina Albino, Gabriella Annunziato, Mallery Breban, Isaac Cammarata, Doug Voung)

Tick-borne diseases including Lyme disease (LD) constitute a major threat to human health in Connecticut. Lyme disease was first described in 1977 following the investigation of a cluster of children with arthritis-like symptoms in Lyme, Connecticut. *Ixodes scapularis*, commonly referred to as the blacklegged (deer) tick, is the vector of *Borrelia burgdorferi*, the bacterium that causes LD. Connecticut has had pervasive populations of *I. scapularis* in all of its eight counties since 1998 and remains a hotspot of disease transmission. In 2017, 2,022 LD cases were reported in Connecticut with an incidence rate of 56.6. Connecticut is one of 14 states that account for 95% of Lyme disease cases.

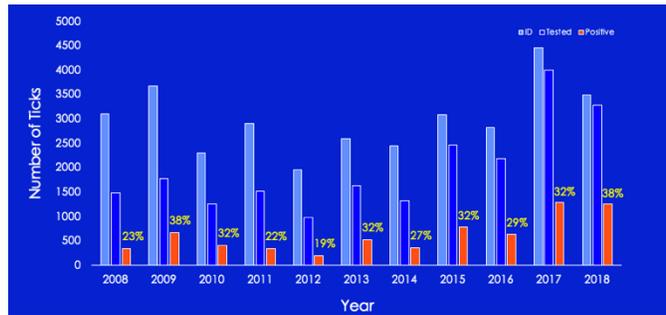
The CAES Tick Testing Program was established in 1990. Each year, an average of 3,000 ticks are submitted for testing. However, in recent years, the number of submissions has substantially increased. In 2018, the CAES Tick Testing Laboratory received a total of 4,362 ticks. In the past, testing was limited to *B. burgdorferi*, the LD agent, but in view of increasing human cases of tick-related illnesses in the state, testing has been expanded to include *Anaplasma phagocytophilum*, the causative agent of human granulocytic anaplasmosis, and *Babesia microti*, the causative agent of babesiosis. Of the total of 4,362 ticks submitted by Connecticut residents, health departments and/or physicians' offices, 3,491(80%) were identified as *I. scapularis* (blacklegged tick), 725 (16.6%) as *Dermacentor variabilis* (American dog tick), 138 (3.2%) *Amblyomma americanum* (lone star tick), and 8 (0.2%) a few other species. Of the 3,273 engorged nymph and adult *I. scapularis* examined, 38.3% tested positive for LD; 9.5% for babesiosis; and 12% for anaplasmosis.



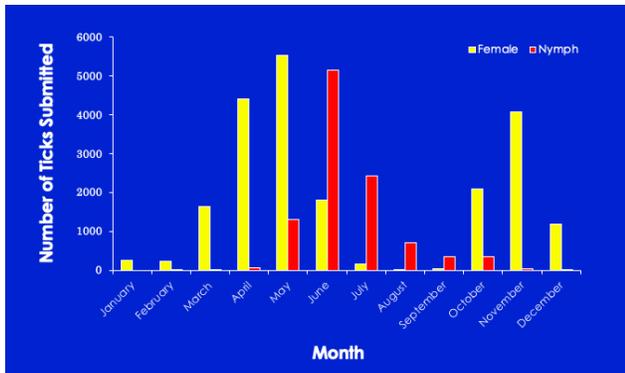
Impact: As a passive surveillance, testing human-biting ticks provides important spatial and temporal information on infection rate and the risk of human infection with tick-borne pathogens including, *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, and *Babesia microti*, the causative agents of Lyme disease, human granulocytic anaplasmosis, and babesiosis, respectively, in Connecticut. Tick testing results generated by this passive surveillance, in conjunction with other lines of evidence, can also be used to make the important decision as to whether treatment is required.



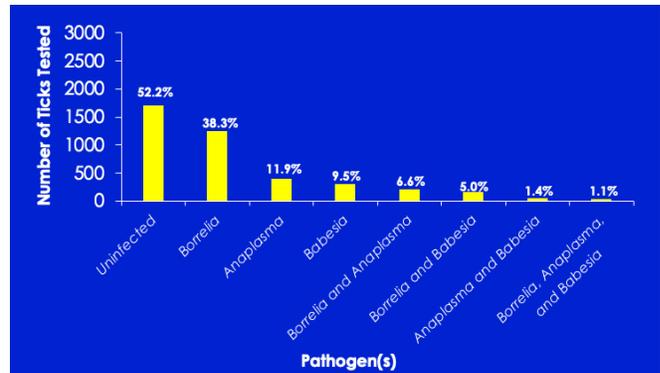
Tick Species Abundance and Composition, in Connecticut, 2018



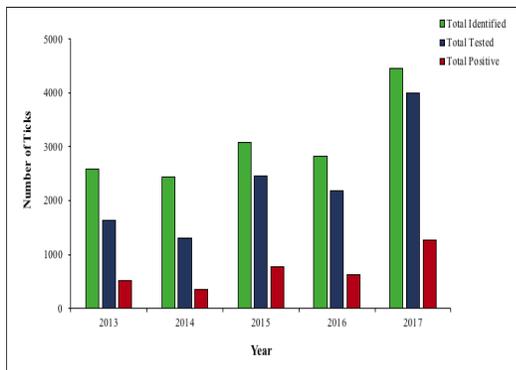
Ixodes scapularis Infection with *Borrelia burgdorferi* in Connecticut, 2008-2018



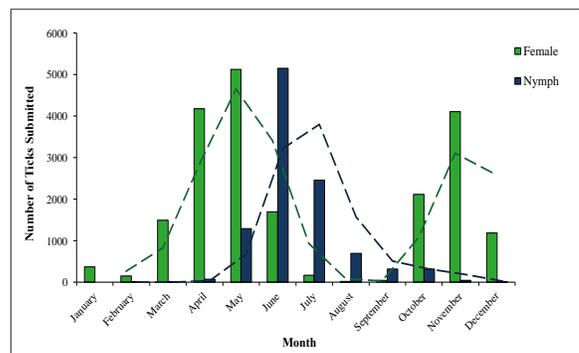
Nymph and Adult *Ixodes scapularis* Submissions by Month, in Connecticut, 2008-2018



Ixodes scapularis Infection and Co-infection Rate in Connecticut, 2018



Number of Ticks Received, Tested, and Positive for *Borrelia burgdorferi*, 2013-2017



Temporal Pattern of Nymph and Adult *Ixodes scapularis* in CT, 2007-2017

I. Active Tick Surveillance Program to Assess Public Health Risk for Tick-borne Pathogens
(Dr. Doug Brackney, Dr. Kirby Stafford, Dr. Scott Williams, Dr. Megan Linske, Duncan Cozens)

The increasing prevalence of Lyme disease (LD) and the emergence of other human tick-associated diseases in the United States have become major public health concerns. To gain a better understanding of the risk associated with these diseases we have initiated a statewide tick surveillance program in order to determine the distribution and abundance of the black-legged tick as well as the prevalence of not only Lyme disease but also babesiosis, anaplasmosis, and Powassan virus encephalitis. Further details on this program are given in the Entomology Department section.

J. Virus-Vector Interactions: Adaptive Potential of Powassan Virus (Lineage II) to be Transmitted by Connecticut Tick Species

(Dr. Doug Brackney, Dr. Phil Armstrong, Dr. Rohit Sharma)

Arthropod-borne RNA viruses, including Powassan virus lineage II (POWV), exist within hosts as heterogeneous populations of viral variants and, as a result, possess great genetic plasticity. POWV is maintained in an enzootic transmission cycle between white-footed mice and *Ixodes scapularis* ticks. POWV is transmitted throughout the northeastern U.S., including Connecticut, and is an emerging threat to human health. Over the last 20 years, there has been a significant increase in human infections resulting in death or long-term neurologic sequelae. Other tick species, such as *Dermacentor variabilis* (dog tick), *Amblyomma americanum* (lone star tick), and *Haemaphysalis longicornis* (Asian longhorned tick), reside in CT and previous field reports have found they too can be infected with DTV; however, it is unknown if they participate in the transmission cycle or can even transmit the virus. Further, it is unknown if DTV can adapt to and emerge within these other tick species as a function of its aforementioned genomic plasticity. We are currently investigating these unknowns by performing vector competence studies with POWV in *De. variabilis* and *Am. americanum* ticks. Further we are performing experimental evolution studies in tick cell culture to evaluate the ability of POWV to evolve adaptive mutations suitable for maintenance in these different tick species.

Environmental Microbiology

A. Employing Mesocosms to Characterize Wetland Responses to Disturbance

(Dr. Blaire Steven)

Our overarching objective is to better understand how interactions between plant community composition and water quality alter freshwater wetland carbon fluxes. We conducted a wetland mesocosm experiment to investigate how plant traits of three common wetland plants (*Typha latifolia*, *Phragmites australis*, *Spartina pectinata*) and three water quality impairments (i.e., sea salt, road salt, N-enrichment) interact to alter carbon gas flux and sediment microbial community composition (Figure 1). We found aboveground biomass to be positively correlated with CO₂ uptake and CH₄ emissions across species. We further showed that salt addition reduced biomass production relative to fresh-water controls, and thus reduce CO₂ uptake and CH₄ emissions. Our data clearly show that different perturbations affect the productivity of wetland ecosystems.



Figure 1. Wetland mesocosms at the University of Connecticut campus. Perturbations consist of nitrogen, road salt, and sea salt additions.

B. Characterizing the Development of the Apple Flower Microbiome in the Presence of the Fire Blight Pathogen *Erwinia amylovora* (Dr. Blaire Steven and Dr. Quan Zeng)

Fire blight, caused by the bacterial pathogen *Erwinia amylovora*, is one of the most devastating diseases of apples and pears. We are studying how the apple flower microbiome develops in the presence of the pathogen in order to identify potential antagonists to disease development. One hundred individual flowers were sprayed with *E. amylovora* and assessed for microbiome composition (Figure 2). *E. amylovora* was identified on all of the flowers, however several flowers showed lower pathogen counts, which was also associated with the presence of unique taxa. We are currently screening isolates from these taxa for an ability to inhibit fire blight.

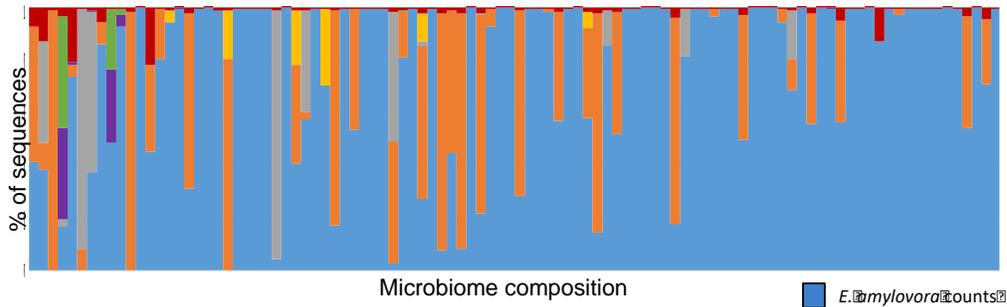


Figure 2. Microbiome composition of 100 flowers sprayed with the fire blight pathogen *E. amylovora*. Each column represents an individual flower and the colors indicate different bacterial taxa. The blue bars are the pathogen *E. amylovora*. Certain taxa appear to compete with the pathogen and may be potential biocontrol agents.

C. Mosquito Microbiota: The Presence of Antibiotic Resistant Bacteria in the Mosquito Microbiome (Dr. Doug Brackney, Dr. Blaire Steven)

The presence of a host associated microbiota or the “microbiome” (the collection of bacteria living on or in animals) is a commonality shared among most animals including mosquitoes. We set out to characterize the antibiotic-resistant bacterial populations in mosquitoes. Antibiotic-resistant bacteria, including multi-drug resistant strains, were identified in both colony-reared and wild caught mosquitoes collected from sites around the state. These data suggest that antibiotic resistant bacteria are common members of the mosquito microbiome. This indicates that mosquitoes can act as a vector to shuttle antibiotic-resistant bacteria between environments.

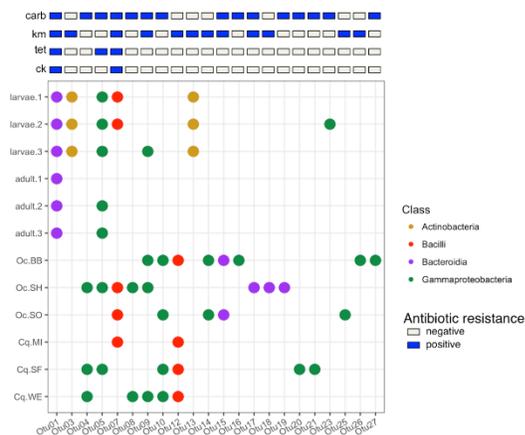
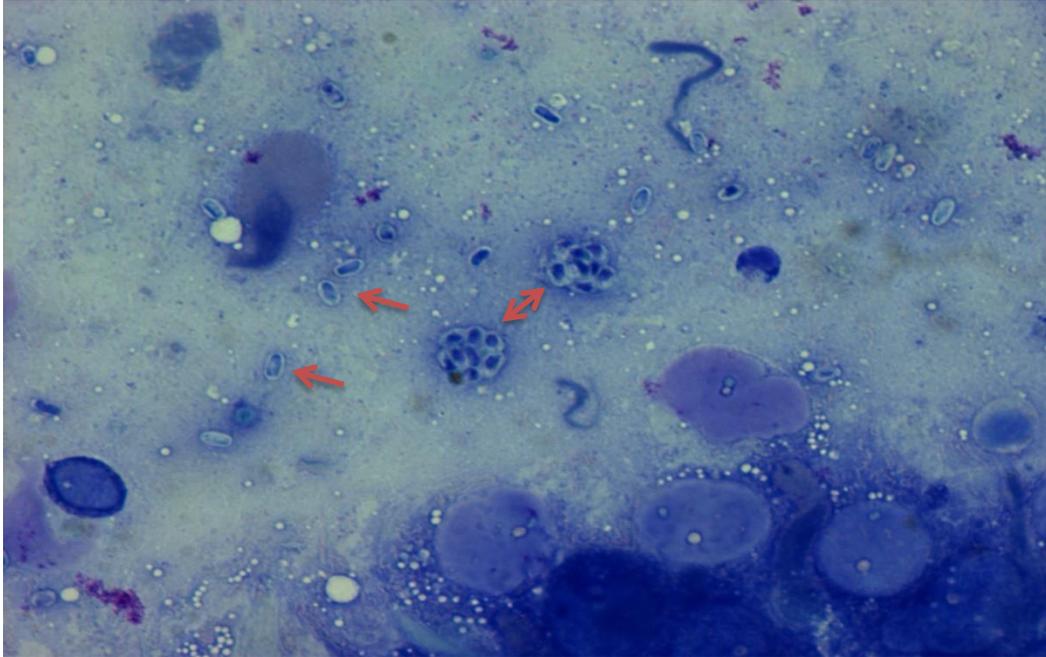


Figure 3. Antibiotic resistant bacteria were identified in both colony-reared and wild-caught mosquitoes.

D. Ecological Genomics of the Microsporidia

(Dr. Charles Vossbrinck)

As a result of a team effort and advances in fields such as computational biochemistry, the possibility of designing small molecules to structurally block metabolic pathways of undesirable parasites and cells is now in sight. We have recently completed the structure of the ribosome from the insect parasite *Vairimorpha necatrix*. The ribosome is the cellular structure involved in all protein synthesis and blocking the bacterial ribosome, for instance, is the basis of several important antibiotics including Chloramphenicol, Erythromycin, and Clindamycin. *Vairimorpha necatrix*, our model parasite, is closely related to *Nosema ceranae*, one of the main causes of sudden hive collapse in honey bees. By visualizing detailed 3D structures of the microsporidial ribosome, we may be able to design antibiotics against the honey bee parasite and prevent this devastating disease of this important domestic insect. Our paper has recently been accepted for publication in Nature microbiology.



Spores of *Vairimorpha necatrix*, our model species, shown as individual spores (arrows) or spores in packets of eight (double headed arrow).

Growth and Production of Figs in Connecticut

(Dr. Charles Vossbrinck)

Three aspects of fig cultivation in Connecticut are of interest: 1) can figs overwinter outdoors; 2) can we extend the growing season to allow figs to ripen in Connecticut; 3) is there a possibility for a fig growing industry in Connecticut?

Figs grow well in greenhouses because of the protection against severe conditions and the added growing season the greenhouse provides. Some fig trees survive the winter outdoors in some of our shoreline towns such as West Haven. We are now turning our attention to using low tunnels to overwinter figs and to extend the growing season at Lockwood Farm in Hamden.



Greenhouse grown figs (variety Conadria) at Lockwood Farm.

Invasive Aquatic Plant Program

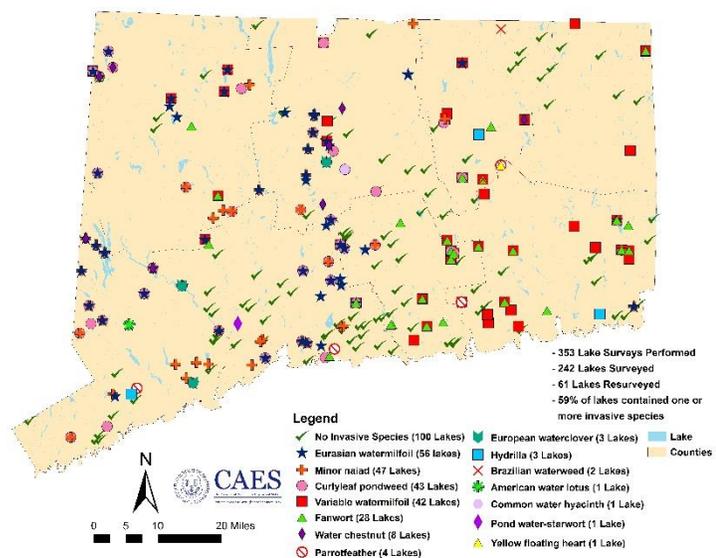
(Mr. Gregory Bugbee, Ms. Summer Stebbins)

We are quantifying the locations of invasive aquatic plants in Connecticut's lakes and ponds, determining their effects on native plant communities, establishing baseline data to track their spread and providing information that is critical for management strategies.

A. Surveillance and Monitoring

Since 2004, the Connecticut Agricultural Experiment Station Invasive Aquatic Plant Program (CAES IAPP) has completed 353 aquatic vegetation surveys of 242 Connecticut lakes and ponds. A total of 61 waterbodies have been resurveyed to determine how invasive plants are changing the quality of lakes and the effectiveness of management practices over time. In fiscal year 2018-2019, Gregory Bugbee and staff mapped the aquatic vegetation in two new and 12 previously surveyed waterbodies. Lake Candlewood, Connecticut's largest lake, was surveyed for the tenth consecutive year to determine the effects of deep and shallow winter drawdown and recently introduced grass carp (*Ctenopharyngodon idella*) on Eurasian watermilfoil (*Myriophyllum*

Locations of Invasive Plants Found by CAES IAPP 2004-2018



Locations of invasive plants in Connecticut's lakes and ponds as found in CAES IAPP surveys from 2004-2017.

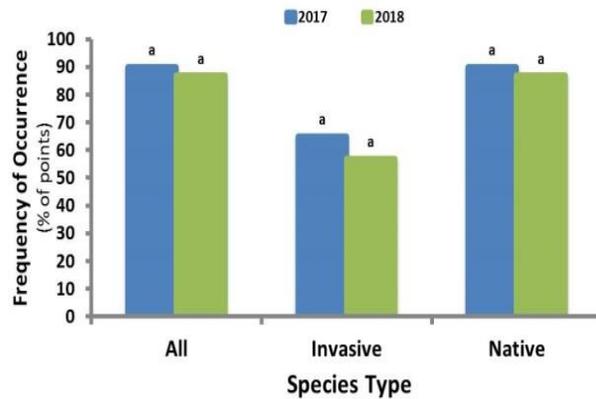
spicatum), minor naiad (*Najas minor*), and curlyleaf pondweed (*Potamogeton crispus*). Nearby Squantz Pond was also surveyed. We established transects in each waterbody using global positioning systems to quantify changes in native and invasive aquatic species abundance and distribution. We collected water samples and analyzed them for pH, temperature, dissolved oxygen, clarity, alkalinity, conductivity, and phosphorus. This data, along with watershed information, is being used to investigate the factors that influence the susceptibility of waterbodies to individual invasive species. We archived dry specimens of all plant species in the CAES herbarium for future reference. We designed our Invasive Aquatic Plant Program to utilize the latest digital technology to rapidly and comprehensively report our findings to the public. Lake survey maps and other data are published online (<http://www.portal.ct.gov/caes-iapp>). Nearly 60 percent of the waterbodies contained one or more invasive plant species and some lakes contained as many as four invasive plant species.

CAES IAPP Surveys Performed in 2018			
Number	Lake Name	Town	Acres
1	Amos Lake	Preston	112
2	Bushy Pond	Clinton	8.5
3	Candlewood Lake	Sherman	5400
4	Hidden Lake	Higganum	39
5	Lake Elise	Middlebury	16
6	Laurel Lake	New Hartford	16
7	Lower Bolton Lake	Bolton	176
8	Pachaug Pond	Griswold	817
9	Private Pond, Madison	Madison	0.1
10	Private Pond, Rocky Hill	Rocky Hill	0.04
11	Squantz Pond	New Fairfield	266
12	Taunton Lake	Newtown	124
13	Twin Lake North	Simsbury	13
14	Twin Lake South	Simsbury	16

The most common invasive plants are Eurasian watermilfoil, variable watermilfoil (*Myriophyllum heterophyllum*), minor naiad, curlyleaf pondweed, and fanwort (*Cabomba caroliniana*). Less common are water hyacinth (*Eichhornia crassipes*), water shamrock (*Marsilea quadrifolia*), hydrilla (*Hydrilla verticillata*), and water chestnut (*Trapa natans*). Our 2009 survey of Fence Rock Lake in Guilford discovered Connecticut’s first infestation of Brazilian waterweed (*Egeria densa*) and our resurveys in 2010, 2011, 2012, and 2013 found the population expanding. We have since found Brazilian waterweed in Lower Moodus Reservoir (East Haddam), Staffordville Reservoir (Stafford Springs), and Mono Pond (Coventry). We are working with the local lake associations and the CT DEEP to develop and test novel control technologies.



Surveying aquatic vegetation in Lake Quonnipaug, Guilford.



Change in aquatic vegetation in Pachaug Pond from 2017-2018.

We surveyed Pachaug Pond in 2017 and again in 2018 to document changes in aquatic vegetation over time. In the early spring of 2018, the level of Pachaug Pond was lowered 1-2 m and then raised to normal by summer. Our surveys found similar occurrence and species richness of aquatic plants between the two years, but the abundance had decreased dramatically throughout the center of the lake. These results suggest early spring lake drawdowns may be an alternative to the typical winter drawdowns.

Hydrilla is a very troublesome invasive aquatic plant in many southern states. Following reports of the plant occurring in the Connecticut River, an investigative task force led by the CAES IAPP was formed. Comprising over 30 experts from throughout the northeast, the task force performed preliminary surveillance of the river from central Vermont to southern Connecticut in 2018. The Connecticut portion of the river was presumed to be “ground zero” for the infestation and received the majority of the effort.



Hydrilla infestation in Middletown, CT on the Connecticut River. Photo courtesy of Judy Preston, CT Sea Grant.

Hydrilla was not found in New Hampshire or Vermont and the first sightings were just north of the Massachusetts/Connecticut border near Six Flags Amusement Park in Agawam. Travelling south, *Hydrilla* became common, creating large dense stands between Hartford and East Haddam.

The *Hydrilla* found in the river is more robust than seen elsewhere in Connecticut. CAES IAPP in collaboration with the University of Wisconsin-Whitewater, performed genetic tests on the Connecticut River *Hydrilla* and found it to be a different strain than previously found in North America. This could mean the plant has an enhanced ability to spread, harm aquatic ecosystems and resist current control practices. Movement of the CT River *Hydrilla* to lakes and ponds via fragments on trailered boats and wildfowl is of utmost concern. CAES IAPP has been commissioned to provide additional surveillance in 2019 to document the full extent of *Hydrilla* infestation in the state.

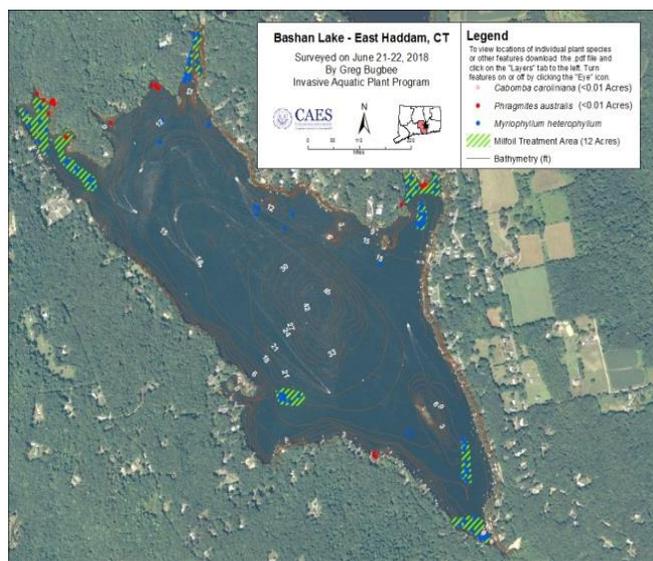
B. Control Technologies

The goals of this objective are 1) to research novel means of control that minimize herbicide usage and protect native vegetation and 2) to investigate non-chemical management options such as winter water level drawdown.

1. Herbicides.

Novel methods of chemical control with herbicides can rapidly remove invasive plants and begin to restore native plant communities to aquatic ecosystems.

Bashan Lake – East Haddam, CT. We are in the 17th year of research involving the use of spot applications of herbicides to control variable watermilfoil in Bashan Lake. We had largely restored the lake to preinfestation conditions prior to lowering the lake for dam repairs in 2014. Surveys of Bashan Lake in 2018 found a regrowth of variable watermilfoil and a number of areas where phragmites (*Phragmites australis*) had become established. A new herbicide called ProCellaCOR was registered in

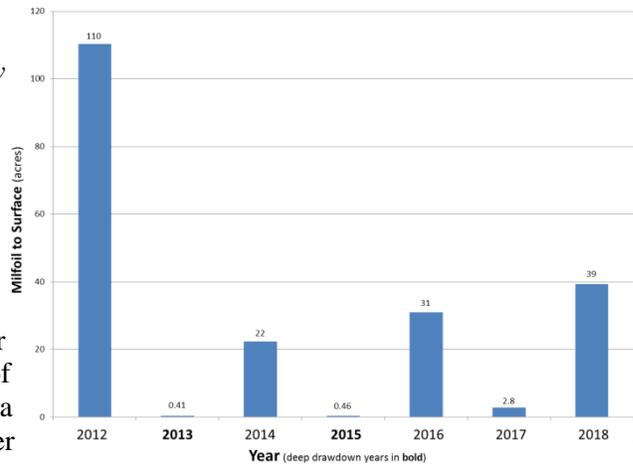


Locations of phragmites and variable watermilfoil in Bashan Lake in 2018.

2018 for use on variable watermilfoil. In collaboration with the Bashan Lake Association, the Town of East Haddam, SePro Corp., and Solitude Lake Management Inc., a targeted application of the new product was administered to variable watermilfoil in late September. Control attributed to the ProcCellaCOR treatment was excellent in all sites except for the south cove where most of the variable watermilfoil was unaffected. CAES IAPP is working to determine the reason.

2. Winter water level drawdown and grass carp.

Candlewood Lake - Brookfield, New Fairfield, New Milford, Sherman, CT. Candlewood Lake’s aquatic plant community is dominated by Eurasian watermilfoil. Winter water level drawdown has been used for decades to manage the plant. In 2015 and 2017, a total of nearly 10,000 sterile plant-eating grass carp were introduced to provide additional control. Using state-of-the-art geospatial technology, we have documented the success of the drawdowns each year since 2007 and have begun to determine the effects of the grass carp. The surface coverage of milfoil shows a negative relationship to drawdown depth. Eurasian water milfoil reductions attributable to the grass carp appear to be substantial in many shallow coves and less so in the majority of the lake. As the grass carp get larger and consume more vegetation this would be expected to change.



Yearly changes in the acreage of Eurasian watermilfoil at the surface in Candlewood Lake (deep drawdown years in bold).

3. Benthic barriers.

Lake Quonnipaug - Guilford, Bashan Lake - East Haddam, and Lake Beseck - Middlefield. Benthic barriers are blankets designed to be placed over nuisance vegetation in lakes and ponds. They provide an alternative to herbicides and are thought to control vegetation by blocking the light aquatic plants need to grow. Benthic barriers are not new; they are typically placed over weed beds early in the growing season and removed in the fall. Recently, marketers of benthic barriers have claimed that their products need only be placed over weeds for a few weeks and then moved to another location or removed. To test this practice, we collaborated with the Towns of Guilford and Middlefield and placed benthic barriers at the Lake Quonnipaug and Lake Beseck public beaches. The beaches had problems with Eurasian watermilfoil and other invasive and native aquatic plants. We placed the benthic barriers in April and removed them within two months. The results are promising with little vegetative regrowth throughout the summer. We are also testing the use of benthic barriers to control a pioneer infestation of fanwort in Bashan Lake. Further



Benthic barriers installed in the beach area of Lake Beseck, Middlefield.

tests are needed to determine why these barriers provide impressive weed control even when they are used for short periods of time.

C. Outreach.

We strive to disseminate all information from our program to the public in a timely fashion and educate stakeholders in the identification, prevention, and management of invasive aquatic species. We make every effort to engage citizens, lake associations, and other stakeholders. CAES IAPP scientists have organized several workshops on the identification of invasive aquatic plants. We also have given presentations to professional organizations such as the Northeast Aquatic Plant Management Society, the Northeast Aquatic Nuisance Species Panel, and the Connecticut Federation of Lakes. In addition, CAES IAPP staff members speak to numerous lake associations, town meetings, and student groups such as the Connecticut Envirothon. We have made our information freely and readily available via our website. Included are digitized interactive lake maps, our herbarium, and publications (<http://www.portal.ct.gov/caes-iapp>).



Invasive aquatic plant workshop at the 2019 high school Envirothon.

Our invasive aquatic plant control and outreach efforts have resulted in the protection of lakes and provided scientifically proven methods for use by others. Our workshops have trained hundreds of citizens to recognize and report new infestations in order to prevent future problems and the associated control expenditures.

Soil Testing Laboratory (Mr. Gregory Bugbee)

Testing soil samples for fertility and suggesting methods for growing better plants are provided for citizens of Connecticut. At the laboratory in New Haven, 6,457 samples were tested and approximately 1,500 related inquiries were answered.

The soil testing services and recommendations made by the Connecticut Agricultural Experiment Station reduce unnecessary fertilizer treatments to lawns and nursery stock throughout the state. This provides direct economic and environmental benefit to the suburban community by reducing nitrogen runoff into soil and water.



Soil testing information is used to help residents grow better crops.

DEPARTMENT OF FORESTRY AND HORTICULTURE

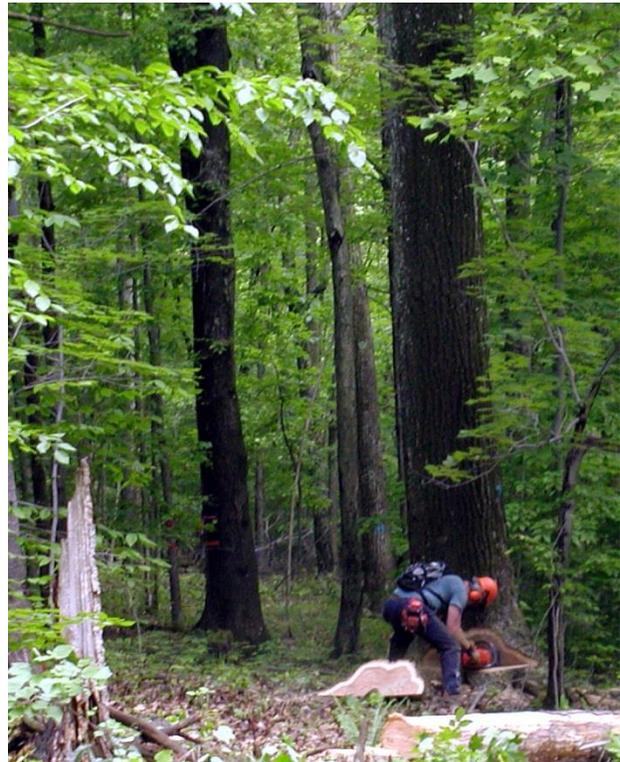
Connecticut's landscape is a quilt of forests, farms, towns, and cities. Scientists in the Department of Forestry and Horticulture are studying the factors that influence both forest and farm productivity, including how trees respond to novel pests and a changing climate, innovative forest management practices, the effect of the growing deer population on natural and managed landscapes, and novel specialty crops.

The value of the forest to Connecticut is much more than the timber and other forest products. First and foremost, forests protect watersheds, aquifers and groundwater supplies that provide the bulk of our clean drinking water. Trees also provide air pollution control, acting as giant filters to remove dust, particulates, and some airborne chemicals. In addition, trees cool our environment in the summer by recycling water and reflecting sunlight. Forests contribute to the character of Connecticut and add to our enjoyment throughout the year.

Managing Mature Oak Forests

(Dr. Jeffrey S. Ward assisted by Mr. Joseph P. Barsky)

Within the eastern upland oak forest, mature oak stands are an increasing component that currently occupies 13.3 million acres (5.4 million ha) in the northeast and north central United States. Implementation of regeneration prescriptions in many, if not most, of the mature oak stands will be delayed to stand ages older than those of earlier recommendations. However, there is little information available to foresters on the feasibility and consequences of alternatives to initiating regeneration. In addition, the unbalanced age class distribution of the oak-hickory forest, and most individual forest stands, presents a challenge to both private and public forest landowners wishing to implement sustainable forest management. Three factors are driving the necessity of developing innovative alternatives to “high-grading” or initiating regeneration harvests in these stands: obtaining a more balanced age-structure, increased public desire for partial cutting, and increased parcelization of ownership. Crop-tree management has been proven successful in younger oak stands and could be a viable alternative in older oak sawtimber stands where maintaining high forest cover and non-commodity attributes are important considerations.



In 2003, Dr. Jeffrey Ward began a study to determine if crop tree management would increase growth of large, mature oak sawtimber (> 18 inches dbh, diameter at 4.5 feet aboveground) without a loss in bole quality and stand growth rates in cooperation with CT DEP-Division of Forestry, Metropolitan District Commission, and Torrington Water Company. The six oak management study areas were in East Hartland, Hamden, Goshen, West Hartford, and Winchester. Each study area had three 0.62-acre treatment plots: B-level thinning (traditional forest thinning), crop tree, and unmanaged. Each plot was located within a 3- to 5-acre area with similar treatment. The mature red oak sawtimber (> 11 inch dbh) stands had no prior

management and were 82 to 125 years-old; upper canopy oaks averaged 17.2 inches dbh. Oaks accounted for 80 percent of the average merchantable stand volume of 13.3 Mbf (thousand board-feet) per acre. All trees larger than 4 inches were permanently numbered and measured annually for 5 years. Stocking was reduced from fully stocked (100%) prior to harvest to 62% and 60% stocking on the B-level and crop tree management plots, respectively. Over the next eleven years, stand stocking growth on crop tree and B-level plots was nearly double that observed on unmanaged controls. Much of the difference of stand stocking growth was caused by an actual decrease in poletimber (4-11 inch dbh) stocking on control plots in contrast to an increase on treated plots.



Despite lower stocking levels following initial harvests, sawtimber volume growth over the eleven-year period did not differ among treatments. For the eleven-year period after harvesting, both managed and unmanaged stands averaged 2.3 Mbf/acre of oak sawtimber growth, of which, 1.9 Mbf/acre were high value oaks. In addition, stand volume growth over the eleven-year period for both total and oak sawtimber was independent of stand age class. This strongly suggests that stand volume growth does not decline at least through 125-year-old stands in both unmanaged and managed stands with a residual stocking of sixty percent or greater.

Why did stand volume growth remain unchanged after stocking had been reduced to sixty percent? Eleven-year diameter and volume growth of individual oak sawtimber trees was greater on B-level and crop tree plots than on unmanaged controls. Both active management treatments removed many of the competitors around the residual trees – giving them more room to grow and access to more light, soil moisture, and soil nutrients. Growth response increased with degree of release and was maintained for the length of the study. Diameter growth of completely released oak sawtimber averaged 2.7 inches over the eleven-year period compared with 1.6 inches for unreleased trees. The increase in diameter growth resulted in an increase in individual tree volume growth for sawtimber oaks, but not for other, less valuable species. Eleven-year volume growth of completely released oak sawtimber averaged 126 bf compared with 86 bf for trees that were not released.

Impact: This research found that forest managers are not limited to initiating regeneration in older oak stands, but can prescribe a commercial intermediate treatment to generate income for the land owner without sacrificing stand volume growth of the more valuable oak. However, care must be taken because both thinning and crop tree management increased individual tree diameter growth and stand stocking of non-oak poletimber. This may increase difficulty of regenerating oak in the future.

Influence of Hunting and Harvests on Forest Regeneration

(Drs. Jeffrey S. Ward and Scott C. Williams assisted by Mr. Joseph P. Barsky)

Nearly 3.6 million acres of New England’s forests are classified as oak-hickory and oaks are a major component on another 1.4 million acres. While oak forests are mostly concentrated in southern New England, oak stands extend into southern Vermont, New Hampshire, and along coastal Maine. The future composition of these forests is of concern to forest managers because of the inconsistent ability to regenerate oak on medium to high quality sites. Regional conversion from oak dominated forests to forests composed primarily of maple, birch, and beech will have serious long-term consequences. This change in the landscape will affect not only the quality and makeup of forest products available to future generations, but will also affect the quality and variety of wildlife habitats. The slower stand growth rates associated with more tolerant species will decrease regional forest productivity.

To address the extent of oak regeneration success and failure, in autumn 2015 we began a systematic survey of stands that had had a regeneration harvest within the past twelve years. The survey was finished in late spring 2018. Connecticut DEEP Forestry, local water companies, and others provided us with stand boundary maps of areas where they had conducted regeneration cuts within the past twelve years. In total, we examined 108 stands with 2210 sample points covering 4454 acres of regeneration harvests.

It was impossible to get stand level deer density estimates for the period immediately before and after harvests, especially for stands cut more than a couple of years ago. Therefore, whether hunting was allowed (n=62) or prohibited (n=46) was used as a crude surrogate for potential browse damage. The following treatment categories were assigned using residual stand basal area: Open - <25ft²/acre (n=32), Irregular shelterwood 25-50 ft²/acre (n=45), shelterwood 50-90 ft²/acre (n=31). A few “shelterwood” stands had over 90 ft²/acre and were not included in the analysis. The irregular shelterwood stands we sampled were final regeneration cuts in that no future harvests were planned to release regeneration. Stands were designated as 2-4, 5-8, or 9-12 years old.

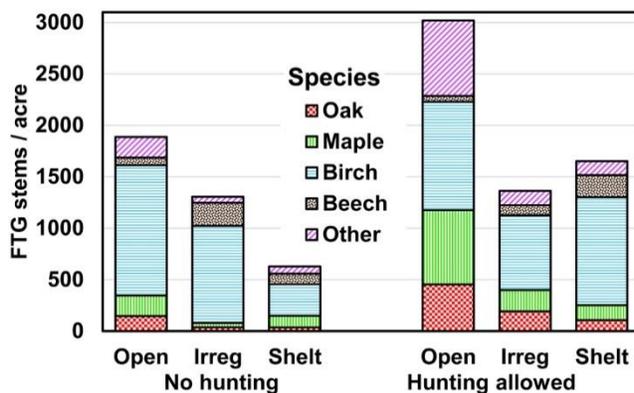


Figure 1. Density and composition of free-to-grow stems varied by residual stand basal area and whether area was hunted.

and had low residual basal areas. FTG oaks were essentially non-existent in most stands with more than 25 ft²/acre where hunting was prohibited. A similar pattern was noted for the grab bag of species labelled Other. Next, hunting had no significant effect on density of either birch (mostly black birch) and beech. The ability of these species to tolerate deer browsing explains in part their increasing importance in areas where deer density is high. Lastly, density of FTG beech was the same regardless of residual basal area. Thus, it is not surprising that beech is increasing in stands with partly-to-moderately shaded conditions and

Whether or not hunting was allowed and residual stand basal area both had a significant influence on free-to-grow (FTG) stem density and on species composition (Fig. 1). For a given residual stand basal area, FTG density was much higher on areas where hunting was permitted. In general, FTG density decreased with increasing residual stand basal area. I should note that a seedling/sapling as designated was FTG in relationship to other seedlings/saplings; it was imagined that pole and sawtimber trees were not there.

So what accounted for differences? First, the highest oak and maple (mostly red maple) FTG densities were on stands that were both hunted

high browsing levels. These findings extend Dr. Ralph Nyland’s mandate of “shoot the deer, poison the beech” for regenerating Adirondack hardwoods to our oak forests.

While the likelihood of obtaining adequate oak regeneration is low where hunting is prohibited and lower still in stands with high residual basal area, there occasionally occurs good oak regeneration in un hunted shelterwood stands. Conversely, we have all seen oak regeneration failure in areas with low browse intensity following a complete overstory removal. So what are the odds of success?

If we make the generous assumption that every sample point with at least one free-to-grow oak will have a free-to-grow oak at age 12, then we can estimate a probability of obtaining adequate oak regeneration. Because the standard of how many FTG oaks there should be for the management goal to be successful will vary among ownerships and foresters, several different categories are presented in Figure 2. Please realize that the numbers presented here are preliminary estimates through stand age 12. How many of these oaks will survive and grow into the sawtimber size class will be lower. If you are an optimist, when most of those not directly competing with other oaks will remain in the upper canopy. If on the other hand you are a pessimist, no more than half will remain in the upper canopy through age 50 and fewer than one-quarter through age 100.

Unless you are an optimist and your management goal is fewer than fifty oaks per acre, it is clear that obtaining adequate oak will require both low residual basal area and a reduction of browse damage. If either of these conditions cannot be met, then a prescription to regenerate other species (e.g., sugar maple) should be considered. The dramatic reduction of FTG oak in irregular shelterwoods relative to open stands was a surprise. Earlier studies in West Virginia found irregular shelterwoods had good oak regeneration for the first ten years. Oak regeneration then greatly decreased through stand age 20 as the crowns of residual oaks expanded by nearly 90%. If this delayed expansion of residual crowns also occurs in New England, then we can anticipate a corresponding decrease in the number of FTG oak.

Impact: This study indicates that successfully regenerating oak will require both heavy cutting to reduce, if not eliminate, overstory density and a method such as hunting to reduce deer browse damage levels.

Deer Herbivory Exclosure Study
(Drs. Scott C. Williams and Megan Linske assisted by Mr. Michael R. Short)

Deer Herbivory Exclosure Study

(Drs. Scott C. Williams and Megan Linske assisted by Mr. Michael R. Short)

One method to study the impact of deer on natural ecosystems is to compare growth rates and species diversity of vegetation protected from white-tailed deer (*Odocoileus virginianus*) herbivory to unprotected plots. Drs. Scott Williams and Megan Linske are collecting vegetation data within deer exclosures and adjacent control plots in collaboration with the Metropolitan District Commission (MDC) and the Wildlife Division of the Connecticut Department of Energy and Environmental Protection (DEEP). Deer exclosures prevent deer from accessing vegetation within. Growth rates and species diversity of enclosed vegetation

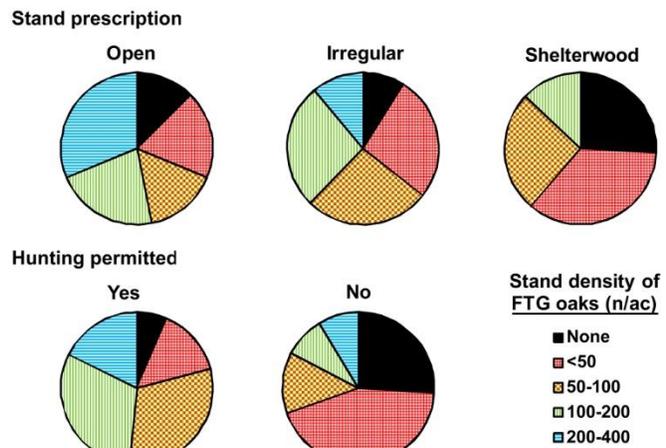


Figure 2. The proportion of stands with adequate oak regeneration is decreased by residual stand basal area and by lack of hunting.

are compared with that of an adjacent control plot, where deer have access to vegetation. Plots have been sampled for woody and herbaceous plants for the past several years. Preliminary data analyses indicate that herbaceous cover within exclosures is greater than control plots. Density of tree seedlings at least two feet tall is twice as high within exclosures compared to control plots. All locations will be resampled for both woody and herbaceous vegetation in late summer 2019. Results from this study will reveal plant species composition and growth rates in the absence of browsing deer. An additional deer fence was erected elsewhere on the property to investigate impacts to different silvicultural treatments in the presence and absence of deer browsing.



Drs. Scott Williams and Megan Linske and technician Michael Short sampling oak regeneration in a control plot adjacent to a deer exclosure in a recent clearcut, Barkhamsted, CT.

Impact: Overabundant herds of white-tailed deer negatively affect forest regeneration by repeated herbivory. This in turn will negatively affect the future of the timber industry and other wildlife populations in Connecticut. CT DEEP and MDC are using these data to scientifically justify and document the results of their deer management program to limit overbrowsing of vegetation by white-tailed deer to insure forest regeneration to protect the drinking water supply of greater Hartford. The Metropolitan District Commission will use these data to monitor similar impacts by overabundant deer but as it relates to water quality in terms of minimizing erosion and siltation into surface drinking water bodies.

New Crops Program

(Dr. Abigail A. Maynard)

Investigation of new crops is essential to provide new opportunities for farmers during a time of changing agriculture in Connecticut. Today, about 11,000 acres on 733 farms in Connecticut are devoted to vegetable production with a cash value of 30.2 million dollars. This compares to 19.1 million dollars from 582 farms in 2002. Seventy-nine percent of these farms are less than 100 acres in size; sixty-three percent are less than 50 acres in size. With numerous small farms, there is a need for growers to find a diversity of high value niche crops. In addition, small farm sizes in Connecticut have resulted in marketing shifts from wholesale

contracts with local supermarkets to direct retail sales. Approximately 560 farms offer direct sales through roadside stands and sales rooms, where a variety of fruit, vegetables, nursery stock, and Christmas trees are offered. About 16 of these are open all year. Nearly 20% of these farms offer pick-your-own fruit and vegetables to reduce the cost of harvest labor. These savings are passed on to the consumer.

The development of a network of farmers' markets in Connecticut's major urban centers and densely populated suburbs is an important segment of direct sales of vegetables to consumers. All produce sold at farmers' markets must be "Connecticut Grown." Farm fresh produce is offered at reasonable prices to urbanites who cannot travel to the farms. Niche crops valued by diverse ethnic groups are generally sold at these markets. According to the Connecticut Department of Agriculture, there were 120 farmers' markets in 2018, attended by over 300 farmers compared to 87 markets in 2007, a 38% increase.

As the popularity of farmers' markets in Connecticut have surged, so too has the need for growers to find a diversity of high value niche crops. Consumers used to a wide variety of fruits and vegetables in large supermarkets are seeking a greater diversity of ethnic and specialty crops at farmers' markets and roadside stands. A recent survey of vegetable growers by The Connecticut Agricultural Experiment Station showed that over 70 vegetable crops are currently being grown in Connecticut. The Connecticut Agricultural Experiment Station has been investigating specialty crops to provide new opportunities for Connecticut's farmers since 1982. Over 50 fruits and vegetables have been studied resulting in over 50 publications. Results have been, and continue to be, communicated to growers at meetings and farm visits. Some of the crops studied in the New Crops Program include globe artichoke, Belgian endive, radicchio, heirloom tomatoes, sweet potatoes, specialty melons, okra, and tomatillos. Research included cultivar trials and experiments to determine the best cultural methods for growing each specific crop in Connecticut. Crops that were chosen have a high market value and an existing or expanding market that would readily accommodate these commodities.

Sweet Potato Trials: A 1998 Connecticut Department of Agriculture survey noted that sweet potato is one of the most popular specialty vegetables. In addition, it is very nutritious, with high values of beta carotene (vitamin A) and vitamin C. North Carolina and Louisiana are the leading US producers where they are grown in hilled soil, but we have found that they can easily be grown in Connecticut. Since they have a long growing season and thrive in warm soil, they have always been grown in the Northeast with black plastic mulch. However, black plastic mulch and hilling the soil increases both the labor and the cost per acre of producing the crop. In 2018, Dr. Maynard evaluated the effect of different cultural treatments on the yield and quality of sweet potatoes. There were 4 treatments: black plastic/flat soil, black plastic/hilled soil, no mulch/flat soil, and no mulch/hilled soil.

Impact: The greatest yields were from plots amended with black plastic mulch (7.1 lbs/plant) compared to bare soil plots (4.1 lbs/plant). By growing sweet potatoes on black plastic instead of on bare soil, the grower can produce over 43,500 more pounds/acre. At a retail price of \$0.99/lb, the grower can gross over \$43,000 per acre by utilizing black plastic. Hilled plots averaged 5.6 lbs/plant compared to 5.5 lbs/plant from flat soil plots. Thus, hilling the soil is not necessary to produce optimum yields. The long-term benefits of growing sweet potatoes include additional revenue for farmers and providing a product that has growing consumer demand. In addition, there may be health benefits for those who consume sweet potatoes. About 43% of vegetable growers in Connecticut grow sweet potatoes.

Brussels Sprouts Trials: Brussels sprouts are related to other better-known vegetables in the mustard family including broccoli, cabbage, and cauliflower. Typically, it is grown as an annual and the axillary buds, which resemble miniature cabbages, are harvested either by hand with several harvests of 5-15 sprouts, or by cutting the entire stalk at once for processing. Each stalk can produce about 2 lbs per stalk. Brussels sprouts grow best in temperatures ranges of 45-75°F with the highest yields at 60-65°F. Quality does not decrease from freezing, and, in fact, sprouts are considered to be sweetest after a frost. Sprouts that develop in hot weather often do not form compact heads and can be bitter. In 2018, Dr. Maynard evaluated the yield and quality of ten cultivars of Brussels sprouts at Windsor and Lockwood Farm. In addition, the crop was grown with and without black plastic mulch. Black plastic mulch controls weeds. However, as Brussels sprouts are cool loving plants and black plastic raises the soil temperature, it is important to determine the effect of plasticulture on the yield and quality of marketable sprouts in Connecticut



Impact: Jade Cross E (5.6 lbs/plant) averaged the greatest yields followed by Dagan (4.7 lbs/plant), and Dimitri (4.6 lbs/plant). Cultivar selection can dramatically increase yields and grower profits. By growing the cultivar Jade Cross E (5.6 lbs/plant) instead of the cultivar Igor (2.2 lbs/plant), the grower can produce almost 33,000 more pounds per acre of Brussels sprouts. At a retail price of 3.50/lb, the grower can gross over \$115,000 more per acre by growing Jade Cross E. Average yield from the black plastic amended plots were 3.4 lbs/plants compared to 4.2 lbs/plant from the bare soil plots. Using black plastic reduced the yield almost 8,000 lbs/acre or gross revenue of about \$27,000. The long-term benefits of growing Brussels sprouts include providing a product that has growing consumer demand and additional revenue for growers who attend farmers' markets or have their own roadside stands. In addition, there may be health benefits for those who consume Brussels sprouts. About 30% of vegetable growers in Connecticut grow Brussels sprouts.

Butternut Squash Trials: Winter squash varieties such as butternut, buttercup, acorn, and Hubbard have long been favorite fall crops for vegetable growers who operate roadside stands and attend farmers' markets. An Experiment Station survey of vegetable growers found that 93% grow winter squash with butternut squash the most popular. Consumers often purchase by the bushel because they store well and can be eaten well into the winter months. Most squash varieties are long-vined and discourage home growers with limited space. New cultivars have been developed that produce fruit on shorter vines, allowing closer spacing. In 2018, Dr. Maynard evaluated the yield and quality of 5 semi bush butternut squash varieties and 5 traditional long vined varieties at Lockwood Farm and Windsor.

Impact: Atlas (semi bush) averaged the greatest yields (19.7 lbs/plant) followed by Ultra (long-vined) (19.1 lbs/plant). Cultivar selection can dramatically increase yields and grower profits. By growing the cultivar Atlas (19.7 lbs/plant) instead of another semi bush cultivar Butternut 900 (6.7 lbs/plant), the grower can produce almost 63,000 more pounds per acre of butternut squash. At a retail price of \$0.59/pound, the grower can gross over \$37,000 more per acre by growing Atlas. For long vined varieties, by growing Ultra (19.1 lbs/plant) instead of Avalon (7.0 lbs/plant), the grower can produce almost 59,000 more pounds per acre of butternut squash. At a retail price of \$0.59/pound, the grower can gross almost \$35,000 more per acre by growing Ultra. The long-term benefits of growing butternut squash include providing a product that has growing consumer demand and additional revenue for growers who attend farmers' markets or have their own roadside stands. Butternut squash is an especially important product for growers in the fall after a frost when other vegetables are not available.



Heirloom tomato trials: In 2012, tomatoes were the most popular vegetable crop grown in Connecticut with 631 farms growing the fruit. According to an Experiment Station survey, 78% tomato growers grow heirloom tomatoes. A strong market for heirloom tomatoes has developed because home gardeners and consumers seek tomatoes with excellent flavor in a variety of colors, shapes, and sizes. Consumers perceive that heirlooms taste better and have thinner skins than hybridized tomatoes. In addition, heirloom tomatoes demand a higher price on the marketplace. Heirloom tomatoes provide an excellent opportunity

for local growers, despite several production problems. Most heirloom tomatoes have little disease resistance. In addition, because their skin is tender, heirloom varieties may crack easily. Earlier variety trials were conducted on heirloom tomatoes 2004-2006 and 2007-2009 in which a total of 57 varieties were evaluated. A 2018 catalog from Totally Tomatoes lists 138 different heirlooms. In 2018, Dr. Maynard evaluated the yield, quality, and disease resistance of 10 (previously not tested at CAES) heirloom tomato varieties at Lockwood Farm and at Windsor.

Impact: Granny Cantrell had the greatest yields (46.7 lbs/plant) followed by Mrs. Maxwell's Big Italian (38.4 lbs/plant), Mule Train (37.7 lbs/plant), and Dester (35.3 lbs/plant). Golden Jubilee (28.4 lbs/plant) also produced consistently excellent quality fruit. Cultivar selection can dramatically increase yields and grower profits. By growing Granny Cantrell (46.7 lbs/plant) instead of Fireworks (21.7 lbs/plant, the grower can produce 25 more pounds for each heirloom tomato plant. At a retail price of \$3.49/pound, the grower can gross almost \$90 more per plant by growing Granny Cantrell instead of Fireworks. Comparing heirloom tomatoes with conventional tomatoes, the average total yield of the two research plots (150 plants) was 3,789 lbs or a retail value of \$13,224. The same yield of the same number of conventional tomatoes would have a retail value of \$7,616 (\$2.01/pound). The long-term benefits of growing heirloom tomatoes include providing a product that has growing consumer demand and additional revenue for growers who attend farmers' markets or have their own roadside stands.

Pawpaw Trials: Pawpaws are shrubby trees that are native to the temperate woodlands of the eastern United States. The American Indian is credited with spreading pawpaws across the eastern U.S. to eastern Kansas and Texas, and from the Great Lakes almost to the Gulf. They are woodland understory plants that need shade to protect the seedlings but once established prefer full sun. They produce maroon, upside-down flowers which are self-incompatible, requiring cross pollination from another unrelated pawpaw tree. They are not pollinated by bees but by flies and beetles. The pawpaw is the largest edible fruit native to America. Individual fruits weigh 5 to 16 ounces and are 3 to 6 inches in length. The tasty fruit has a smooth, custard texture. In this trial, 4 cultivars of pawpaws were planted in 2002. Since 2013, annual yields were recorded from each tree.

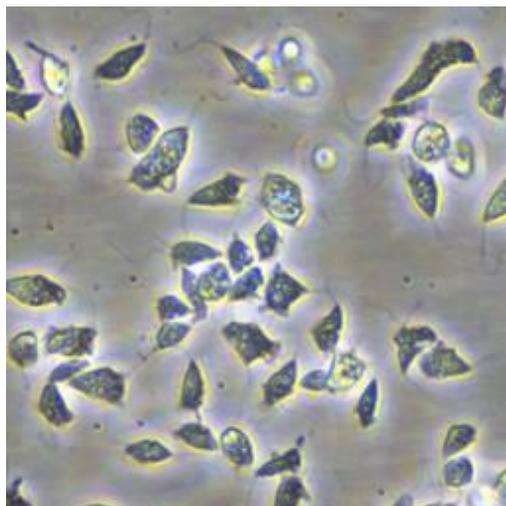
Impact: Thus far, the cultivars Rebecca's Gold and Overleese have averaged the greatest yields (72 and 49 fruit/tree, respectively) with Sunflower producing the largest fruit (8.1 oz/fruit). Pawpaws are an ideal fruit for Connecticut growers who attend farmers' markets or have their own roadside stands as they are very delicate and difficult to ship long distances. The long-term benefits of growing pawpaws include an additional unique product and revenue for growers.

PLANT PATHOLOGY AND ECOLOGY

The Department of Plant Pathology and Ecology is led by Chief Scientist Dr. Wade Elmer and has seven research scientists that are supported by two full-time technicians. The Plant Disease Information Office serves as the Department Flag Ship serving the citizenry and agricultural industries of Connecticut and provides vital support to other Connecticut state agencies and CAES departments. The department has active cutting-edge research programs that address important disease problems caused by bacterial, fungal, and viral pathogens of crops important to Connecticut while addressing national and international issues.

RESEARCH ACTIVITIES

The Roles of Protists in Shaping Microbiomes and Plant Health



Dr. Lindsay Triplett and Dr. Blaire Steven (Environmental Sciences), along with collaborators at the University of Connecticut, initiated a USDA-funded project in 2019 to understand the functional roles of protists in shaping bacterial communities of plant roots. Protists are single-celled organisms that prey upon bacteria in the soil, and some protists can greatly enhance plant growth by releasing nitrogen or feeding on harmful bacteria. This study will characterize the diversity of soil protists and bacteria associated with the roots of corn grown at CAES research farms in Griswold and Hamden, and will isolate protists for studies on their feeding patterns, growth characteristics, and roles in plant health.

Soil Protist (courtesy Dr. A. Jousset, Utrecht University, The Netherlands)

Impact: Plant-associated microbes have a strong influence on the sustainability of crops and ecosystems, and the market for beneficial microbial products has surpassed \$2 billion. However, the roles of protists among these microbes are still poorly understood. This study will help us understand which protists are most beneficial to plants and why, and which could lead to new protist-based strategies for crop enhancement.

Effect of Crop Domestication on the Evolution of Agriculturally Important Pathogens

Erwinia amylovora is the causal agent of fire blight, one of the most devastating diseases of apple and pear. *E. amylovora* is thought to have originated in North America and has now spread to at least 50 countries worldwide. *E. amylovora* is highly homogeneous, which could be caused by an evolutionary bottleneck due to the domestication of apples and pears. To better understand the pathogen evolution, we performed an extended search for disease symptoms on non-crop rosaceous hosts (other than apple and pear), such as mountain ash, crabapple, and hawthorn. Some of these samples were collected in collaboration with the Arnold Arboretum of Harvard University in Boston, MA. We are currently performing genome analysis of these isolates and comparison between them and the apple and pear isolates trying to find clues about how our domestication of crops affected the evolution of the pathogens.

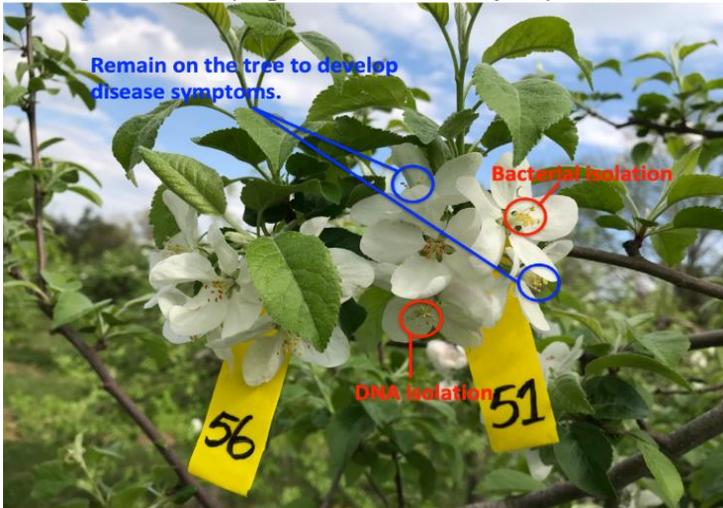


Dr. Quan Zeng and Dr. Andrew Kapinski of Harvard University, and Jon Clements of UMass Amherst, collected samples from a diseased mountain ash tree at the Arnold Arboretum of Harvard University.

Impact: Our results inform us that although domestication of crops and intensive field production increases the agricultural productivity, it may also promote the evolution of economically important pests.

The Influence of Apple Flower Phytobiome to the Infection of Fire Blight Disease

Apple flowers are not only important reproductive organs of plants but also the main entry points of many economically important pests. In this study, we are trying to understand the microbiome composition and its impact to the infection of fire blight, an important disease of apple and pear. This study is based on an observation that when flowers were evenly inoculated with the pathogen, only 40% of the flowers later developed disease symptoms while the majority of the flowers remained healthy. We hypothesize that each



individual flower harbors a unique set of microbiome, which determines whether a flower will be susceptible to *E. amylovora* infection or not.

Apple flower clusters tagged for the flower microbiome research at Lockwood Farm in 2018.

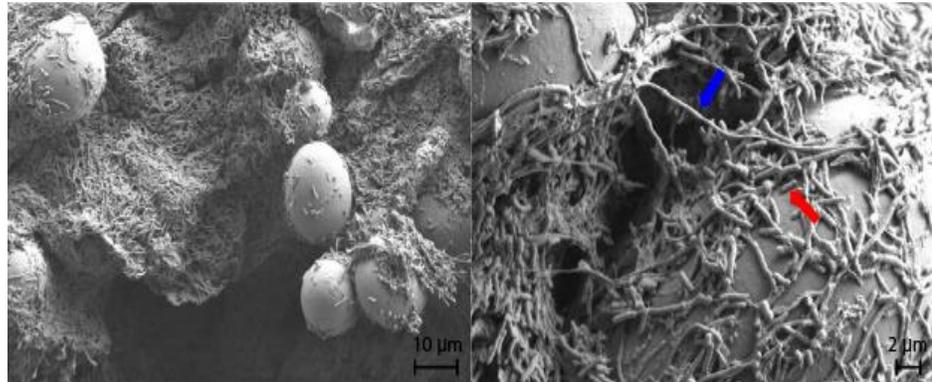
Our findings identified an antagonistic relationship between the fire blight pathogen *E. amylovora* and the Pseudomonadaceae family of bacteria, suggesting a potential niche exclusion relationship between these taxa.

Impact: The management of fire blight is challenged by the spread of streptomycin resistance in the pathogen population. While the streptomycin is less useful in fire blight management, alternative control measures have not been developed yet. In Connecticut, most growers still rely heavily on the streptomycin spray. This not only puts the growers at risk of control failure in case of resistance, but also significantly limits the organic tree fruit production in CT, as antibiotics are no longer allowed in organic production after 2014. Thus, effective, environmentally-friendly options for fire blight control are urgently needed in CT.

Characterize the Growth/Virulence Trade-offs in the Plant Pathogen *Dickeya dadantii*

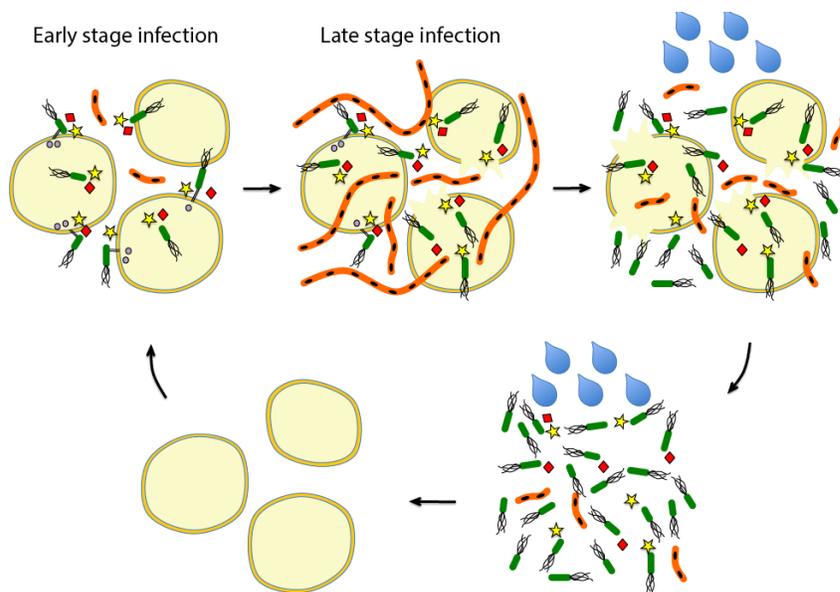
Necrotrophic plant pathogens acquire nutrients from dead plant cells, which requires the disintegration of the plant cell wall and tissue structures by the pathogen.

Filamentous cells and short cells of *D. dadantii* formed on potato tuber during later stage of infection at two magnifications.



Infected plants lose tissue integrity and functional immunity as a result, exposing the nutrient rich, decayed tissues to the environment. One challenge for the necrotrophs to successfully cause secondary infection (infection spread from an initially infected plant to the nearby uninfected plants) is to effectively utilize nutrients released from hosts towards building up a large population before other saprophytes come. In this study, we observed that the necrotrophic pathogen *Dickeya dadantii* exhibited heterogeneity in bacterial cell length in an isogenic population during infection of potato tuber. While some cells were regular rod-shape (<10 μm), the rest elongated into filamentous cells (>10 μm). Short cells tended to occur at the interface of healthy and diseased tissues, during the early stage of infection when active attacking and killing is occurring, while filamentous cells tended to form at a later stage of infection. Short cells expressed all necessary virulence factors and motility, whereas filamentous cells did not engage in virulence, were non-mobile and more sensitive to environmental stress. However, compared to the short cells, the filamentous cells displayed upregulated metabolic genes and increased growth, which may benefit the pathogens to build up a large population necessary for the secondary infection. The segregation of the two subpopulations was dependent on differential production of the alarmone guanosine tetraphosphate (ppGpp). When exposed to fresh tuber tissues or freestanding water, filamentous cells quickly transformed to short virulent cells. The pathogen adaptation of cell length heterogeneity identified in this study presents a model for how some necrotrophs balance virulence and vegetative growth to maximize fitness during infection.

Impact: Virulence and vegetative growth are two distinct lifestyles in pathogenic bacteria. Although virulence factors are critical for pathogens to successfully cause infections, producing these factors is costly and imposes growth penalty to the pathogen. Although each single bacterial cell exists in one lifestyle or the other at any moment, we demonstrated in this study that a bacterial population could accomplish the two functions simultaneously by maintaining subpopulations of cells in each of the two lifestyles. During the invasion of potato tuber, the soft rot pathogen *Dickeya dadantii* formed two distinct subpopulations characterized by their cell morphology. The population consisting of short cells actively produced virulence factors to break down host tissues, whereas the other population, consisting of filamentous cells, was only engaged in vegetative growth and was non-virulent. We hypothesize that this phenotypic heterogeneity allows *D. dadantii* to break down plant tissues and release nutrients, while efficiently utilizing nutrients needed to build up a large pathogen population at the same time. Our study provides insights into how phenotypic heterogeneity could grant bacteria abilities to “multi-task” distinct functions as a population.



An illustration of the model for the *D. dadantii* short cell/filamentous cell differentiation and their respective functions during the infection of potato tuber (Left). At the early stage of infection, the majority of *D. dadantii* cells are in the short cell morphology (green colored). These short cells produce pectate lyases (diamonds and stars) to disintegrate plant cell wall and secrete type III effector proteins (circles) to induce host cell death. As infection progresses,

many plant cells are killed and nutrients are released, a subpopulation of filamentous cells starts to emerge (orange-colored). These filamentous cells do not produce any virulence factors, do not have motility, and are relatively sensitive to environmental stress. However, these cells have much faster metabolism than the short cells, which enable them to more efficiently consume the nutrients released and build up a large population. When environmental conditions favor infection or spread (e.g., when freestanding water is present), the filamentous cells which contain multiple nucleoids, convert back to short cells and cause secondary infection.

Characterization of Stress-Tolerant Physiological States of Plant Pathogenic Bacteria

Antimicrobial treatments often leave behind a small population of survivor bacteria, and this is hypothesized to arise from a portion of the population that is in a state of dormancy. Dr. Lindsay Triplett, along with collaborators at the Pennsylvania State University, initiated a USDA-funded project in 2019 to understand the physiological and genetic basis of this survival state, and to determine whether it impacts the effectiveness of biological control treatments or plant genetic resistance. Early experiments in this project found that treatment of the pathogen *Pseudomonas syringae* with the antibiotic streptomycin caused a significant increase in the proportion of cells having a unique combination of physiological characteristics. Future work will determine whether these cells are culturable or associated with stress survival.

Impact: Antibiotic and biological control treatments are widely relied upon to control many bacterial crop diseases, but bacteria that survive can still damage crops and evolve resistance to these treatments. Understanding why some bacteria survive long periods of exposure can help us design ways to increase the effectiveness and lower the cost of disease control products.

The Contribution of Toxin-Antitoxin Systems to Bacterial Plant Disease

Toxin-antitoxin systems are genetic modules that help human bacterial pathogens survive antibiotic treatments. Drs. Lindsay Triplett and Quan Zeng, along with postdoctoral researcher Dr. Teja Shidore, continued a project identifying the roles of numerous different toxin-antitoxin systems in bacterial plant disease. Previously Dr. Shidore characterized the role of five potential TA systems in the fire blight pathogen *Erwinia amylovora*, a significant disease in Connecticut orchards, and showed that one system was required for persistence of *E. amylovora* to the antibiotic spray streptomycin. This year, she validated the function of three TA systems; discovered that the persistence gene inhibits cell division, which may

help slow *E. amylovora* growth and result in better antibiotic survival; and found that other TA systems may play an important role in pathogen fitness during other stresses and during infection on pear fruit. With collaborators at Michigan State University, the researchers have also characterized the function of the membrane-disrupting toxin *hok*, identifying a potential antibiotic survival role.

Impact: In addition to being virulence factors, toxin-antitoxin systems are thought to play a major role in bacterial survival of antibiotics and survival in the host, making it difficult to eradicate disease in an area. Discovering which ones are important will tell us which ones to target for disease control strategies, and which ones could be used to improve biocontrol strains for improved survival.

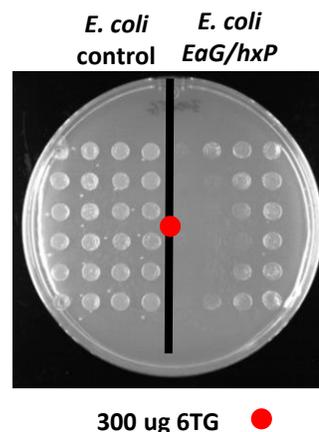
Nucleobase Transport in Fire Blight Disease

Dr. Schultes is studying *Erwinia amylovora*, the causal agent of a devastating disease of apples and pears called fire blight. Fire blight causes large losses in apple and pear production and is a major disease for commercial farmers. Like other bacteria, *E. amylovora* has a panel of membrane localized transporters that import nitrogen-rich purines and pyrimidines from the environment – effectively increasing its growth potential. *E. amylovora* also produces and excretes purine guanine derivatives called 6-thioguanine. This antimetabolite is toxic to other microbes and plant cells and is thought to aid in disease establishment. Dr. Schultes’ objectives are: 1) to determine the function and biochemical properties of nucleobase cation symporter 2 (NCS2) transporters from *E. amylovora*; 2) to determine if these transporters can move the toxic purine derivative, 6-thioguanine, that *E. amylovora* synthesizes and excretes; 3) to determine if these transporters contribute to pathogen establishment on the host; and 4) to isolate the gene for a known guanine transporter from apple – the nucleobase cation symporter 1 (NCS1) - and determine if it can transport 6-thioguanine. We have determined the function of the *E. amylovora* uracil transporter, guanine-hypoxanthine transporter, adenine transporter and xanthine transporter through heterologous complementation in *E. coli* strains deficient for endogenous nucleobase transporters. Only the guanine-hypoxanthine transporter is capable of transporting 6-thioguanine. We have also generated specific gene deletion-insertion mutations in the *E. amylovora* genes encoding for the guanine-hypoxanthine, adenine and uracil transporters. These mutant *E. amylovora* lines were compared with wild type *E. amylovora* line Ea1189 in immature pear pathogenicity tests and determined that there is no difference in pathogenicity. Using the same heterologous expression system in *E. coli*, it was shown that the apple NCS1 can transport guanine and 6-thioguanine with high affinity. The function of the apple NCS1 transporter was also determined through heterologous expression in the *E. coli* mutants and transported both guanine and 6-thioguanine with high affinity.



Pear pathogenicity tests revealed that the *E. amylovora* strain carrying a deletion of the guanine hypoxanthine transporter gene (Δ G/HX) can still cause disease symptoms once inoculated into immature pears.

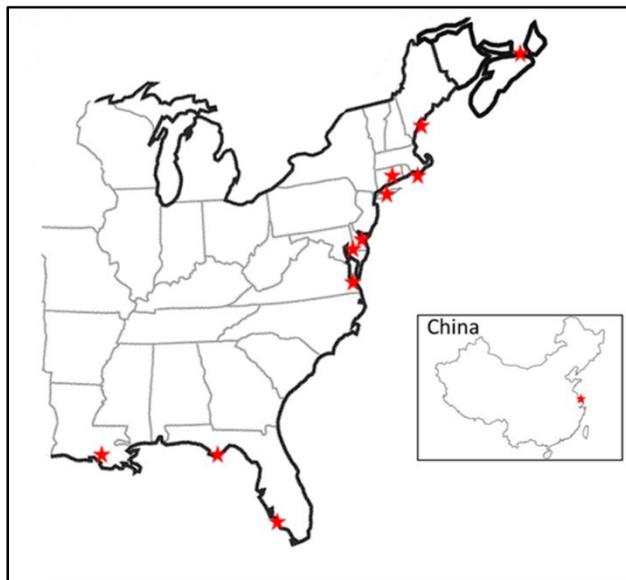
Growth inhibition of *E. coli* control strains (left) or containing the *Erwinia amylovora* Guanine/hypoxanthine transporter gene [EaG/hxP] (right) to 300 micrograms of 6-thioguanine diffusing from a spot in the center of the petri plate.



Impact: Comprehending how *Erwinia amylovora* utilizes the nucleobases and the derivative – 6 thio-guanine – in disease establishment will contribute to devising new strategies for fire blight control. The research is being conducted by Dr. Neil Schultes and a colleague Dr. George Mourad in the Dept. of Biology at Purdue University, Fort Wayne, IN.

Genetic Variation and Dispersal Dynamics in *Fusarium palustre*, Associated with Sudden Vegetation Dieback in Salt Marshes of Eastern United States

Dr. Bob Marra's research on *Fusarium palustre*, the fungal pathogen of *Spartina alterniflora* (described previously by Drs. Elmer and Marra) made significant progress this past year. Because of the unique nature of *F. palustre* distribution, Dr. Marra is interested in testing hypotheses about the introduction and spread of the pathogen, and relatedness among populations. Distribution of the 32 isolates comprising the population used to screen microsatellite loci for length polymorphisms (i.e., the number of repeats of the targeted microsatellite motif) (right).



A key component of wetland dieback syndrome, *F. palustre* has been shown by Dr. Marra to have a surprisingly high degree of genetic diversity both within and among populations sampled from various marshes ranging from Louisiana to Maine.

In addition to constructing molecular phylogenies using DNA sequences from three genes, Dr. Marra has used Amplified Fragment Length Polymorphisms (AFLP) in a previous study to show a significant amount of genetic variability among a group of approximately 100 *F. palustre* isolates from North America as well as several from China. The genetic diversity in *F. palustre* demonstrated via AFLP analysis was unexpected, given the absence of an observed sexual state, and therefore no obvious known means for generation the observed levels of genotypic diversity. This warranted the development of a more robust set of genetic markers for purposes of studying the epidemiology of this fungus. To that end, Southern Connecticut State University graduate student Alysha Auslender completed and successfully defended her Master's thesis research, in which she developed a suite of 47 microsatellite markers, all of which showed remarkably high genetic diversity. Dr. Marra and Ms. Auslender first generated a whole-genome sequence for the fungus' type specimen, CaesSaCT2, through the facilities at the Yale Center for Genome Analysis. The genome was then queried for tri-, tetra-, and pentanucleotide microsatellite motifs. Primers were then designed to flank these candidate microsatellite loci, and then used to screen for length polymorphisms against a screening population of 32 isolates representing the currently known distribution of the fungus: Louisiana, Florida, Virginia, Maryland, Delaware, New York, Connecticut, Massachusetts, Maine, and Nova Scotia, as well as China. All isolates were confirmed to be *F. palustre* based on morphological conformation as well as through a phylogenetic analysis of sequences from the translation elongation factor-1 (*tef1*) gene. All 47 tested microsatellite loci were polymorphic among the isolates of the screening population, with 23 loci having more than 10 alleles segregating in the screening population. These highly informative markers are now being used to test hypotheses on population subdivision and genotypic diversity using populations of *F. palustre* from two nearby but disjunct saltmarshes affected by SVD.

Impact: Nothing is known about the means of dispersal of *F. palustre* from one salt marsh to the next. This is particularly intriguing given that salt marshes are typically disjunct in their distribution, and experience tidal inundation on a daily basis, suggesting the possibility that dispersal is by means of water. We currently do not know the means by which *F. palustre* generates these high levels of genetic and genotypic diversity

among the sampled isolates, a conundrum given the absence of a known sexual state. Research into the epidemiology and dispersal dynamics of this fungus is critical, given the importance of salt marches as buffers against the impacts of climate change and associated sea-level rise on coastal ecology.

Forty-seven microsatellite loci determined to be polymorphic among the isolates of the screening population (right).

Neonectria Canker Caused by *Neonectria ditissima*

Perennial Target Canker (also known as Neonectria canker) continues to be researched by Dr. Marra. This research focuses on the ecology and genetics of the causal agent of perennial target canker, the fungal pathogen, *Neonectria ditissima*. The goal of this research is to gain a fuller understanding of the life history, evolution, population dynamics, and host-interactions of *N. ditissima*, particularly with respect to its principal hosts, black and yellow birch (*Betula lenta* and *B. alleghaniensis*). Fundamental knowledge of the natural history of *N. ditissima* is lacking, yet is an essential component to effective management strategies. Dr. Marra has developed the field techniques and laboratory tools necessary to the study of this fungus and the disease it causes, and has used these tools and methods to examine the relationship between mating system and genetic structure.

Previously, Dr. Marra developed and used a set of 13 polymorphic microsatellite markers to study mating and genetic differentiation in *N. ditissima* from two nearly adjacent sites at West Rock Ridge State Park in New Haven, CT. This study revealed a paradoxical juxtaposition of high levels of genetic diversity alongside high levels of selfing and biparental inbreeding. The results confirm an earlier hypothesis that *N. ditissima* has a “mixed mating system” (selfing and outcrossing occurring in the same population). All observations of selfing were confirmed through the use of AFLPs.

This past year, Dr. Marra generated a whole-genome sequence of a Connecticut isolate, and, working in collaboration with a graduate student, Cameron Stauder, at West Virginia University, used published whole-genome sequences of other isolates of *N. ditissima* to identify the two alleles (idiomorphs), *MAT1-1* and *MAT1-2*, of the mating-type locus (*MAT1*). Screening a collection of isolates obtained from cankers, Dr. Marra and Mr. Stauder have found that *N. ditissima* isolates have either one idiomorph or the other, never both, ruling out the possibility that self-fertilization occurs by virtue of isolates having both idiomorphs in the same haploid genome; such is the paradigm observed in other ascomycetes. Dr. Marra developed a Taqman-based real-time PCR assay to allow for quick and efficient screening of large numbers of isolates. Using this protocol, this year’s USDA Plant Health Fellow, Olivia Rianhard, a student from Eastern Connecticut State University, is assisting with the screening of numerous sets of sexual (ascospore) progeny that have previously been shown to be the result of self-fertilization by analysis at 13 microsatellite loci. Preliminary results are showing that the *MAT1* idiomorphs segregate even among ascospore progeny that appear

Microsatellite Locus	Number of alleles
GAA4	23
TCT5	22
TCCT1	21
TTC4	20
AGA2b	19
GTA2s	19
TCT4s	18
TTC6	18
CTTC1	17
CAGT1	16
AAG1	16
GAAGG1b	16
GAA3s	15
TTC1s	14
CTC2	14
AGA3s	14
AGA1	13
TCC3	13
GTT1s	12
GAA1s	12
CTC3s	12
GTT3s	11
GTT2	11
CAT1	9
GTA1s	9
TCT2s	9
GACAA1	9
ATG2	8
CAT3	8
TTTC1b	8
GTAT1	8
TCC2s	8
ACAGC1	8
TGTA1	8
TGA1	8
ATC1	7
AAC1s	7
AAGA1	7
TGAGG1s	7
TGC1	7
GCA1b	7
CAT2	6
TTG1	5
TCC1b	5
GAC1	5
ATG1	4
CTC1s	2

otherwise to be the result of self-fertilization, despite the occurrence of only one or the other idiomorph in the parental genome. This observation may be a first, and warrants further investigation into this genetic conundrum.



Black birch (*Betula lenta*), with multiple *Neonectria ditissima* cankers distributed along stem. Because cankers typically only form on stems younger than ~15 years of age, lower cankers were likely initiated many years before those higher up the stem.

Impact: Due to its increasing abundance in Connecticut, black birch is a tree of growing importance and concern. Although trees infected with Perennial Canker can persist for decades, the extensive scarring caused by the cankers renders them of little value for lumber or veneer. Our efforts to more fully understand the biology and natural history of *N. ditissima* is an important contribution in the fields of mycology and evolutionary biology, and will contribute to the identification and utilization of control strategies. An important result of this research is that it provides empirical support for theoretical models that posit the importance of biparental inbreeding to the evolutionary stability of mixed mating.

Winegrapes in Connecticut

In cooperative involvement with the federal multi-state project entitled “NE-1720, Multi-state evaluation of winegrape cultivars and clones” (<http://www.ngwi.org/>), Dr. Francis Ferrandino is continuing the project, “Coordinated wine grape variety evaluations in the eastern USA,” which was initiated by Dr. William Nail in 2008. Frequent heavy rainfall this spring and early summer resulted in a heavy outbreak of grape downy mildew, which created variability in fruit set depending on cultivar and the timing of flowering. This year, the three cold-hardy hybrid cultivars (Itasca, Aromella, and Briana) planted in 2017, are coming into fruition and have exhibited considerable resistance to the effects of downy mildew. The performance of the 15 cultivars at the three CAES experimental farms (Windsor, CT; Griswold, CT; and Hamden, CT) will provide information on the effect of climate variation on growth, yield, and disease susceptibility.



Grape downy mildew causes chlorotic spots on the top of leaves and sporulates on the bottom.

Impact: The economic choice of suitable winegrape cultivars is vitally important to the success of a vineyard/winery based on “Connecticut Grown” produce. This choice must be made on the performance of cultivars in producing consistent crops of high quality fruit under varying climatic conditions and a range of disease pressure.

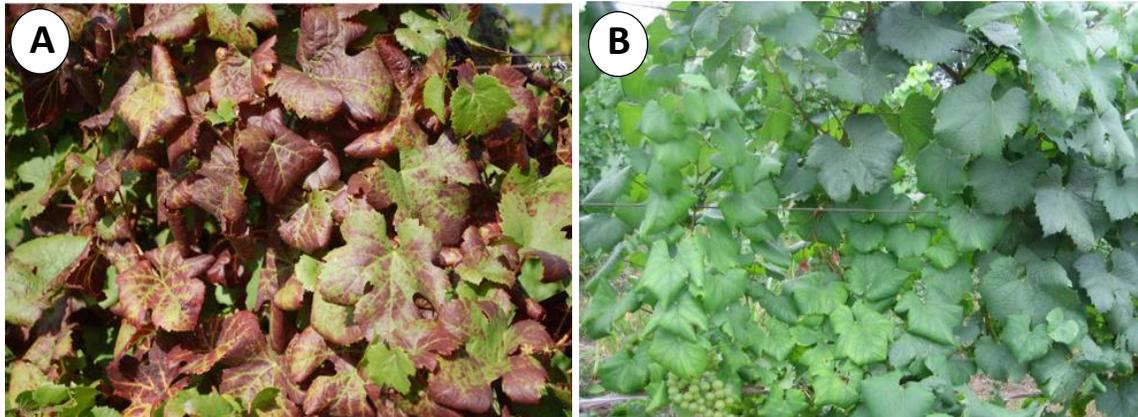
Since 2009, Dr. Ferrandino has maintained three remote sensing weather stations located on the CAES research farms (Hamden, CT; Windsor, CT; and Griswold, CT). Weather data from the three CAES experimental farms is available at: <https://www.hobolink.com/s/d0696313715dd96f86b25f3552cc1f47>. This link is available on the CAES website. Each weather station measures temperature, relative humidity, sunlight, wind speed and direction, rainfall, leaf wetness, and soil temperature every 15 minutes. On-site weather station data are used to calculate disease risk assessments, which are delivered to the winegrape growers on a weekly basis.



Survey for Grapevine Leafroll-Associated Viruses in CT

Dr. da Silva is leading a three-year statewide survey along with Dr. Gale Ridge (Entomology) and Dr. Francis Ferrandino (Co-PI) to investigate the viruses that cause grapevine leafroll disease (GLD). Our objective is to develop efficient management strategies to control this devastating disease in Connecticut vineyards. GLD is the most detrimental and widespread viral disease of grapes worldwide. It can cause up to \$40,000 loss per hectare during a single grape growing season. The only management options are to plant healthy grape seedlings and to eliminate infected plants from vineyards, because arthropod vectors can spread the viruses from infected to healthy plants. The problem is exacerbated because GLD can take up to five years to develop visual symptoms and many common grape cultivars do not show GLD symptoms when infected. Our collaborative effort to identify the extent of the viruses spread and the insect vectors (hemipterans) that transmit these viruses in CT raise awareness among grape growers, vineyard managers, and vintners of the damage caused by these diseases on grape production and quality. CAES is partnering with the CT Department of Agriculture in knowledge dissemination and outreach.

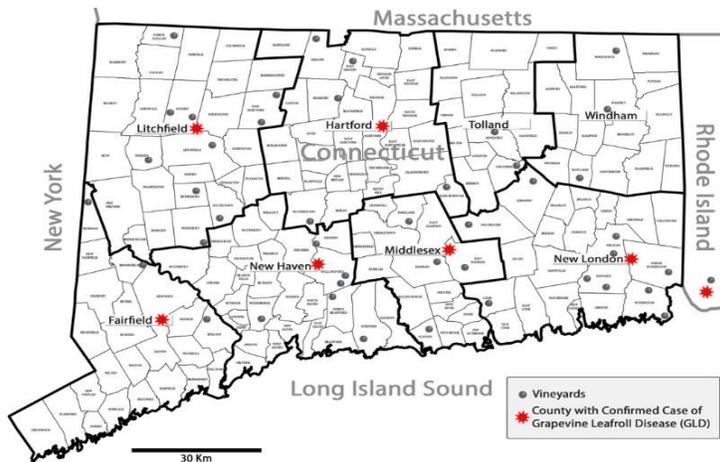
The long-term goal is to develop a statewide management plan that is mechanistically and economically feasible, which might then be adopted by all growers throughout the northeastern region of the United States.



Foliar symptoms of grapevine leafroll disease in Pinot Noir (A) and Chardonnay (B). Credits: Marc Fuchs.



Mosaic-like on leaves and small berry malformation (A) and development of redness on grapevine young shoots and old leaves (B) resembling leafroll diseases.



Map of the state of Connecticut highlighting the location of vineyards (gray dots) and counties with confirmed cases of grapevine leafroll disease (red stars).

Impact: With the survey results in hand, we will be able to assist growers on decision-making processes. We will provide data to growers of the percentage of the vineyards that is infected with leafroll disease and the plants tested so that growers can remove infected plants to reduce the spread of the virus. Our new virology lab at CAES will provide services to growers so that samples can be tested before planting to avoid introduction of grapevine virus diseases in CT vineyards.

Using Nanoparticles to Deliver dsRNA for Controlling Destructive Plant Viruses

The achievement of virus resistance in plants by the application of exogenous double-stranded RNA (dsRNA) is well documented. Essentially, dsRNA is recruited by the plant RNA silencing machinery to guide the cleavage of complementary virus RNA by a sequence-specific manner, resulting in virus infection suppression. The trouble is that the application of naked dsRNA on plant leaves provides a short-lived protection window (~five days) against target viruses—it is quickly assimilated by the plant regulatory mechanisms and also degraded by environmental factors. Nanoparticles have emerged as a promising dsRNA delivering system that protects and gradually delivers dsRNA in plants. Drs. da Silva and Zuverza-Mena are working to develop this technology at CAES with the long-term goal of developing a novel and innovative way to control plant virus infections. Our three specific objectives are: 1) to characterize and screen dsRNAs from tobacco plants infected with Potato virus Y (PVY), 2) to evaluate commercially available nanoparticles and to synthesize and characterize nanoparticles as potential dsRNA delivering systems, and 3) to use nanoparticles to sustainably deliver those dsRNA molecules to protect tobacco plants.

Impact: Tobacco is a valuable crop in Connecticut with an annual farm-gate value of ~\$41 million, which is planted primarily for cigar wrapping and no blemishes are acceptable on the leaves. Potato virus Y (PVY) is associated with deformities on leaves of several solanaceous species, including tobacco, and it has become an endemic disease in CT and neighboring states. In 2009 alone, losses in tobacco linked to PVY infections were greater than \$10 million in CT and contributed to 45% of the crop being discarded—the loss was 100% in some farms, causing growers to cease all production. The results from this research have the potential to change the way that we protect plants and to create sustainable plant virus disease control strategies that will help to mitigate crop losses due to virus diseases in CT tobacco farms.

Using Nanoparticles of Cu, P, and Si to Enhance Plant Health

Nanoparticles (NP) of Cu (CuO and CuPO₃) have shown to be effective promoters of plant health when applied foliarly. Dr. Wade Elmer along with Dr. Jason White (Analytical Chemistry) have partnered with the NSF funded Center for Sustainable Nanotechnology (CSN) to advance the use of NP of Cu, P, and Si in plant health management. Copper plays essential roles in activating enzyme systems that are essential in host defense. For example, polyphenol oxidase is a tetramer that contains four atoms of Cu per molecule and catalyzes the oxidation of *o*-diphenols to produce antifungal *o*-quinones. These and other defense products are increased by NP of Cu. Drs. Elmer, Lindsay Triplett (Plant Pathology and Ecology), and White have conducted numerous greenhouse and field trials on many vegetable and ornamental plants. NP of Cu frequently outperform the NP of other micronutrients like B, Mn, and Zn and provide season-long protection following a single application. We have calculated on eggplant that a single application of NP CuO that costs <\$20.00 per ha could generate up to \$6,300 more profit per ha (\$15,567 per acre) in New England. NP of Cu have also increased yields of pumpkin and cabbage and improved disease suppression of begonia, cyclamen, soybeans, tomatoes, violets, and watermelon.

Phosphorous is an element required in large amounts by plants. Considerable waste occurs each year from excessive applications of P to CT soils, which in turn, leaches into the groundwater, and contaminates waterways and ultimately Long Island Sound. Biodegradable composites produced by CSN colleagues at Johns Hopkins University have been designed to slowly release P over time. Preliminary studies with tomatoes have shown that the degradable composites provided phosphorus nutrition and produced plants that did not differ from plants that received the leachable phosphate salts, but drastically reduced the amount of P that leached from the pot.

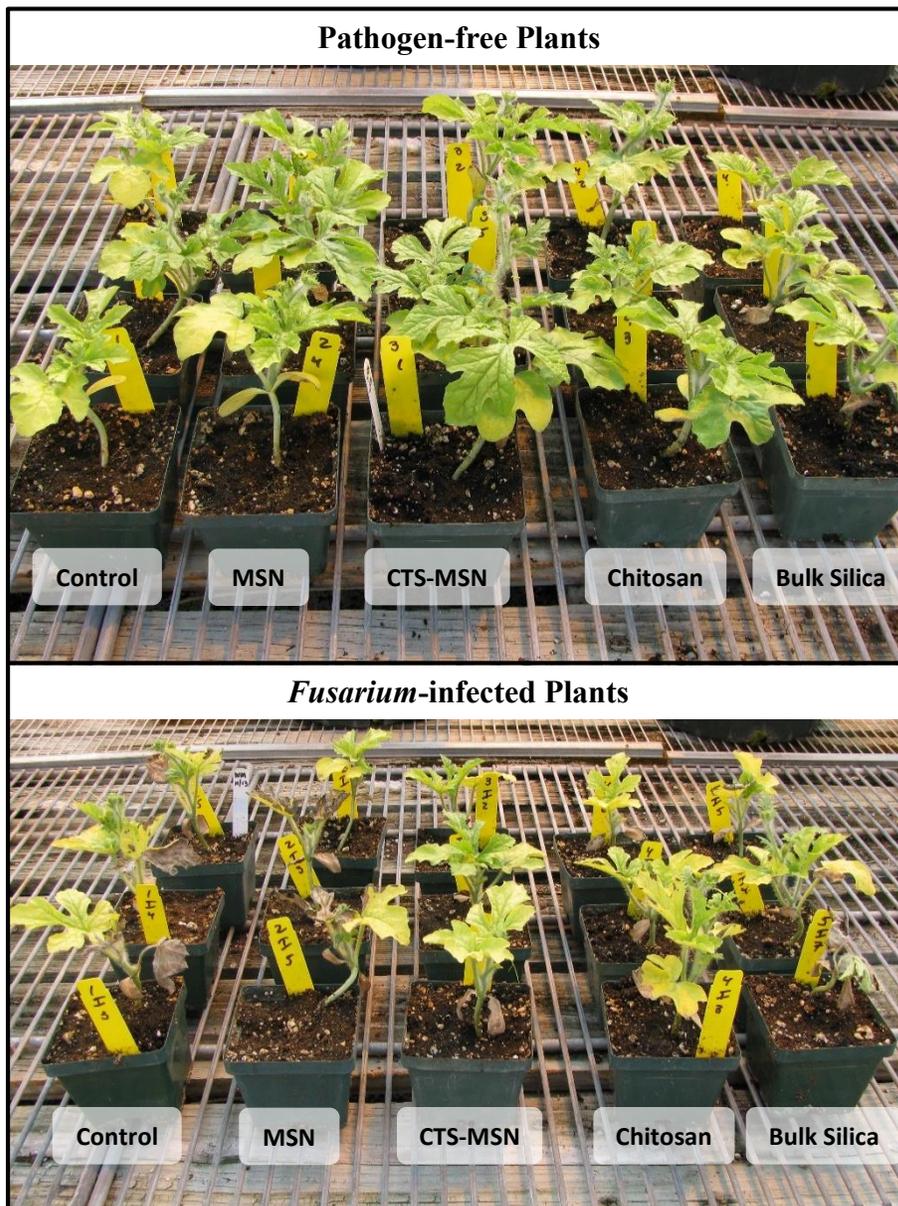


Untreated Control CaPO₄ salt (low rate) CaPO₄ salt (high rate) PHA alone PHA NP (low rate) PHA NP (high Rate)

Comparison of bio-degradable P composites to PP₄ salts on growth of tomato.

Future studies are being designed to assess their effects on yield production. Considerable research has also been conducted using mesoporous silica nanoparticles (MSN) on Si-accumulating species like watermelon. NP MSN composites that were functionalized with Chitosan (CTS), a plant resistance inducing compound, increased seed germination, plant growth, and watermelon yield and reduced the ratings of disease severity. Studies that determine the effect of NP size found NP MSN with smaller sizes (<30 nm) were more effective in increasing biomass and reducing disease ratings than larger size MSN (>50 nm). When MSN composites that possess different dissolution behaviors were examined, we observed that MSN NP composites that released the majority of Si initially as opposed to slowly were better in promoting plant health. MSN NP

constructed with (3-aminopropyl) triethoxysilane (APTES) and N-[3-(Trimethoxy silyl) propyl] ethylenediamine (NPED) were superior to all other formulations.



Images of the non-inoculated plants (top) and *Fusarium*-infected plants (bottom) treated with MSN, MSN plus Chitosan, Chitosan alone, or bulk silica.

Impact: These studies revealed that applications of NPs of Cu, P and Si offer an improve delivery system for applying these elements to susceptible tissues. Nanoparticles offer great promise in increasing food and fiber production without additional chemical inputs may be the new weapon in plant disease management by enhancing plant health for nominal costs and without the cultivation of new land or application of chemical inputs.

Nanoparticle Effects on Chrysanthemum Wilt: An Approach to Incorporate Undergraduate Training into Original Field Research

Dr. Lindsay Triplett and collaborators at Southern Connecticut State University completed the second year of a USDA-funded project to train the next generation of the agricultural workforce through undergraduate research experiences. As part of this project, ten undergraduate students each summer have participated in a group research project aimed at determining the effect of nanoparticle treatments on a fungal wilt disease of chrysanthemums. Students participated in plot design, planting, disease inoculation, taking three types of plant health measurement, and analyzing data. The second year yielded publishable data consistent with

the first year, indicating that some nanoparticle treatments significantly affected chrysanthemum growth. The project was prepared along with Dr. Wade Elmer and maintained by Mr. Peter Thiel and farm staff.



Ten undergraduate researchers participated in a USDA-funded project in 2018. Front row (L-R): Gillian Page, Victoria Romero, Colette McMahon, Ceara Wetterman, Melvin Mercado Ayala, and Dr. Lindsay Triplett (CAES); back row (L-R): Zach Seltzer, Jillian Tate, Tia Brown, Lance Moore, Kelvin Mintah, Dr. Elizabeth Roberts (SCSU), and Dr. Rebecca Silady (SCSU).

Impact: Although field research skills are strongly needed on the job market, there are currently extremely few opportunities nationwide for meaningful undergraduate training in agricultural field research. This project has exposed 30 undergraduate students to participation in a complete field project, and will generate pedagogical resources used to increase opportunities for future students. Second, fungal wilt is a significant problem of Chrysanthemum, which represents a \$124 million market in the United States. The disease can be lethal and is currently only treated with fungicide drenches. Nanoparticles may represent a better alternative for control of root diseases.

Can Nanoparticles Suppress Vascular Wilt Diseases of Trees?

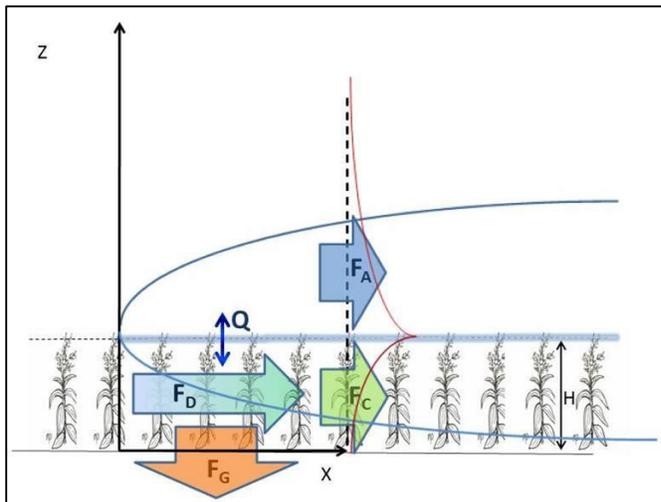
Great promise has been shown in the use of NP for delivery of metallic oxides and other compounds to crop plants to enhance growth and protect against disease. However, this technology has yet to be used in the treatment of tree diseases. The current treatment for Dutch Elm Disease (DED), a deadly vascular wilt caused by the fungus, *Ophiostoma novo-ulmi*, involves the prophylactic injection of fungicide (usually tebuconazole) into trees every 1-3 years. Although *O. novo-ulmi* is highly sensitive to copper, phytotoxicity issues have precluded its use in conventional treatments such as sprays. However, phytotoxicity has not been an issue when copper has been delivered via NP formulations for treatment in other pathosystems. In October of 2017, Dr. Marra planted an orchard of 50 American elms (*Ulmus americana*) and 50 sugar maples (*Acer saccharum*) at the CAES Lockwood Farm in Hamden, CT, which will be used in experiments testing the efficacy of prophylactic injections of copper and other metal-oxide NP formulations for both DED and sapstreak of sugar maples caused by the vascular wilt fungus, *Ceratocystis virescens*.



Fifty sugar maples (*A. saccharum*) and 50 elms (*U. americana*) interplanted in checkerboard arrangement in November 2017 (top) and May 2019 (bottom) at Lockwood Farm in Hamden, CT. The trees, started from wild-collected seed, were enclosed within “tree tubes,” which protect from harsh winter weather as well as from deer, and bark-chewing rabbits and rodents. The tubes were removed in the spring of 2019.

Impact: If NP are effective in suppressing the onset of vascular wilt disease symptoms, a new fundamental approach for tree management can be developed.

Analytical Epidemiology



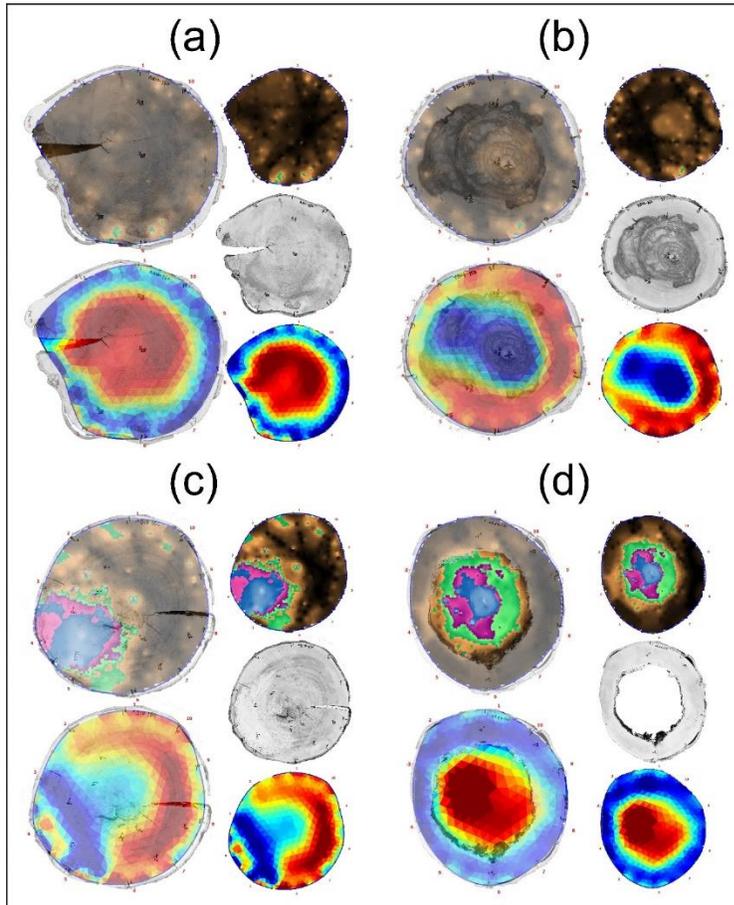
Dr. Ferrandino is examining model solutions to the advective-diffusion equation which describe the dispersal of airborne particles near the edge of a field. Most previous work has concentrated on steady state dispersal over a very large area. However, the importance of transient solutions at the edge of a field or between two different fields is not well studied. This involves a detailed description of the relative flux of particles to the ground, foliage and downwind targets. When used to describe pollen dispersal, this is important in the quantification of outcrossing, particularly in the generation of GMO (Genetically Modified Organism) seed stock. When applied to aerosol droplets of pesticide or herbicide the model will

predict the expected spray drift dose. Dr. Ferrandino has found a transient solution using Laplace Transform techniques in the form of Modified Bessel functions. This more general solution has been shown to encompass other limited self-similar solutions found in the literature.

Impact: To maintain seed purity in plant breeding programs, or in seed production fields, or in commercial grain production fields it is important to limit as much as possible cross fertilization between plots or fields of maize (or other grasses) of different types (cultivars). Thus, border strips of isolating foliage are used to genetically isolate different fields. The necessary width of these strips depends on a thorough knowledge of the transport processes between fields.

Quantifying Uncertainty in Tomography-Based Estimates of C in Living Northern Hardwoods.

In this project, funded by the NSF, Dr. Marra and colleagues demonstrated and validated a novel and unprecedented methodology, using sonic and electrical-resistance tomography (SoT and ERT), to nondestructively quantify the structural carbon (C) sequestered in living trees, and thereby to derive estimates of the amount of C cycled back into the atmosphere, in the form of carbon dioxide, through the process of internal decay.



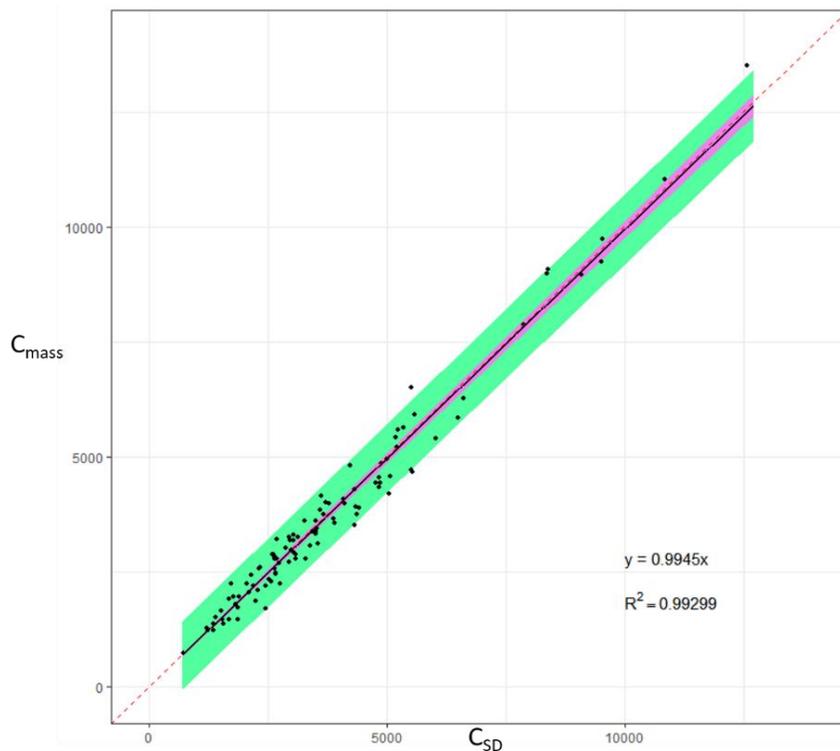
Stem-disk SoT and ERT tomograms and photographs corresponding to each of four decay categories, tabled below (a) Category A: No Decay; (b) Category B: Incipient Decay or Wetwood; (c) Category C: Active Decay; (d) Category D: Cavity. The five images within each set are, clockwise from top right: SoT tomogram—stem-disk photograph—ERT tomogram—ERT tomogram with photograph overlay—SoT tomogram with photograph overlay.

This methodology, now validated, can be applied at larger scales to refine current models of forest carbon sequestration and storage. An additional benefit of the project was the validation of the accuracy with which SoT and ERT permit qualitative assessment of the internal condition of trees, as shown in the Decision Rules Table (below) and Figure 1, which will be of benefit to the tree-care industry. The study was conducted at Great Mountain Forest, a private nonprofit research forest, in Norfolk, CT, and involved performing tomography at multiple cross-sections on 68 trees (sugar maple, yellow birch, and American beech). The methodology for C quantification was validated using 105 stem-disks excised from 39 trees that were felled for this purpose. For each stem-disk, the amount of C in the stem-disk estimated indirectly using tomographic data was compared with the amount estimated for the stem disk based on its mass. As shown in Figure below tomography was highly predictive of C mass. The methodology was then applied to the entire sample of tomographed trees to demonstrate that the percentage of C in the lower boles of these trees lost to internal decay ranged from 0-36.7%.

Impact: As forests are increasingly looked upon to sequester and store atmospheric carbon, it is essential that all components of carbon cycling be considered in the carbon balance models that are used to assess and quantify the role of forests in carbon sequestration. The results of this project constitute an important first step in Dr. Marra’s long-term goals of addressing these c carbon balance modelers. Pending the successful procurement of additional research funds, Dr. Marra’s methodology will be applied at larger scales in northern hardwood forests, and will also be applied to longer-term (5-, 10-, 15-year) studies that will constitute the first inquiry into rates of internal decay at these scales. This research and its publication have been featured by local and national media, as well as publications aimed at the general public (<https://nenc.news/podcast/episode-123-meth-use-compounding-opioid-crisis-counting-the-trees-that-store-the-carbon/>); (<https://www.wnpr.org/post/how-do-you-measure-amount-carbon-tree>). The British publication “Physics World,” featured a piece on this research (<https://physicsworld.com/a/sonic-tomographs-sound-out-tree-rot/>), as has another British publication, Scientia (<https://www.scientia.global/tomography-an-innovative-technique-for-assessing-forest-carbon-storage/>).

Table 1. Decision Rules for predicting internal condition based on tomographic data.

Decay Category	SoT		ERT		Predicted Internal Condition
	color	density	Color	moisture	
A	brown	maximum	Red	none	No decay
B	brown	maximum	non-red	present	Incipient decay
C	non-brown	reduced	non-red	present	Active decay
D	non-brown	reduced	Red	none	Cavity



The mass of 105 stem-disks, estimated using tomography (C_{SD}) compared to direct estimates based on the stem-disk mass (C_{mass}), showing that estimates based on tomography are highly accurate.

Using Tomography to Nondestructively Assess the Impact of Perennial Injections for Treatment of Dutch Elm Disease on Internal Decay

The native American Elm, with its unique umbrella-like canopy, is the iconic tree of streets and parks of the American landscape. For nearly a century,

the American Elm has been decimated by Dutch elm disease (DED), caused by the invasive fungal pathogen, *Ophiostoma novo-ulmi*, which is spread by both elm bark beetles (also invasive) and by intraspecific root grafts, further propitiated by the traditional monocultural planting of this magnificent tree. The most effective treatment of DED has been through the delivery of fungicides, principally as prophylactics, via multiple injections around the perimeter of the trunk, administered through small (~1/4") holes drilled through the bark and into the conducting tissue (the xylem). Effective control via this treatment regime requires that these injections be repeated once every one to three years.

Although the trunk-root interface is physiologically prone to rapid compartmentalization and healing around holes such as those drilled for these injections, the holes still represent a potential entry point for a variety of wood-decaying fungi and bacteria. However, no research to date has been done to determine if elms undergoing regular (every 1-3 years) injections have a higher incidence and severity of internal decay relative to those that do not receive injections.

Dr. Marra and his collaborator on this project, Dr. Nicholas Brazee (University of Massachusetts Amherst), have undertaken a three-year study using sonic and electrical-resistance tomography to nondestructively examine elms that have been undergoing regular fungicide injections for treatment of DED, and to compare these elms to elms that have not received injections. Elms in this latter category are typically maintained through vigilant scouting for early signs of elm bark beetles and DED, followed by aggressive pruning and other strategies for maximizing the trees' health and vigor.



Dr. Marra performing tomography on one of the American elms on the National Mall, Washington, D.C.

The field work for this project has been completed, with 253 sonic and electrical-resistance tomograms generated from 210 American elms in Connecticut, Massachusetts, New York City (Governors Island), and the National Mall of Washington, D.C. Of these, 91 trees have been receiving fungicide injections, and 119 have not. The elms of the National Mall are of particular significance to this study because fungicide injections have not been used; the National Park Service has instead opted for scouting, pruning, and, in cases of severe infection, replacement.

Final statistical analysis found no significant differences in the incidence of internal decay between groups with injection history (31%) and those without any history of injection (29%).

Impact: American elms of the urban landscape continue to mature, their continued survival despite the onslaught of Dutch elm disease will be via aggressive management regimens that include routine trunk injections. The consequences of these repeated injections are not well-understood, and management decisions are so far uninformed by the potential consequences of injections vis-à-vis internal decay. This work should facilitate those responsible for the care of these trees to make and advise more informed decisions, especially in the case of trees shown by tomography to have advanced stages of decay. A manuscript describing this work is now available in *Arboriculture and Urban Forestry*, the principal journal of the International Society of Arboriculture.

Using Sonic Tomography to Predict Strength Loss in Trees

In this study, tomographic and stem-disk data from the Great Mountain Forest study (see above) were used to determine whether sonic tomography could be used to improve the accuracy of estimating the loss of load-bearing capacity caused by internal defects. The study showed that incorporating the greater geometrical detail of internal decay afforded through sonic tomography resulted in much more accurate estimates of loss in load-bearing capacity compared to any of six other analytical methods currently used in the field of consulting arboriculture. This work was published in the journal *Trees*.

Impact: Previous efforts to predict strength loss associated with internal defects in trees were based on simplifying assumptions regarding the geometry and volume of these internal defects. Sonic tomography permits a much more accurate estimate of both the geometry and location of internal decay, thus allowing for improvements in estimates of strength-loss.

Disease Survey

In the year 2018-2019, unusually warm temperatures in December and extremely cold temperatures in January resulted in severe winter damage on various woody ornamentals. An above-average rainfall and extreme wet summer and spring weather conditions in 2018 and 2019, respectively, resulted in severe epidemics of fungal and bacterial diseases. Dr. Yonghao Li diagnosed a wide range of fungal, bacterial, viral, nematode, and abiotic diseases on trees, shrubs, herbaceous ornamentals, lawn grasses, fruits, and vegetables during the year.

Herbaceous and Woody Ornamentals:

Severe epidemics of boxwood blight started in late summer 2018 due to warm and wet summer weather conditions. Boxwood blight was confirmed on 467 of 1,254 boxwood samples that were examined during the year. Infected boxwood and pachysandra plant materials left in landscapes from this outbreak will provide a significant amount of inoculum for the epidemic of boxwood blight in coming years when weather conditions are conducive. Severe dieback of boxwood was also caused by winter injury, *Volutella* blight/canker, and *Macrophoma* leaf spot. Rainy and cool spring weather conditions in 2019 resulted in epidemics of many foliar fungal diseases including oak anthracnose, sycamore anthracnose, dogwood anthracnose, hornbeam anthracnose, fungal leaf spot of cherry, and apple scab, which caused significant distorted new growth and premature defoliation. Spot anthracnose, an uncommon fungal disease of dogwood, was prevalent in spring 2019. *Gymnosporangium* rust diseases were found on crabapple, pear, quince, serviceberry, hawthorn, and cedar. *Exobasidium* leaf gall was widespread on azalea and rhododendron. Rust and *Phyllosticta* leaf spot were identified on azalea. *Botryosphaeria* canker was found on crabapple, hornbeam, and aucuba. *Caliciopsis* canker was first confirmed on white pine in the state. A fungal species in the genus *Phomopsis* was found associated with significant declines of Balsam and Canaan firs in a Christmas tree farm. *Rhizosphaera* needlecast and *Stigmina* needlecast were two major foliar diseases on spruce. *Phytophthora* root rot was problematic on Fraser fir in many Christmas tree farms. *Pestalotiopsis* needle blight was prevalent in arborvitae, which might be associated with winter injury on the trees. Significant diebacks of rhododendron, juniper, weeping cherry, and oak caused by winter injury were observed.



Boxwood blight.



Oak anthracnose.

Various root rots were major disease problems on annual and perennial flowers, such as *Pythium* root rot on lupine, poinsettia, and geranium; *Thielaviopsis* root rot on lavender, phlox, and calibrachoa; *Rhizoctonia* root rot on impatiens; *Phytophthora* root rot on lavender and hellebore. Powdery mildew was problematic on beebalm, rudbeckia, and zinnia. *Botrytis* blight and *Alternaria* leaf spot were found on *Pelargonium* spp. Bacterial leaf spot and *Alternaria* leaf spot were problematic on Zinnia. Bacterial leaf spot was found on greenhouse-grown salvia, lavender, poinsettia, chrysanthemum, begonia, and heuchera. *Botrytis* blight, leaf blotch, powdery mildew, and anthracnose were found on peony.



Bacterial leaf spot of salvia.



Anthracnose of peony.

Vegetables:

Leaf mold, powdery mildew, Botrytis blight, and Fusarium wilt were found in greenhouse-grown tomato plants. Septoria leaf spot, blossom-end rot, anthracnose, and bacterial leaf spot were common diseases in garden- and field-grown tomatoes. Herbicide injury was frequently found in home vegetable gardens. On peppers, bacterial leaf spot and Phytophthora blight were problematic. Basil downy mildew was found in early summer of 2019. Powdery mildew, anthracnose, bacterial wilt, and bacterial angular leaf spot were major disease problems on cucurbits. Sclerotinia bulb rot of onion was found in a farm.



Sclerotinia white rot of winter squash.



Sclerotinia bulb rot of onion.

Tree and Small Fruits:

Cedar-apple rust, scab, frog-eye leaf spot, Marssonina leaf blotch, and black rot were prevalent on apple trees. On pear trees, rust, Phoma leaf spot, and Fabraea leaf spot were found. Leaf curl, scab, and brown rot continued to be major diseases on peach. Black knot and winter injury caused significant diebacks on cherry trees. Black rot, powdery mildew, downy mildew, and anthracnose were commonly found on grapevines. Phomopsis canker, Botryosphaeria canker, and mummy berry were major diseases on blueberry.



Brown rot of peach.



Peach scab.

Turf:

Brown patch, summer patch, red thread, anthracnose, and rust were common diseases of lawn grasses. Dollar spot and slime mold were prevalent in the summer of 2018 because of wet weather conditions and higher relative humidity. Many cases of *Pythium* blight, *Drechslera* leaf spot, and *Bipolaris* leaf spot were found in lawns that were frequently irrigated and over-fertilized.



Bipolaris leaf spot of lawn grass.



Slime mold on lawn grass.

Weeds:

Poison ivy, Oriental bittersweet, Japanese knotweed, Asiatic dayflower, Virginia creeper, horsetail, garlic mustard, mugwort, nightshade, pigweed, spurge, Japanese stiltgrass, and sumac remained significant problems in residential properties and gardens. Running bamboo continued to be a topic of increasing public concern because it causes problems between neighbors. Crabgrass, annual blue grass, bittercress, creeping bentgrass, chickweed, clover, ground ivy, yellow nutsedge, purslane, red sorrel, wild garlic, and wild violets were major weed problems in turf grasses.

Impact: Information from disease surveys in Connecticut landscapes, greenhouses, nurseries, vegetable fields, orchards, natural woodlots, forests, and home properties each year helps to monitor and assess the impact of these problems on the overall health of plants in the state. This information also assists in detecting new diseases or in identifying potentially important emerging diseases on specific plants, which can then be monitored in the years that follow.

SERVICE ACTIVITIES

Members of the Department of Plant Pathology and Ecology are involved in a wide range of service and public outreach activities. Some of these services involve presentations, publications, displays at meetings and other outreach events, tours of facilities, and interviews, in addition to being conducted in cooperation with other state agencies.

Seed Testing: In Cooperation with the Connecticut Department of Agriculture, Bureau of Regulation and Inspection

Every year, official samples of vegetable, crop, and lawn grass seeds are collected by inspectors from the Bureau of Regulation and Inspection of the Connecticut Department of Agriculture and submitted to The Connecticut Agricultural Experiment Station, an official seed testing laboratory for Connecticut. In 2018, 317 vegetable, 9 lawn, and 6 crop seed samples were tested for germination and purity, which are required for compliance with the Connecticut Seed Law Regulations and the Federal Seed Act, by following strict protocols designated by the Association of Official Seed Analysts. As of the date of this report, tests for 249 of the 317 vegetable seed samples were completed and 10 of the tested seed samples failed label claims for germination. Lawn seeds are tested for both germination and purity. Nine lawn seed mixture samples consisted of 21 species of grasses, of which 15 grass samples passed the tests and 6 failed. Crop seeds are also tested for both germination and purity. All six crop seed samples tested passed label claims. No noxious weeds were found in any of the seed samples. A *Station Technical Bulletin* will be written to report the results of this year's testing.

Impact: Results of seed tests conducted by Station staff are reported to the Seed Control Official of the CT Department of Agriculture who has the authority to stop the sale of products that do not meet label claims or contain noxious weeds. In the short term, this program protects state residents from purchasing inferior seed and ensures that seeds comply with the Connecticut Seed Law Regulations and the Federal Seed Act. The long-term benefit of the seed testing program is to minimize the unintentional introduction of noxious weed seeds that could potentially impact crops of economic importance and the state's ecosystem.

Samples for Analytical Chemistry and the Connecticut Department of Consumer Protection

During the year, Dr. Li examined 44 samples from the Connecticut Department of Consumer Protection at the request of the Department of Analytical Chemistry at the Experiment Station.

Citizen Inquiries

Plant Disease Information Office

Dr. Li answered 5,112 inquiries about plant health from Connecticut citizens. Although the majority of inquiries were on ornamentals, trees, and shrubs (78%), other categories, such as food crops (10%) and turf grasses (3%), were also well represented. A moderate percentage of inquiries fell into the miscellaneous category (9%), which included identification of various plants, weeds, and mushrooms, and information about pesticides and their relationship to health and environmental concerns. The majority of inquiries were from commercial growers and plant care professionals (51%) and Connecticut homeowners (41%). One percent of inquiries were from cooperative extension and 7% were from health departments, news, agricultural personnel, and other groups. A further breakdown of inquiries showed that 19% of the questions came in by phone, 36% came in by mail, 13% came in by email, and 32% were brought in person. In response to inquiries, 2,896 letters and email messages with attached files of fact sheets were sent from the PDIO. Many citizens opted to download fact sheets posted on the CAES website in lieu of letters since this gave them instant access to the information of concern.

VALLEY LABORATORY

Scientists at the Valley Laboratory conduct research on insects, diseases, soil nutrition, mycology, integrated pest management and weeds of concern to commercial agriculture and homeowners in Connecticut. The Valley Laboratory, located in Windsor, was originally established in 1921 to conduct tobacco research. While research on tobacco continues today, the research mission has expanded to reflect the diverse agriculture present in the State. Scientists and staff also diagnose insect and plant health problems, test soils for fertility, conduct outreach to growers and homeowners by speaking to professional and community groups, host informational meetings, and assist municipalities, state agencies, and students.

Activities on the Farm

There were a total of 44 experimental plots at the Windsor research farm during the past year. Four Windsor-based scientists had 38 of these plots; four New Haven-based scientists were using 10 plots. Additional plots were maintained by the Farm Manager as rotation crops or for seed collection. Valley Laboratory scientists also conducted experiments in many plots off site, such as in growers' fields, the CAES Lockwood and Griswold farms and in State forests. Valley Laboratory Farm Manager James Preste kept the farm and equipment ready and in excellent shape. He expertly maintained the many field plots and addressed the specific needs of each scientist. He and his summer research assistants did an outstanding job maintaining the extensive ornamental garden in cooperation with the Connecticut Nursery and Landscape Association. Mr. Preste and Dr. LaMondia coordinated the Valley Laboratory effort to comply with EPA Worker Protection Standards for Agricultural Pesticides and organized and conducted safety and pesticide training sessions for the staff.

RESEARCH ACTIVITIES

Hemlock Woolly Adelgid Research

Biological control using imported predators of *Adelges tsugae*, the hemlock woolly adelgid (HWA) is a major long-term national strategy for reducing the impact and spread of this damaging and invasive insect which threatens the entire range of eastern and Carolina hemlocks. *Sasajiscymnus tsugae* (Coleoptera: Coccinellidae), originating from Honshu, Japan, discovered and studied at the CAES, is one of the first biological control agents released for HWA management in the US and the only major species released in Connecticut. From 1995-2007 >176,000 *S. tsugae* were mass reared and released in 26 state forest and parks, municipal, water company and private forest sites throughout Connecticut. Encouraging results of hemlock recovery from HWA damage in Connecticut were recorded from 2005-2009 in >75% of sites with *S. tsugae* releases. The overall goals of this project are to integrate established and new approaches, into (1) an overall current assessment of the health of forest hemlocks in Connecticut, 30 years after the arrival of HWA, and (2) to improve the understanding of the role of climate and biological control of HWA with the introduced adelgid predator, *S. tsugae*. *S. tsugae* remains the only biological control agent for HWA available commercially due to ability for large scale laboratory rearing. Current assessments are evaluating the implementation of *S. tsugae* to manage HWA infestations as an important and economical option for public and private stakeholders who cannot or do not want to use chemicals for controlling HWA. These assessments quantify predation of HWA under hot humid summer conditions.

Extensive surveys in most of Connecticut indicated that HWA populations in 2019 had crashed to negligible levels in most areas of Connecticut. Levels of HWA have never been this low or hard to detect throughout most of Connecticut with very few pockets of HWA resurgence occurring nearer the coast and near large bodies of water. Winter mortality of HWA assessments in 2019 were not extensive due to the lack of available samples. This information on the dramatic decrease in HWA statewide is important for

homeowners and forest managers, reducing the need for prophylactic chemical treatments for HWA control, which should only be necessary where resurgence is detected. Wind-downed random hemlock branch tip samples (>750) were collected from 31 sites during the winter and spring of 2019 from northwestern, northeastern and a few coastal areas and rated for HWA and elongate hemlock scale (EHS) levels. Very low levels of HWA were only detected in 1 site (3%) while 71% of sites had medium to medium-high EHS, 2 sites (6%) had very high densities of EHS and the remainder had low levels of EHS. Several of the older *S. tsugae* release sites which had low levels of EHS were found to now have explosive increases of EHS and concurrently, thinning, highly chlorotic crowns, in spite of the beneficial higher rainfall and lack of HWA. Baseline sites (healthy sites with negligible or no HWA nor EHS history) have been rated and assessed for >14 years for comparisons of hemlock stand conditions with *S. tsugae* sites that have had HWA and EHS in the past. Surveys in 2019 indicated the encroachment of EHS to the high elevation baseline sites in the extreme northwestern sector of Connecticut, while HWA had vanished, which is of concern. The extended extreme drought of 2015-2017 officially ended in April 2017 and heavy rains and cool temperatures in spring and early summer of 2017 favored dramatic hemlock refoliation and recovery statewide. The summer of 2018 was the 4th warmest with above normal precipitation which favored continued hemlock recovery in many sites, but not in all. The increased precipitation triggered tremendous reflashes of new growth in hemlocks at almost all sites, partially counteracting previously high needle loss due to drought impacts and EHS stress in many areas. Most ridgetop sites that had observed hemlock borer outbreaks in 2017 showed some recovery and refoliation and the number of fresh borer attacks appeared reduced in 2019. The drought-induced hemlock borer outbreaks on rocky ridgetop sites with poor soil did not expand in 2019. Mature hemlock deaths from hemlock borer attacks were also observed in several high elevation baseline sites with increased EHS densities. Fifteen *S. tsugae* release sites were revisited to assess hemlock crown health ratings one year later post drought in late winter and spring 2019. Only 3 sites had very low levels of EHS and these were also the sites with greater hemlock crown recovery as compared to the drought stressed crowns of 2017. Preliminary analyses showed that sites with low or negligible EHS levels had significantly better recovery than sites with higher EHS levels in 2018. 2018 foliar transparencies in baseline sites were significantly higher than in 2016, indicating that stress from drought and increasing EHS densities had resulted in thinner crowns. Declining crowns were not due to HWA, which has never been a stressor in those sites. Mean foliar transparencies from *S. tsugae* release sites which had HWA were statistically similar to baseline sites, indicating similar rates of recovery.



Differences in eastern hemlock foliage color due to heavy EHS infestations.

Below are examples of hemlock recovery at former *S. tsugae* release sites around Connecticut:



Natchaug State Forest, Eastford, February 2019.



Mashamoquet Brook State Park, Pomfret, March 2019.



Salmon River State Forest, East Hampton, March 2019.



Bigelow Hollow State Park, Union, May 2019.



Burr Pond State Park, Torrington, May 2019.



Enders State Forest, Granby, April 2019.



The Clamshell from the summit, Steep Rock Association, Washington, May 2019.

Impacts:

- Documenting the rapid recovery of eastern hemlocks in a changing climate of extremes is a new finding. Hemlocks previously severely stressed by drought and increased EHS infestations can recover with ample precipitation if left to do so, even in poor sites, now that HWA, decimated by successive severe winters, is no longer a serious threat in Connecticut. This is important planning information for land and forest managers.
- Mature hemlock forests should be preserved as increasingly important carbon dioxide sinks in a warming world and the ability of hemlocks to recover in a climate of increasing precipitation emphasizes this.
- Eastern hemlock habitat recovery is important to the many bird, amphibian, fish and mammal species which are dependent on the hemlock ecosystem.
- Eastern hemlocks are an important component of recreational and hiking areas for the public and a popular landscape species and this documented recovery shows that eastern hemlock can be a sustainable resource without human intervention.
- Data showing the changing pest levels on eastern hemlocks is communicated to homeowners for reduction of annual prophylactic chemical treatments for HWA.

Implementation of Biological Control of Mile-a-Minute Weed in Connecticut

Mile-a-minute weed, *Persicaria perfoliata*, (MAM) originates from Asia, was first discovered in eastern U.S. in the 1930s and is classified as a serious invasive weed in Connecticut. Infestations are found in 14 eastern states from North Carolina to Ohio and the first record of MAM in Connecticut was in Greenwich in 1997, later confirmed in 2000. As of June 2019, 53 towns in Connecticut have confirmed reports of MAM, with Cheshire, Chester, Durham, Old Lyme and Trumbull reported as new towns in 2018. Several towns have only limited reports of a few plants which have since been removed. This rapidly growing prickly and prolific vine is annual in its northern range but quickly forms dense thickets which overwhelm and displace native vegetation and reduces plant diversity. An introduced weevil, *Rhinoncomimus latipes* (Coleoptera: Curculionidae), imported from central China, has been successfully reared and released for biological control of this invasive species in the Mid-Atlantic and southern New England states. This project

has been a collaboration between the CAES and Donna Ellis, Senior Extension Educator at the University of Connecticut and is funded by USDA APHIS PPQ, in cooperation with the New Jersey Department of Agriculture Phillip Alampi Beneficial Insect Laboratory, who rear and provide the weevils to cooperating states. Many volunteers and cooperators from the private sector state, town and federal officials work together with our team, in joint efforts to implement MAM biological control to manage and limit the spread of MAM. Dr. Cheah and Donna Ellis have collaborated on the releases and monitoring of all the release sites since 2009. Donna Ellis retired in February 2019 and Dr. Cheah is continuing to implement the biological control program in 2019-2020.

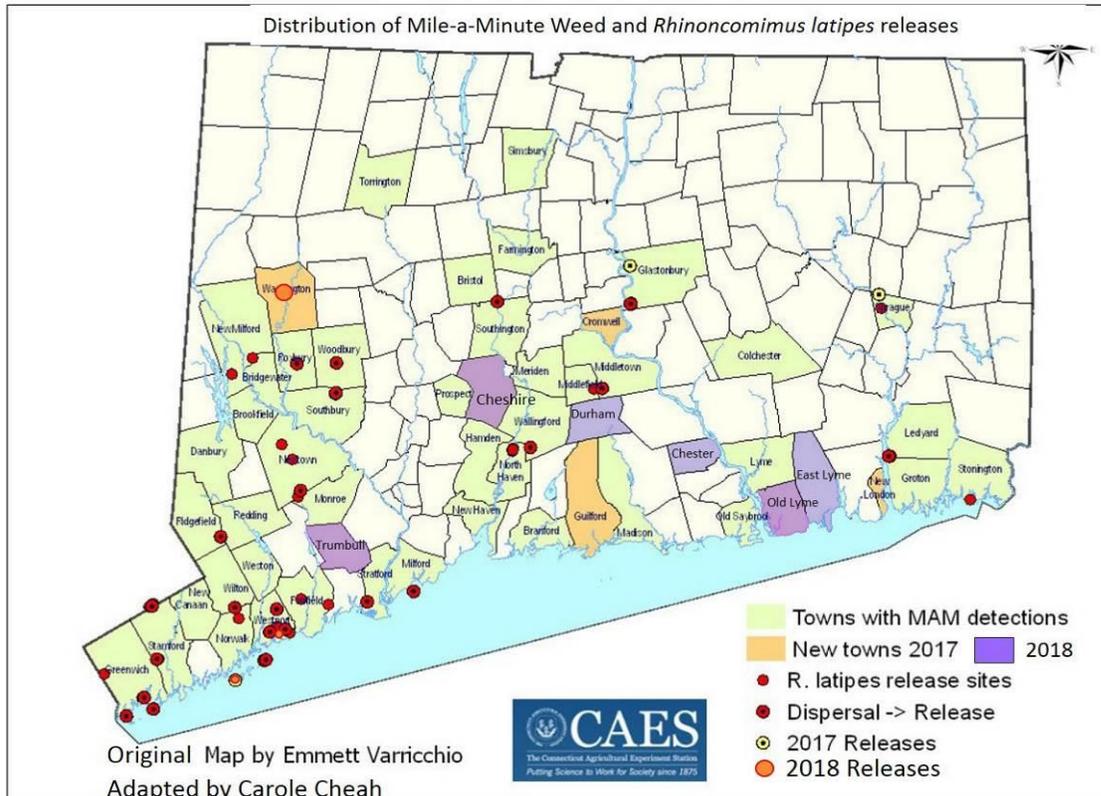
The heavy precipitation and hot temperatures during the summer and fall of 2018 were highly favorable to the expansion and growth of MAM in many sites. There were 5 new towns with confirmed reports of MAM in 2018. Weevil activity and feeding damage was, however, very low in >50% of sites and only 24% of sites monitored had moderately high MAM damage. It is not known if the continuous and heavy precipitation in 2018 affected weevil feeding and reproductive activity.

A rainy cool spring delayed germination and initial growth of MAM in May and early June 2019. With the help of volunteers, new infestations of MAM were located on Durham Open Space where a few weevils had dispersed, probably from a Middlefield release 3.5 miles away. Cooperation from the public is invaluable for locating new MAM sites for weevil releases and for documenting weevil dispersal. However, by the end of June 2019, the advent of hot temperatures facilitated rampant growth of MAM.



Josh Miller, Durham Conservation Commission, and Aubree Keurajian locating weevils on MAM in Durham Meadows WMA, June 2019

Releases of *R. latipes* began in 2009 in Connecticut, and to date, 59,124 weevils have been released in 26 towns at 51 sites as of June 30, 2019. In 2019, Connecticut received 4,000 weevils from NJDA PABIL for releases as part of the federal biological control program. Weevils were released for the first time in Old Lyme (n = 500), with an additional new site release in Fairfield at the Paterson Golf Course (n = 1500), and an augmentation on Calf Island, Stewart B. McKinney Wildlife Refuge, off the coast of Greenwich (n = 1000).



Distribution of MAM and weevil release sites in Connecticut through 2018.



Brian Carey, Fairfield Conservation Director, releasing weevils June 21, 2019.



Mile-a-minute infestations on Calf Island, Stewart B. McKinney Wildlife Refuge.



Kris Vagos, USFWS biologist, releasing weevils on Calf Island June 28, 2019.

Impacts:

- Fifty-two Connecticut towns were recorded with confirmed reports of MAM to date by the end of June 2019 (<https://mam.uconn.edu/distribution/>) with 59,124 weevils released in 26 towns since 2009. Data collected indicated that MAM continues to spread and is a nuisance and threat to native plant diversity.
- Monitoring in 2018 showed the weevils' continued presence at all sites and very late maturation of MAM fruit into October. However, abnormally high precipitation and hot temperatures in 2018 were particularly favorable to MAM growth and proliferation while weevil activity appeared reduced from continuous rain, except in some areas where weevil damage was high. Reasons for site differences in weevil damage levels are unknown.
- Weevils overwintered successfully again in Connecticut into 2019. Weevils have survived severe flooding, drought, storms, variable winters, site interference from mowing, tree felling, vegetation clearance, and herbicide treatments but impacts on population densities are unknown. This marks the 10th year of weevil overwintering and establishment.
- Weevils continued to spread and disperse over many miles from original release sites in a variety of different habitats on the mainland and to offshore islands in Long Island Sound.
- Establishment of *R. latipes* for mile-a-minute weed appears to have limited the spread of mile-a-minute vine in some towns. Other cultural methods such as volunteer hand-pulling and chemical

means of control have also been employed in many towns. Biological control of MAM will hopefully reduce the need for chemical control, especially in watershed areas, in utility rights-of-way, agricultural lands, bird refuges, etc.

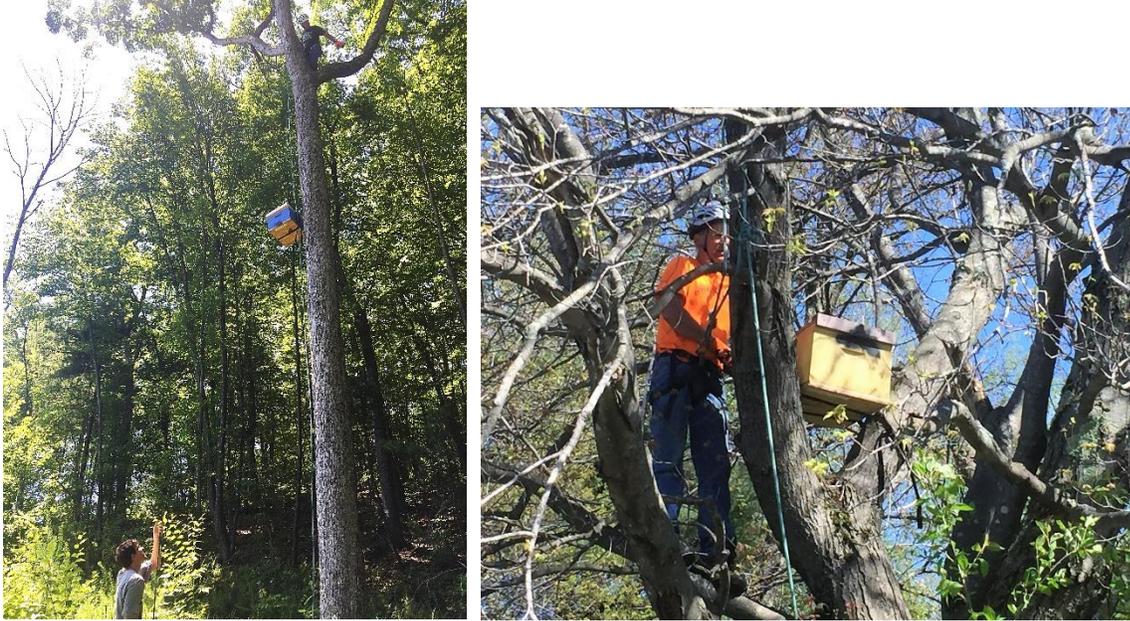
Insect Management

Dr. Richard Cowles continued efforts to study the potential for neonicotinoid insecticides to cause harm to pollinators. Systemic insecticides were applied to plants of value in the ornamental horticulture industry, chosen to be model plants because they produce relatively large quantities of nectar and/or pollen, sufficient for residue analyses. Collections of nectar and pollen from ‘PJM’ cultivar rhododendrons, which were treated once with insecticides in 2017, were completed. In 2018, dahlias were used as model plants for collecting pollen samples, and in 2019, woodland clary (*Salvia nemorosa*) is being used for nectar samples. Information about the concentration of these insecticides in floral rewards (nectar and pollen), the sensitivity of pollinators to the insecticides (known as intrinsic toxicity), the quantity of the pollen or nectar collected by the pollinators, and the duration of time that the pollinator may be exposed can be combined to assess the overall risk to pollinators from having applied systemic insecticides to these plants. These data are valuable for establishing best management practices for nursery growers, and to determine whether these insecticides can be used in ways that are not likely to harm pollinators.

Honey Bee Health

Honey bee colonies have experienced poor overwintering survival in Connecticut for the past several years, with losses each year of about 50% of hives. The chief suspect for poor honey bee health is varroa mite infestation. These mites not only weaken bees through direct parasitization, but also by transmitting viral diseases within and between hives. A “vicious cycle” exists, in which colonies that have died during the winter are restocked by beekeepers during the spring by purchasing packages of bees. If these replacement queen bees have poor genetic traits and the colonies are also poorly managed for varroa mite infestations, then the colony would be likely to die the next winter and have to be replaced. A two-year collaboration between Dr. Cowles and the CT State Bee Inspector, Mark Creighton, was supported by the CT Department of Agriculture Specialty Crops Block Grant program. This project, initiated in 2017, addressed the needs of Connecticut beekeepers by starting a honey bee queen rearing and breeding program. The goal of this project was to obtain bees from exceptional commercial sources (based upon hygienic traits), and also from feral bee populations to use for production of queens to share with CT beekeepers. Indiana “mite biter” bees were found to be an excellent source of bees with anti-varroa traits and are readily commercially available. Feral bees obtained from swarm traps, in general, were not suitable for using in a genetic improvement program. Efforts in 2019 involve making local queen production sustainable, through a model similar to Heifer Project. Volunteer beekeepers obtaining materials from the queen rearing project are committed to rear additional queens that they will share with other local beekeepers wishing to requeen their hives to improve hygienic traits. Two beekeepers, Jon Nelson from Rhode Island, and Byron Martin from Danielson, CT, are producing queens to be tested by Connecticut beekeepers, and then used to produce more queens for local beekeepers.

Another aspect of improving honey bee health is to enhance the quantity and quality of bee forage. Two projects involve efforts to grow and evaluate bee forage, one is supported by a Feed-A-Bee grant and consists of replicated plots at Lockwood Farm. The other is a SARE-supported project to establish high-yielding honey crops within Christmas tree plantations. The other ecological functions that bee forage in Christmas tree crops should provide will be nitrogen fixation (from legumes), and floral resources to support natural enemies of armored scale pests of Christmas trees.



Lifting and setting traps to collect feral bee colonies.

Impacts:

- The honey bee queen production and improvement program has been handed off to the Connecticut Queen Breeders' Association. They have launched sales of the SeleCT Line of queens, which are available to interested beekeepers.
- Christmas tree growers are implementing use of sulfur to improve the health of their true firs.

Mycology Research

Dr. DeWei Li conducts research on indoor molds of human health concern, fungal succession on water-damaged building materials, and infiltration of mushroom spores from outdoors into residences.

Intercropping Wine-Cap Mushrooms in Christmas Trees

A new three-year project started from Jan. 2019 to develop a new intercrop, wine-cap mushroom for Christmas tree farms using woodchip mulch between rows of Christmas trees in Connecticut. The project has dual purposes: 1) develop a new cash crop, wine-cap mushroom for Christmas tree farms; 2) the woodchip mulch will improve root health by controlling weeds and thus preventing damage from herbicides, maintaining cool, moist soil conditions, suppressing injurious root pathogenic nematodes, and adding organic matter into the soils. Four experimental plots have been set up at the Valley Laboratory, Humming Grove Farm and at Jones Family Farm. The plots have been inoculated with wine cap mushroom inoculum and the fungus has successfully colonized the woodchips.

Impact:

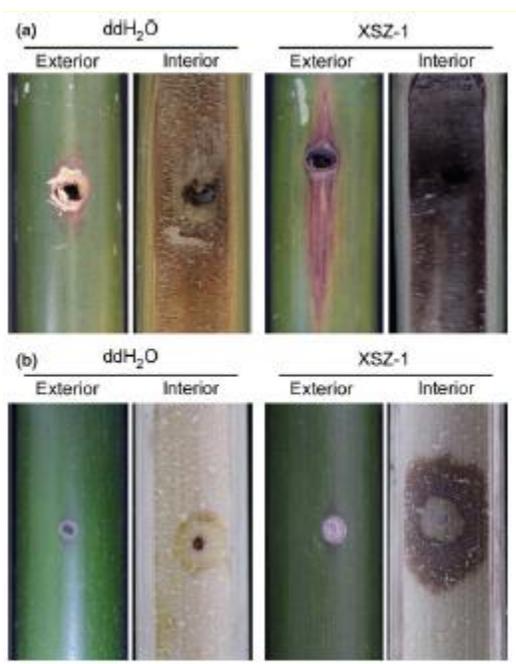
- Wine Cap Mushroom (*Stropharia rugoso-annulata*) is an edible gourmet mushroom. The result of this study will help Christmas tree farmers to develop a new product - wine cap mushrooms. The new crop will increase their profit in the future.

Study on New Plant Diseases

A number of newly emerged diseases, canker on culm of *Bambusa multiplex* caused by *Fusarium incarnatum* (Figure 2). *Septotinia populiperda* causing leaf blotch of *Salix babylonica*, *Aucuba japonica* stem canker caused by *Botryosphaeria dothidea* and *Colletotrichum* causing leaf blotch of *Liriodendron chinense* × *tulipifera* were found and studied from both pathological, morphological and phylogenetic aspects. The study has led to three publications. This is a collaboration with several plant pathologists in China.

Impact:

- These new diseases of ornamental plants are causing severe damage to the ornamental plants and the landscape. Determination and characterization of these pathogens is imperative for disease management and future studies to fully understand the diseases for finding solutions to these diseases.



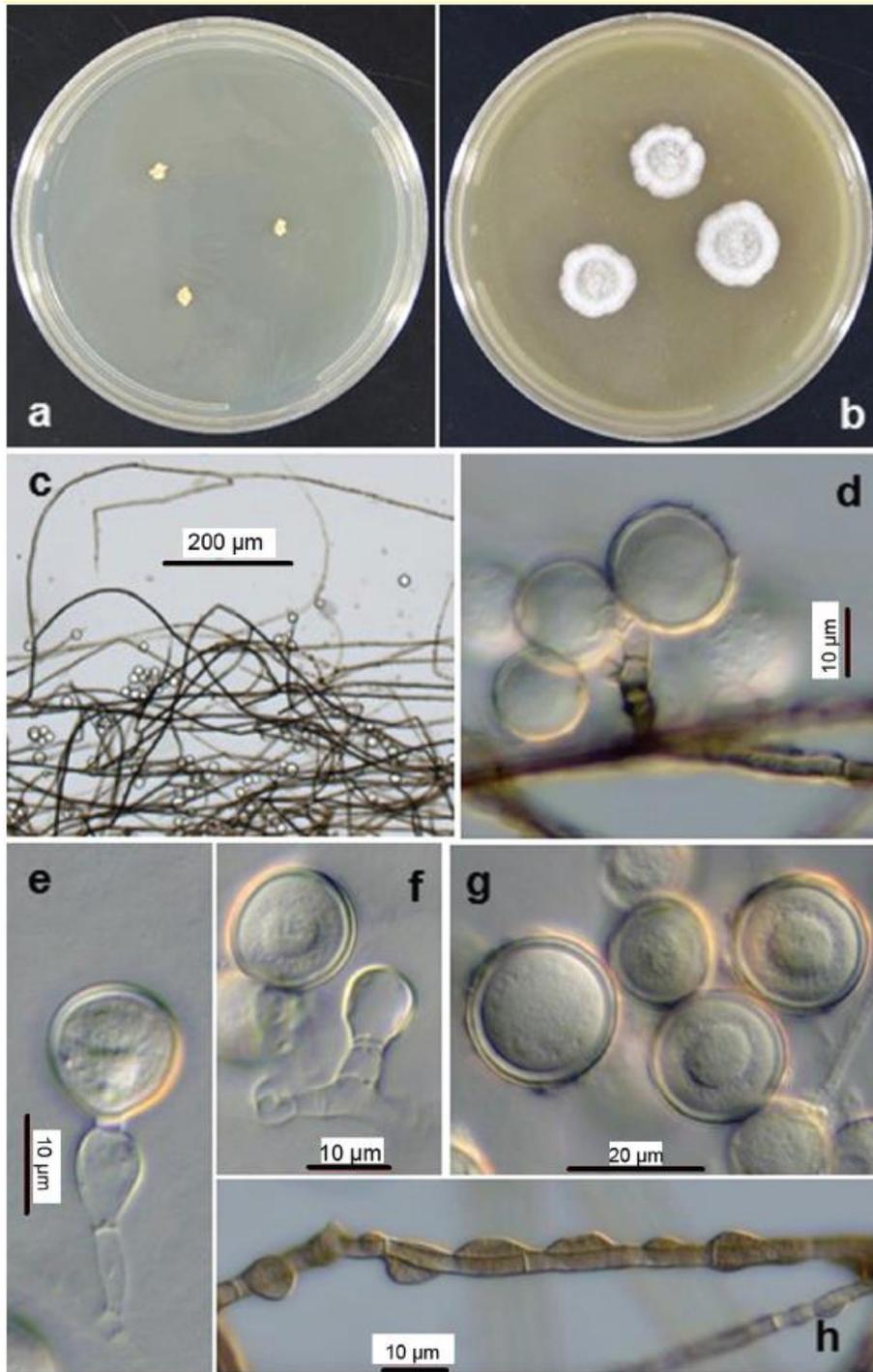
Symptoms on culms of *B. multiplex* that developed from inoculation with XSZ-1 in the field (a) and laboratory (b).

Fungal Taxonomic Study

This collaborative study with Dr. Neil Schultes and mycologists from several countries: Brazil, Canada, Cuba, China, and Mexico, has led to the discovery of two new fungal species: *Botryotrichum domesticum* (Figure 1) and *Spadicoides matsushimae* and one new genus, *Anisospadicoides*. These new species and genus have been published in two papers. *Botryotrichum domesticum* was collected from an indoor environment.

Impact:

- Discovery and descriptions of new fungal species add very important information for fungal diversity in the world and for the studies such as fungal ecological studies, in which fungi need to be identified. The newly described species adds new information to fungal diversity, resources and conservation and utilization.



Botryotrichum domesticum (NHES L1707, extype UAMH 11929). (a) Colonies growing on MEA for a week; (b) Colonies growing on V8 for a week; (c) Aerial hyphae and conidia; (d) Conidia and conidiogenous cell on aerial hypha; (e and f) Conidia and conidiogenous cells on immersed hyphae; (g) Conidia; (h) Tuberculate aerial hypha.

Weed Science

Ornamental Nursery Trials

Dr. Aulakh evaluated several herbicides for tolerance of container and field grown ornamental plants. Plant species evaluated included: black-eyed Susan, goldenrod, purple coneflower, Jenny's stonecrop, Virginia sweepspire, white stonecrop, and zinnias. Herbicides evaluated were: Basagran, Gemini G, Pennant Magnum, and Tower.

Ornamental plants differed in response to herbicides and application rates. Basagran herbicide was highly injurious to container-grown purple coneflower. Pennant magnum at 2.6 pints/a was safe to black-eyed Susan variety "Marmalade", goldenrod variety 'fireworks', purple coneflower variety 'Magnus', and zinnia variety 'purple prince'. Both Jenny's stonecrop (*Sedum repustre*) and white stonecrop (*sedum album*) tolerated Gemini G herbicide up to 800 lbs/a. Goldenrod variety 'fireworks' was found highly tolerant to single application of Tower at rates up to 84 fl oz/a. Two sequential applications, spaced 6 weeks apart, at 21 fl oz/a were safe with slight stunting injury observed.

Impact:

- Results from these studies were shared with a group of landscape and nurserymen during a nursery and landscape research tour on September 13, 2018 at Windsor, CT. The results would also help the herbicide manufacturers in extending herbicide labels for use in tested tolerant crops.



Ornamental plant safety trials at the Valley Laboratory in Windsor, CT, 2018.

- Ornamental plant safety trials resulted in the discovery of many newer and safer chemical weed control options for sedum (biathlon and freehand 1.75 G at 200 and 300 lbs/a, respectively), chocolate flower (freehand 1.75 G up to 600 lbs/a), gladiolus (biathlon up to 400 lbs/a), flag iris (biathlon up to 400 lbs/a), and Shasta daisy (biathlon up to 200 lbs/a).

Christmas Tree Weed Management Trials:

Herbicides are the backbone of a successful weed management program in Christmas tree production. Dr. Aulakh evaluated preemergence (Marengo SC and Panoramic 2SL) and postemergence herbicides (Imazapic and Dismiss 4F) for weed control efficacy and tolerance of Christmas trees. Field or container studies were conducted at Lockwood Farm in Hamden, CT; the Valley Laboratory in Windsor, CT; and the

Griswold Research Center, in Griswold, CT. Christmas tree species under evaluation were: balsam fir, Canaan fir, Douglas fir, Fraser fir, Norway Spruce, Nordman fir, Turkish fir, and White Pine.



Christmas tree herbicide tolerance and weed management research trials in 2018 at Windsor and Griswold, CT.

Findings: The herbicide indaziflam at up to 30 fl oz/a was found safe to Balsam fir, Douglas fir, and Nordman fir. Turkish fir tolerated indaziflam up to 15 fl oz/a. Canaan fir, Douglas fir, and Fraser fir were tolerant to preemergence application of imazapic up to 8 fl oz/a. The postemergence research trials discovered varying levels of Christmas trees (balsam fir, Canaan fir, Douglas fir, Norway spruce, Nordman fir, Turkish fir, and white pine) tolerance to imazapic herbicide. Results from these trials were also shared with university and industry researchers at the WSSA annual meeting in New Orleans, LA, February 2019 and Christmas tree growers at the twilight meetings and 59th annual meeting of CCTGA held on March 2 at Middletown, CT in 2019.

Impact:

- Current labels of Marengo SC/Specticle herbicides (indaziflam) allow use on only a few Christmas tree species. These results will help the herbicide manufacturer in including species found tolerant in this study (balsam fir, Nordman fir, and Turkish fir) on indaziflam (Marengo SC/Specticle) herbicide label. Imazapic herbicide is not currently labeled for use in Christmas trees. Extension of the imazapic herbicide label will help the Christmas tree growers in controlling several difficult-to-control weeds such as field bindweed, yellow nutsedge, mugwort, wild carrot, and smooth bedstraw without any serious risk of Christmas tree injury.

Strawberry Weed Management Trials

A16003 (bicyclopyrone) is an experimental herbicide being developed by Syngenta. Experiments were repeated in a second year to evaluate strawberry tolerance and weed control efficacy of A16003 applied preemergence and early-postemergence in newly transplanted strawberries. This research seeks to provide safer and more effective chemical weed management options for strawberry growers in CT. The strawberry cultivar ‘Earliglow’ was very sensitive to A16003 herbicide applied alone at 6.84 fl oz/a or in a tank-mixture with flumioxazin or s-metolachlor herbicides. With a lower rate of A16003 at 3.42 fl oz/a, strawberry injury was highly variable; chlorotic, necrotic, and stunting injuries varied from 0 to 20 percent depending on application time. Further research is required to determine safer application rates for strawberry tolerance to this herbicide.



Weed control efficacy and tolerance of strawberry to bicyclopyrone herbicide (A16003) in 2018 at Windsor, CT. Strawberry Research site, Valley lab, Windsor, CT (A); bicyclopyrone injury on strawberry (B).

Preventing Freeze Injury in Peaches and Nectarines

In 2016, over 95% of Connecticut's peach and nectarine crops were lost due to early spring freeze injury. Dr. Aulakh is investigating different plant growth regulators for their potential for preventing freeze injury in peaches and nectarines through artificially induced bud dormancy. A two-year field experiment has been initiated in spring 2019 at peach grower's farms in Cheshire and Ellington and in peach orchard at Windsor, CT. The desired outcomes of this research are increased winter hardiness by preventing early bud break and improvement in fruit quality and yield. Currently, there are no results to report. First year treatments have been applied and data on various response parameters are being collected. The outcomes of this research will help in protecting peach and nectarine production in CT.

Plant Disease Research

Boxwood Blight

Boxwood blight is a new, introduced disease in Connecticut. The fungus that causes boxwood blight, *Calonectria pseudonaviculata* (*C.ps*), forms leaf spot and stem lesions resulting in defoliation and dieback of boxwood. The impact of the disease has been very high; boxwood plant losses in nurseries were estimated at over \$5.5 million in Connecticut in the first two years since October 2011. While production nurseries have not experienced problems in Connecticut, boxwood blight has been widespread and damaging in landscapes in 2018 due to wet conditions conducive to disease.

Development of the Boxwood Blight Resistance Evaluation Program

The breeding of disease-tolerant boxwood cultivars is important for reducing the incidence of boxwood blight in Connecticut while providing landscapers with cultivars that have desired traits. In order to better assess boxwood tolerance to blight among cultivars, Dr. LaMondia is collaborating with researchers across the United States to create a standard protocol for boxwood evaluations that can be conducted across institutions. This will include rating cultivars against previously tested plants to assign a scaling of 1 (most susceptible) to 5 (least susceptible). The evaluation program began in 2018 and has grown in its second year to include a total of 21 cultivars being assayed at the Valley Laboratory and at 3 other institutions in the United States. These ratings will be used by plant breeders to assess tolerance and by nurseries to convey susceptibilities to consumers.

Movement of *C. pseudonaviculata* Through a Landscape

Boxwoods are an important component of established landscapes, especially historical plantings in which they are highly valued. A better understanding of how boxwood blight moves through a landscape from an infected plant to other cultivars and how fungicides can be used to manage disease spread are important for preserving boxwoods in landscapes. Dr. LaMondia is conducting the second year of a field trial to determine how an infected boxwood plant will spread infection to surrounding boxwoods under conditions of no

fungicide treatments, the use of a protectant spray (a fungicide that stays on the surface of the plant), and the combination of protectant sprays with systemic sprays (fungicides that move into the plant). The fungicide treatments are evaluated using a calendar-based spray approach (every month regardless of disease detection or weather) versus an incidence-based spray approach (fungicides will only be applied after disease is detected). Additionally, temperature and humidity are monitored in the plot to determine how these two environmental conditions affect disease development. The first and second-year results showed a strong dependency on heat and moisture for disease spread. Plant susceptibility was more important than fungicide treatment in effect on movement of the disease. These results will help develop better management practices to reduce or prevent the spread of boxwood blight through established landscapes, including historical plantings.



A: Boxwoods planted in landscape setting to evaluate movement of boxwood blight among plants.
B: Boxwood blight on plants from landscape setting.

Winter Survival of *C. pseudonaviculata* in Connecticut

Previous studies in more mild climates have shown *C. pseudonaviculata* can survive in leaves on the surface soil throughout the winter and be able to re-infect boxwoods in the spring. The ability of the pathogen to survive the winters in Connecticut has not yet been studied. Drs. LaMondia and Allan-Perkins conducted a preliminary study of *C. pseudonaviculata* winter survival by placing infected leaf tissues in field plots over the winter. Leaf samples were treated with fungicides or left untreated to determine if applying pesticides could reduce pathogen survival. Samples were collected monthly and evaluated for the ability of the pathogen to grow on media in the laboratory and to sporulate on leaves. Samples collected after March of winter 2019 were not able to grow in the laboratory, however more leaf samples and locations will need to be tested in future years to fully evaluate how winter temperatures and moisture affect pathogen survival in leaf tissue and future studies will include stem lesions and microsclerotia. The results of this experiment will aid in developing management practices to control boxwood blight in landscape settings and may also help in preventing overwintering of this disease in nursery settings.



Boxwood leaves infected with *C. pseudonaviculata* placed on soil surface in December for evaluation of pathogen survival.

Curative Effects of Fungicides on Boxwood Blight

The fungicides azoxystrobin, azoxystrobin plus benzovindiflupyr, kresoxim-methyl, propiconazole, pyraclostrobin, pyraclostrobin plus fluxapyroxad, tebuconazole, tetraconazole, thiophanate-methyl, and triflumizole fungicides were evaluated for curative and anti-sporulant activity against boxwood blight caused by *Calonectria pseudonaviculata* on detached leaves and whole boxwood plants (*Buxus* spp.). Pretreating detached leaves with 30 or 300 ppm a.i. 24 hours prior to inoculation reduced disease compared to the untreated control for all fungicides. Fungicides were also applied 24 to 96 hours post-inoculation. Only propiconazole reduced diseased leaf incidence to at least half of the control. When leaves were treated post-infection with 300 ppm of the fungicides propiconazole, tetraconazole, tebuconazole, and triflumizole, the pathogen did not sporulate over the following 2 weeks. Propiconazole also reduced the percent of leaf area diseased; lesions were nearly 80% smaller with 300 ppm applied 48 hours after inoculation. ‘True Dwarf’ boxwood plants treated with 450 ppm thiophanate-methyl, 120 ppm pyraclostrobin or 150 ppm propiconazole 48 hours after inoculation demonstrated that only propiconazole reduced the number of diseased leaves, blight lesions and the frequency of pathogen re-isolation from symptomatic tissue. Experiments with ‘Green Mound’ and ‘Green Mountain’ boxwood cultivars and additional fungicides applied 48 hours after inoculation demonstrated that propiconazole at 300 ppm, pyraclostrobin plus fluxapyroxad (150 ppm each), and azoxystrobin (135 ppm) plus benzovindiflupyr (67.5 ppm) reduced disease. While pretreatment with fungicides is most efficacious against the boxwood blight pathogen, infectious periods may occur almost continuously over a long wet period and environmental conditions may limit the ability to apply protectant fungicides prior to infection. In those instances, the reduced incidence, lesion size, and inhibition of sporulation demonstrated by post-infection treatment with propiconazole, fluxapyroxad and benzovindiflupyr fungicides demonstrated in these experiments should combine to slow the development of disease and significantly reduce epidemic development, aiding boxwood blight management.

Sanitizers for Management of Boxwood Blight

The boxwood blight pathogens *Calonectria pseudonaviculata* (*Cps*), and *C. henricotiae* (*Che*), produce microsclerotia on and in leaf tissue and conidia in sticky masses that can be spread. Dr. LaMondia collaborated with Dr. Nina Shishkoff of the USDA ARS to evaluate the effects of sanitizers on conidia, excised microsclerotia or all *Cps* life stages in 4-mm-diameter leaf disks. Leaf disks and excised microsclerotia were exposed to sanitizers or water for 3 to 180 minutes (disks), or 0.5 to 30 minutes, wicked dry and placed onto ½ PDA to determine viability. Conidia were loaded onto a filter, exposed to alcohol concentrations for between 2 seconds to 2 minutes and rinsed with water. Filters were backwashed with air to transfer conidia onto water agar and the percent germination was counted after 24 hours. *Cps* in leaf disks was killed within 10-12 min for 70% ethanol and between 2-3 hours for 0.525% NaOCl. Chlorophenol did not eliminate *Cps* from tissue. Individual microsclerotia were killed by 70% ethanol in 4 minutes. In contrast, microsclerotia exposed to 0.525% NaOCl or 0.05% chlorophenol for 30 minutes still retained viability. Exposing conidia of *Cps* and *Che* to 10%, 25%, 40% and 70% ethanol demonstrated no germination after 20 seconds in 25% ethanol or 5 seconds for 40 and 70% ethanol. Conidia of *Cps* and *Che* exposed to 70% isopropanol were also dead within 5 seconds. A dose-response study for ethanol and isopropanol estimated 99% mortality from exposure to 63.6% alcohol for 2 seconds, with no difference between the alcohols. Ethanol and isopropanol can be used to quickly and inexpensively disinfest tools and contaminated surfaces

Tobacco Disease Research

The Connecticut Agricultural Experiment Station Valley Laboratory was established in 1921 as the Tobacco Substation, to combat tobacco problems and diseases such as wildfire, a devastating disease caused by a bacterial plant pathogen. Wildfire was eventually eliminated by the development of plant resistance to this pathogen. Ever since, tobacco breeding to incorporate genetic plant resistance to plant pathogens has been used to successfully manage diseases. Plant resistance is the most economical, environmentally responsible, and often most effective way to control diseases. The development of plant resistance to Tobacco Mosaic Virus (TMV) in the 1950's, to ozone damage (weather fleck) in the 1960's, black shank in the 1970's, and Fusarium wilt in the 1980's and early 1990's effectively controlled serious diseases which each threatened to seriously impact or even wipe out cigar wrapper tobacco production in the Connecticut River Valley. There are currently a number of pathogens that threaten the crop. Dr. LaMondia conducts an ongoing breeding program to develop resistance to: *Fusarium oxysporum* (causing Fusarium wilt); *Globodera tabacum* (the tobacco cyst nematode); tobacco mosaic virus, and *Peronospora tabacina* (blue mold) for both shade and broadleaf types. An inbred line, C9 was initially released in 1991 and is still being produced as a wilt- and TMV-resistant cultivar. A new hybrid with similar resistance profiles and increased uniformity was released as B1 and is in production. In 2011, a male-sterile F1 hybrid 'B2' highly resistant to Fusarium wilt, TMV, and the TCN and with moderate resistance to blue mold and black root rot was released and subsequently licensed. Black shank, caused by *Phytophthora nicotianae*, has re-emerged as a serious pathogen in Connecticut and we are working to develop a hybrid line with significant resistance to the pathogen. Our first candidate line, B3, was evaluated under field conditions in 2014 and 2015 and, while resistant, was found to be lacking in sufficient wrapper leaf quality. Additional crosses are now being made. Black root rot, caused by the fungus *Thielaviopsis basicola* has been damaging and increasing in impact in recent years with cool wet springs. We obtained three sources of dark wrapper tobacco with high levels of black root rot resistance from cooperating scientists in Kentucky. A back-cross program was used to transfer resistance to CT broadleaf, and resistant plants were selected for broadleaf characteristics. Inbreds have been developed and have been used to develop hybrid lines with resistance to multiple pathogens. A number of these lines are being evaluated under commercial conditions and two (D1 and D2) have now been licensed with a company for commercial seed production. Breeding for resistance to Potato virus Y (PVY) has been a high priority, however, the burley tobacco cultivar (TN-86) that is the commercial source of resistance to Potato virus Y (PVY) has been evaluated and found not to be resistant

to the new PVY strains that occur in potato, tobacco, and other solanaceous crops. No source of resistance to the new strains is currently known, so this objective has been put on hold.

Impacts:

- C9 and B1 broadleaf tobacco carry resistance to Fusarium wilt and TMV. C9 has been widely grown since its release (>80% of acreage) and has prevented more than \$5 million in losses each year since 1992. B1 is more uniform and is replacing C9 over time.
- The development of a male-sterile hybrid broadleaf cigar wrapper tobacco with resistance to most of the major pathogens, including Fusarium wilt, TMV, the TCN and blue mold, will allow sustainable production with reduced disease and much reduced pesticide inputs. Growing B2 eliminates the need for nematode management at over \$500 per acre per year. New varieties in development are resistant to black root rot, for which there are no current management options.
- B1, B2, D1, and D2 have been released as new cultivars and licensed to a local company. Proceeds will support further research on plant resistance. Adding resistance to black root rot will further reduce plant losses to disease.

Tobacco Cyst Nematode Management

Trap crops are being developed for nonchemical control of cyst nematodes. A solanaceous weed, sticky nightshade (*Solanum sisymbriifolium*) is being evaluated to control potato cyst nematodes *Globodera pallida*. Because of the difficulties in working with this regulated pathogen in the United States, Dr. LaMondia is cooperating with scientists from Idaho to conduct experiments with the closely related tobacco cyst nematode *G. tabacum* as a model system. The influence of broadleaf cigar wrapper tobacco (*Nicotiana tabacum*), eastern black nightshade (*Solanum ptychanthum*), and sticky nightshade (*Solanum sisymbriifolium*) on egg hatch and subsequent development of the tobacco cyst nematode, *Globodera tabacum*, was investigated in field microplots over two years. Sixty-five microplots 1-m-diam, naturally infested with various densities of TCN, were transplanted with nematode-susceptible shade tobacco (cv. '8212', nematode-resistant broadleaf tobacco cv. 'B2', Litchi tomato, eastern black nightshade and a cultivated fallow. TCN densities were determined before planting and again after harvest by sampling each microplot with 10 cores 1.5-cm-d to 15-cm depth. Soil was dried and extracted using a modified Fenwick can. Cysts were crushed and the number of viable encysted J2 per cm³ soil determined. Nematode reproduction as determined by the ratio of the final (Pf) to initial (Pi) populations varied between treatments. In 2017, Pf/Pi ratios were 18.63, 7.71, 0.51 1.38 and 0.33 for *Solanum ptychanthum*, susceptible tobacco, resistant tobacco fallow, and Litchi tomato, respectively. These results are consistent with previous research that Litchi tomato, *S. sisymbriifolium*, stimulates tobacco cyst nematode hatch better than resistant or susceptible tobacco but unlike eastern black nightshade, does not allow significant nematode reproduction in roots, indicating that it may be an effective trap crop for management of *G. tabacum*. In addition, *G. tabacum* may be useful as a substitute model for the quarantined pathogen *Globodera pallida* for trap cropping with *S. sisymbriifolium* under field conditions.

Impact:

- Sticky nightshade, *Solanum sisymbriifolium*, stimulates tobacco cyst nematode hatch better than tobacco but unlike eastern black nightshade, does not allow significant reproduction in roots, indicating that it may be an effective trap crop for management of *G. tabacum*. In addition, *G. tabacum* is useful as a substitute model for the quarantined pathogen *Globodera pallida* for trap cropping with *S. sisymbriifolium* under field conditions.

Reduced Pesticide Residues in Tobacco

Connecticut shade and broadleaf tobacco types are used to produce some of the highest quality cigar wrappers in the world. Blue mold, caused by *Peronospora tabacina*, is a leaf spot disease that can completely destroy the crop, valued at up to \$50,000,000 per year. Fungicides can help protect the leaves, but growers and cigar makers want to keep residues low. Dr. LaMondia conducted experiments to maximize disease control with reduced levels of fungicide in cured leaves in 2016, 2017, and 2018. The strategy tested investigated the effects of using azoxystrobin, dimethomorph, mandipropamid, fluopicolide or oxathiapiprolin fungicides early in the season and avoiding or minimizing sprays prior to harvest as opposed to the standard application of the same total amount of fungicide spread out over the season. Leaves were harvested, cured and fungicide residues determined by Dr. Brian Eitzer of the Department of Analytical Chemistry. Our results indicated that fungicide concentrations were stable in the plant and may have more systemic activity than thought. Reduced spray programs were as effective in managing blue mold and target spot as standard sprays with reduced fungicide residues in cured leaves.

Impact: An effective spray program that results in reduced fungicide residues in broadleaf and shade cigar wrapper tobacco types will increase marketability and reduce human exposure to pesticides.

Hops Research Hop Cultivation in Connecticut

Hop (*Humulus lupulus*) cultivation in the Northeastern United States dates back to the first settlers, but disappeared for a century because of disease pressure and the enactment of Prohibition. Subsequently, it was established in the Pacific Northwest, which is currently the largest production area worldwide (53,282 acres; IHGC - 2017 Statistical Report).



Yellow Lupulin glands of female hop cones contain resins, acids, and essential oils, which are responsible for aroma, flavor, and bitterness in beer.

New York State has the largest production area in the Northeast (400 acres, IHGC-2017 Statistical Report) followed by Vermont and Massachusetts (25 acres each; IHGC - 2017 Statistical Report) and Maine (24 acres). Commercial hop production has just started in CT and New Jersey (15 acres each). The increasing popularity of the microbrew culture, local brewpubs, home brewing, and the growing demand for regional products have created a niche market for high quality hops in the Northeast.

Feasibility of Hop Cultivation in Connecticut

Last fall marked the end of a five-year study by Drs. James LaMondia, Katja Maurer, and Elisha Allan-Perkins to investigate the feasibility of hop production in CT. The most common diseases and pests were downy mildew (which is the most damaging disease in the northeastern U.S.), two-spotted spider mites, and potato leafhoppers, the latter being a unique pest to hops in the Northeast. Diseases and pests can be controlled by intensive scouting, rigorous sanitation measures, pesticides, biological controls (e.g., predators), removing weeds, and stripping the lower leaves off of the bines. A region-specific integrated pest management program was established, which includes intensive scouting and timely control measures, and is available as the *Guidelines for Integrated Pest Management for Hops in Connecticut*.



(A) In the spring, the crew prepares the hop yard, trains bines on twine, and prunes. (B) Hop bines can climb more than 20 feet. During the season the hops are fertilized, irrigated, scouted for diseases and pests, and treated. (C) Female mature cones are harvested from the middle of August to the beginning of September. (D) The crew cuts bines to bring them to the shed and hand picks the cones or (E) using a mechanical harvester. The cones are weighed to determine yield, dried, and shipped to a laboratory for quality analysis.

The varieties Cascade and Summit are well suited for CT, with Cascade being more reliable on the high trellis set up, whereas the semi-dwarf variety Summit does well on either high or low trellis. Perle, a German breeding line, had the smallest growth and lowest yield. AlphAroma, moderately resistant in other areas, was the most susceptible to downy mildew. Cascade tended to have less downy mildew and potato leaf hopper damage than the other varieties. Hop plants at Lockwood Farm produced more cones than plants at the Valley Laboratory. Especially on high trellis systems, the varieties tested met the industry standards for yield, and for alpha and beta acid content, except for Newport, which was consistently low and Cascade which was consistently high for alpha and beta acids.

In conclusion, the trial has proven the general feasibility of successful hop production in CT, but not all varieties do well. An additional 44 varieties were planted at Lockwood Farm since 2016 and an additional 17 more varieties were planted in Windsor for evaluation. Preliminary results suggest the varieties Zeus (CTZ), Cluster High, and Super Alpha are highly susceptible to downy mildew in Connecticut. Brewer’s Gold, Chinook, Comet, and Southern Brewer seem to be promising candidates, but more research needs to be done.

Impacts:

- Assessment of different cultivars in terms of their growth, yield, and disease/pest development will lead to a better understanding of successful hop cultivation in Connecticut.
- The general feasibility of successful high quality hop production in CT has been proven.
- Hops varieties differ in yields, growth characteristics, quality, and susceptibility to downy mildew. Not every variety does well in CT.
- Downy mildew, spider mites, and potato leafhoppers, which are the most dreaded disease and pests, can be controlled with rigorous pest management.
- Drs. Allan-Perkins, Maurer, and LaMondia created an Integrated Pest Management Guideline for CT.

Crowning of Hops to Control Downy Mildew

Downy mildew is the most damaging fungal disease of hops in Connecticut. The pathogen, *Pseudoperonospora humuli*, overwinters in hop crowns and infects the newly emerging bines. Hop growers in other parts of the United States “crown” their hops, meaning they remove the upper portion of the crown either through mechanical or chemical damage. This removes diseased tissue and reduces downy mildew in the hop yard. Connecticut growers have asked if this practice could be adapted in Connecticut, with the concern that the hop plants may not have enough time to recover from the crowning damage in our short

growing season, causing a loss in hop cone yield. Drs. Allan-Perkins and LaMondia have started the first year of testing the feasibility of crowning to reduce downy mildew infections in Connecticut. Hop plants were either mechanically crowned, chemically crowned using herbicide, or flamed to remove the top portion of the hop crown. Downy mildew incidence, bine vigor, weed suppression, and hop cone yield are being evaluated. The results of this study will be used to make recommendations to Connecticut hop growers on the best crowning practices for hops in this climate. This practice could reduce the number of fungicide applications needed by the grower to control this disease.



A: Flaming hop crowns to reduce downy mildew. B: Hop research plots that have been mechanically crowned, chemically crowned, flamed, or left untreated to test for the ability of crowning to reduce downy mildew in Connecticut.

New and Emerging Diseases of Hops in Connecticut

Drs. Allan-Perkins and LaMondia are continually monitoring hops in Connecticut for new and emerging diseases to provide this information to hop growers. In late 2018, they confirmed the presence of powdery mildew in a Connecticut hop yard. Powdery mildew is one of the major diseases of hops in other parts of the United States and can cause significant losses in hop cone yield. They have reported this finding to the Connecticut Hop Growers Association, included it in the Guidelines for Integrated Pest Management for Hops in Connecticut, and published this finding in a scientific peer-reviewed journal. The dissemination is important, so Connecticut hop growers actively scout and control this disease to prevent it from becoming widespread or overwintering in Connecticut. Additionally, Drs. Allan-Perkins and LaMondia have discovered a new pathogen infecting the hops being grown at the Valley Laboratory and Lockwood Farm hop yards. They are currently identifying the pathogen causing the disease, assessing environmental conditions conducive to disease, and testing the ability of fungicides registered for hops to control this new disease. In addition to preparing a scientific journal article on this new pathogen, they have presented information on this new disease, currently being called Phomopsis wilt, to the Connecticut Hop Growers Association and included it in the Guidelines for Integrated Pest Management for Hops in Connecticut. The quick dissemination of information on this new pathogen will help Connecticut hop growers recognize and manage this disease to prevent cone yield losses.



A: Phomopsis wilt on hop leaf, B: Phomopsis wilt on hop plant, C: Powdery mildew on hops.

Breeding of Wild Connecticut Hops

Hops are native worldwide, with the most commonly used cultivated varieties for brewing belonging to the European lineage. However, hops are native to North America and can be found growing wild in Connecticut. These wild plants may truly be North American hops, or they may be cultivated varieties that escaped from hop yards and are now growing wild. Dr. LaMondia has collected ten hop plants from Connecticut that represent these native/wild varieties. The hop plants are currently being evaluated at the Valley Laboratory for their disease and pest resistance, growth characteristics, hop cone yield and quality. These plants will be used in a breeding program to establish Connecticut hop varieties that are well-adapted to growing in our climate. This will provide Connecticut hop growers with healthy plant material that may need less management inputs and may have unique flavor profiles that will be desirable in the brewing industry.

Christmas Tree Disease Management

In 2015, Dr. Cowles established a planting of firs in Brooklyn, CT, at a site with a high naturally occurring incidence of phytophthora root rot. This experiment is investigating soil acidification through the addition of elemental sulfur to the soil as a method to prevent infection by root rot organisms. The underlying hypothesis is that *Phytophthora* spp. are less tolerant of acid soils than are the fir tree hosts. Two species were planted, Fraser fir, which is highly susceptible to *Phytophthora*, and Canaan fir, which is somewhat tolerant. Evaluation of tree health in the same year as planting demonstrated a highly significant treatment effects from application of sulfur, which benefitted both species of fir, and a phosphite root dip, which benefitted only the Fraser firs. In the 2016 evaluation of this experiment (the year following planting), the trees in the low pH (acidified soil) plots had twice the terminal growth as the trees in plots not amended with sulfur. Through the spring of 2019, the order from lowest to highest in mortality rate has been Canaan with low pH, Canaan with high pH, Fraser with low pH, and Fraser with high pH. Overall, acidification of soil and substituting Canaan firs for Fraser fir results in a 90% reduction in losses from phytophthora root rot; these minimal losses can make Christmas tree production in fields with phytophthora inoculum profitable.

Diseased trees from this Brooklyn, CT, field site were used by Drs. LaMondia and Cowles to isolate the associated *Phytophthora* pathogen. Gene sequencing conducted by Dr. Schultes and morphological examination by Dr. DeWei Li have determined that this species was previously undescribed. Experiments demonstrated Koch's postulates with this isolate and a species description is being published.

The observation that tree growth one year after planting was associated with better tree color in the year of planting, and that all trees were somewhat yellow in the year of planting, suggests that improvement of plant nutritional status during the year of planting could have tremendous dividends for initial establishment and future growth of the trees. A series of three follow-up experiments, supported by a grant from the Christmas Tree Promotion Board, were established in spring of 2019 at three cooperating farms. The experiments will determine whether bare-root transplants significantly benefit from the addition of controlled-release fertilizer, as evident from their improved color.

Impact:

- Root dips to improve initial establishment and protect Christmas tree bare-root transplants from infection with *Phytophthora* are now being practiced, with the result of reducing by one year the time to grow a salable tree.

VALLEY LABORATORY SERVICE ACTIVITIES

Requests for Information

A total of 6,539 inquiries were answered at the Valley Laboratory during the past year. The majority of these queries were answered by Ms. Rose Hiskes (72%) in the inquiry office (65% of these from the public sector) or by Dr. LaMondia (15% of total inquiries; 90% of which were commercial). About 65% of the information requests to the inquiry office were from the public sector; the remainder was from commercial growers, government, and nonprofit, educational or other (35%). The majority of inquiries answered by Ms. Hiskes concerned insects (26%), diseases (15%), pesticides (12%) or horticulture (11%). Most concerned landscape and nursery (41%), vegetable (7%) and structural entomology (10%). Dr. LaMondia responded to disease (55%), horticulture (25%), insect (5%), fertility (4%), pesticide (4%), weed (1%) and animal (1%) inquiries. These inquiries primarily concerned tobacco (42%), hops (22%), nursery and landscape (15%), vegetables (7%), fruit (5%), golf turf (8%) and Christmas trees (1%). All scientists and many of the staff at the Valley Laboratory assist growers and homeowners.

Valley Laboratory scientists made 97 presentations to grower, professional, and citizen groups (over 5,000 people), were interviewed 17 times, and made 213 visits to commercial nurseries, greenhouses, farms, forests, and landscapes to diagnose complex problems or conduct research projects. Dr. LaMondia maintains surveillance to notify the Connecticut River Valley growers about the presence and likely threat of tobacco blue mold disease in North America, and inform about management options. His laboratory conducted 159 nematode diagnostic samples and conducted testing as an APHIS certified pinewood nematode export testing facility.

Thomas Rathier, emeritus soil scientist, continued to visit specific urban sites where community gardens either already existed or were planned by community organizers. At each site, Mr. Rathier made an assessment of the horticultural capabilities of the site as well as the likeliness of heavy metal contamination being found in soils on the site. Samples were taken at each site and analyzed by Mr. Rathier and Mr. Musante (Analytical Chemistry Department). Mr. Rathier subsequently relayed results to appropriate stakeholders along with suggestions for remediation and/or avoidance of soils whose metal concentrations exceed the Connecticut standards.

Soil Testing

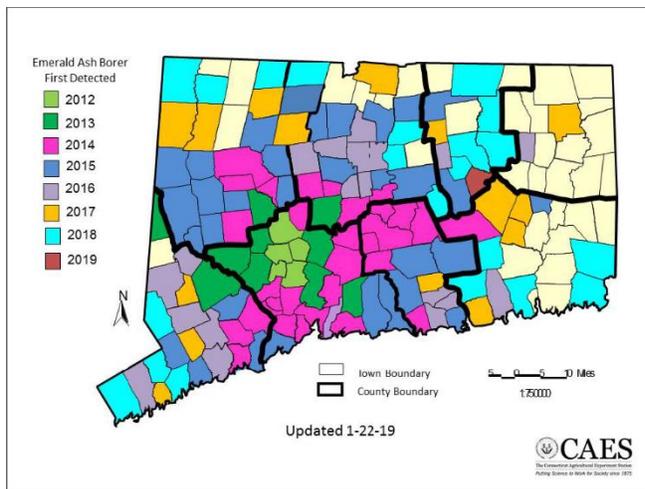
A total of 4,454 soil tests were expertly performed by Ms. Diane Riddle during the past year. About 54% were performed for commercial growers and 46% for homeowners. Of the commercial samples submitted, 71% were for landscapers, 9% for tobacco growers, 6% for vegetable growers, 4% for municipalities, 4% for golf course superintendents, 1% for nursery growers, 2% for small fruit, 1% for Christmas tree growers, and 2% for research.

Impact:

- Approximately 25% of soil samples tested did not require additional fertilizer. Reducing the over-application of fertilizers protects the environment.

Valley Laboratory Information Office Insect, Disease and Plant Health Inquiries

Ms. Rose Hiskes diagnosed a wide range of insect, disease, weed, and plant health problems on herbaceous and woody ornamentals, lawns, vegetables, fruit, and Christmas trees for homeowners, commercial businesses, other government agencies, and nonprofits.



Insects

During the spring and summer months, insect pests, such as emerald ash borer, scales, and the white grub complex beetles affected trees, shrubs, and flowers in landscapes.

Emerald ash borer (EAB) has continued to spread throughout the state. The larvae of the beetle feed on the conducting tissue of ash trees killing them in 2-3 years. Towns and

homeowners are facing budget crises, as they need to take down ash trees that have died from beetle infestations before they fall on homes, cars, and sidewalks. With their low moisture content, ash trees decompose quickly and will drop major limbs within a year of death. Treatment with emamectin benzoate or imidacloprid insecticides on trees with more than 50% of their canopy can be curative and save ash trees that do not have other problems such as ash yellows. Dr. Claire Rutledge, CAES, maintains the map of EAB infestations in Connecticut.

Two armored scales are a serious problem on evergreens such as hemlock, spruce, and fir in landscapes and Christmas trees: the elongate hemlock scale (Figure 1) and the circular hemlock scale. These scales differ from soft scales in that they have a separate cover that comes off revealing the yellow sac-like insect below. Also, they do not secrete honey dew, which usually results in the dark sooty mold on affected plants. Symptoms include a yellow stippling of the needles and eventual drop if the infestation is bad enough. As scales feed on the undersides of needles, small infestations can be missed. Horticultural oil can be sprayed while crawlers are active in July if the weather is not too hot. The systemic, dinotefuran, now a restricted use pesticide, can be applied by licensed applicators early in the season to control both of these scales.



Figure 1. Elongate Hemlock Scale: adult female. © CAES

Adult beetles, such as the Asiatic garden beetle, the Japanese beetle, and the Oriental beetle feed on foliage of many herbaceous plants in our gardens. Their larvae are serious soil pests, feeding on the roots of grasses and ornamentals. Asiatic garden beetle adults are particularly pestiferous because they feed at night and hide in duff on the soil surface during the day. They prefer plants in the aster family. Damage always begins at the leaf edge and moves to the interior of the leaf giving it a tattered look. Leaving porch lights on at night will draw them to window screens where they can be flicked into a cup of soapy water.

Structural and human insect pests continue to create problems for Connecticut citizens. A new species of tick, the Lone Star tick, was brought in for diagnosis. It was partially engorged and thought to be acquired in Storrs. This tick can carry human erlichiosis. Another possible side effect from the bite of this tick is a red meat allergy.

The pea and bean weevil that feeds on dried legumes was brought in for diagnosis this year. Buying that ten pound bag of beans that you don't use up quickly provides the right conditions for this insect to build up a population. All it takes is for an egg or two of the weevil to get through the bean drying and cleaning process. Keeping dried legumes in the refrigerator will slow the progress of this insect significantly.

Diseases

Lawns had a lot of red thread disease as a result of the cool, wet weather in the spring of 2019. This is a foliar disease and once weather warms and rains space out further, most grasses recover. For homeowners, it is usually not worth it to apply fungicides.

Woody plants such as maples, sycamores, and dogwoods suffered from anthracnose diseases, also because of the cool, wet weather of spring. Sycamores, in particular, while heavily defoliated, seem to be able to withstand this disease and show no long-term negative effects. Evergreens have been having problems with needlecasts such as rhizosphaera and dothistroma (Figure 2). Mugo pines, including the large older plant in the Valley Laboratory landscape, have been thinned considerably by dothistroma needlecast. Infections begin in the spring as spores splash onto young susceptible foliage, remain latent through the summer and evidence themselves in the fall as needles begin yellowing and dropping. Fungicides such as daconil or mancozeb can be applied at budbreak and repeated as label directions advise.



Figure 2. Dothistroma needleblight of mugo pine.
©CAES, Rose Hiskes.

Weeds and Herbicides

Homeowners fight weeds in their lawns and landscapes. *Houttuynia cordata* 'Chameleon' is a colorful, perennial, herbaceous groundcover that can grow to 12" tall. However, it spreads aggressively by underground rhizomes and quickly becomes a weed. Requests came in this year for how to control the plant. Planting it where it is kept in bounds by concrete sidewalks and foundations is one way to manage this plant. If it is the only plant in the bed, a thick black plastic can be put down and held in place to suffocate the plant. Reversion to the solid green species can be problematic as this plant has more vigor than the cultivar 'Chameleon'. There are no herbicides labeled for control of *Houttuynia*.

Lawn weeds can be difficult to manage. Many people brought in corn speedwell in the spring and summer. This winter annual needs a different approach than the usual lawn weeds such as dandelion or crabgrass. Seeds of this plant germinate in the fall so any pre-emergence control needs to be applied in late summer when it is not usually available in garden centers. Buying one bag of pre-emergent weed control for a spring application to control crabgrass and a second bag to be applied late summer against winter annuals and a possible second crop of crabgrass is one plan. Another chemical control option for the winter annuals would be to apply a Trimec-type product late fall when the plants have attained 5-6 leaves and the weather is still warm. Trimec can also be applied early spring but needs to be on before flowering. An organic option would be to have a “freedom” lawn and since it is green and can be mowed, leave it be.

Plant Health - Weather

Connecticut’s weather is changing. Climate scientists are predicting the Northeastern US is going to experience more rainfall. What does one do when there is too much rain? Long-term you can think about adding drainage tiles to fields or making raised beds but for the current season you are at the mercy of the weather.

Many large leaf rhododendrons in the northern part of the state emerged from winter with large brown patches on leaves and what looked to be dead branches. Rhododendrons have a shallow, fibrous root system. The drought of 2016-2017 caused root hairs to die from lack of water. Then came 2018 when we received 6” more rain than normal. The decreased root volume became even less with root hair death due to waterlogged soil. However, by the end of June, with severe pruning, some of the plants showed signs of recovery. Why did this work? Was the root hair to leaf surface area balance restored by the pruning?

Frost for most of the northern part of the state came October 18-19. April 11 was the last freeze for the winter.

Impact:

- Accurate identification of pests of agricultural and human health significance has resulted in economic savings to commercial growers and homeowners, reduced human and environmental exposure to pesticides, and increased human safety.

The Gordon S. Taylor Conference Room

Many agricultural organizations used the conference room at the Valley Laboratory regularly for their meetings. During the past year, 15 different groups used the room on 31 occasions. Our most frequent users were the CT Rhododendron Society, CT Invasive Plant Working Group, Invasive Plant Council, CT Farm Land Trust, Nursery Landscape Research Group, CT Nursery & Landscape Association, CAES Board of Control, Co-Operative Invasive Plant Working Group, CT Agricultural Information Council, CT Hop Growers Association, UConn Dairy Council, CT Vineyard & Winery Association, West Hartford Farmers Market, and the Land Trust Alliance Northeast Program. Ms. Jane Canepa-Morrison scheduled the meetings and James Preste and Isaac Buabeng arranged the furniture and ensured that the room was available after hours.

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