

Station News

The Connecticut Agricultural Experiment Station
Volume 6 Issue 8 August 2016



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



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The Connecticut Agricultural Experiment Station

Putting Science to Work for Society since 1875

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ADMINISTRATION

DR. THEODORE ANDREADIS participated in a meeting of the Connecticut Invasive Plant Council held at the Department of Agriculture in Hartford (July 12); was interviewed about federal and state funding for research and surveillance for Zika virus in Connecticut by Fran Schneido WCBS Radio New York (July 21); participated in a press conference held at the Station with Governor Dannel Malloy and Department of Public Health Commissioner, Raul Pino to formally announce the testing of Connecticut residents for Zika virus and provide an update on mosquito testing. The press conference was followed by a tour of the Biosafety Level 3 and Mosquito laboratories (July 21); was interviewed about the Station's Mosquito Surveillance program for Zika virus in Connecticut by Kathleen McWilliams Hartford Courant (July 21); and was interviewed about Plant Science Day 2016 by Ray Andrewsen WQUN AM 1220 in Hamden (July 26).



DR. THEODORE ANDREADIS addressing the press on Zika virus with Governor Dannel Malloy on July 31 in the atrium of the Johnson-Horsfall Laboratory.

ANALYTICAL CHEMISTRY

DR. JASON C. WHITE, along with **MS. KITTY PRAPAYOTIN-RIVEROS**, participated in an FDA webinar with staff from eLEXNET regarding the laboratories upcoming site visit (July 6); participated in a USDA NIFA webinar on reporting project results and highlighting impact statements (July 7); spoke by phone with Dr. Meagan Mauter of Carnegie Mellon University regarding potential collaborative work on nanofertilizers (July 13); was interviewed by Melissa Pandika, a reporter for OZY, on the use of nanotechnology in agriculture (July 13); along with **DR. BRIAN EITZER**, hosted Dr. Kalubmu Malekani and Dr. Paul Reibach of Smithers Viscient and discussed potential areas of overlapping interest (July 14); along with **MR. MICHAEL CAVADINI**, **MR. JOSEPH HAWTHORNE**, **DR. WALTER KROL**, **MR. CRAIG MUSANTE**, **MS. KITTY PRAPAYOTIN-RIVEROS** AND **MS. TERRI ARSENAULT** participated in the monthly FDA FERN cCAP teleconference call (July 14); along with **MR. MICHAEL CAVADINI**, **MR. JOSEPH HAWTHORNE**, **DR. WALTER KROL**, **MR. CRAIG MUSANTE**, **MS. KITTY PRAPAYOTIN-RIVEROS**, **DR. CHRISTINA ROBB**, **MR. JOHN RANCIATO** AND **MS. TERRI ARSENAULT** hosted the FDA eLEXNET team for a one-day onsite training (July 21); participated by WebEx in a career panel question and answer session with graduate students from the Duke University Center for the Environmental Implications of Nanotechnology (CEINT)(25 participants) (July 27); participated by WebEx in a laboratory group meeting focusing on the fate of ingested nanomaterials with collaborations at the Harvard University School of Public Health (10 participants) (July 28); and attended the USDA NIFA AFRI Food Safety Program Project Directors annual meeting and get a lecture entitled “Nanomaterial contamination of agricultural crop species” (55 attendees) (July 30).

DR BRIAN EITZER along with **Dr. SANGHAMITRA MAJUMDAR** was a participant in the FDA mycotoxin multi-lab review conference call (July 14); and was the program co-chair and presided over a session on Advanced Analytical Techniques at the 53rd Annual North American Chemical Residue Workshop in St. Petersburg Beach, FL (350 attendees) (July 23-28).

ENTOMOLOGY

DR. KIRBY C. STAFFORD III was interviewed by Henry McNulty, Hartford Courant, for an editorial on the gypsy moth outbreak and emerald ash borer (July 5); interviewed by John Charlton, Fox61, about the adult gypsy moths (July 6); interviewed by Andrew Revkin, The Times (Opinion), about the gypsy moth (July 6); interviewed by Joy VanderLek, The Cheshire Citizen, about the gyps moth (July 11); interviewed by Denise Coffey, Hartford Courant Community News, about the gypsy moth (July 11); interviewed by Carl Castro, Valley Independent Sentinel, about flies and increased insect activity (July 18); interviewed by Carolyn Beans, NPR, about a tick review (July 19); interviewed by John Penney, The Norwich Bulletin, about expectations for the gypsy moth in 2017 (July 21); interviewed by Aliyya Swaby, New Haven Independent about the emerald ash borer in Wooster Square (July 21); and was interviewed by Chris Woodside, CT Woodlands Magazine, about the gypsy moth (July 27).

MS. KATHERINE DUGAS attended the Connecticut Nursery and Landscape Association summer meeting at Monrovia nurseries in Granby and staffed a Cooperative Agricultural Pest Survey table (July 20); attended the Connecticut Tree Protective Association summer meeting at the Farmington Club in Farmington and staffed a CAES table (July 21); and staffed a Forest Pest table at the East Haddam Farmers' Market (July 27).

MR. MARK H. CREIGHTON attended the Eastern Apicultural Society annual short course and conference at Stockton University in Galloway Township, NJ and taking courses on queen rearing and breeding and microscopy for disease identification/dissection of honey bees. Mr. Creighton also attended presentations about honey bee health and varroa mite management (July 25-29).

DR. GALE E. RIDGE was interviewed by Denise Coffey from the Hartford Courant about how citizens might manage the Gypsy moth populations next year (2017), and what they might do now in preparation (July 11); in collaboration with Haralabos Tsoakis and Salvatore Ragusa of the Università di Palermo, Italy there was a revision in taxonomy of the predatory mite *Neoseiulus fallacis* first identified by Garman in 1948 to a new species *Neoseiulus garmani*. Findings were published in the International Journal of Acarology; interviewed by Carl Castro from the Valley Independent about an increase of blow flies in homes and a connection with current high rodent populations in the state (July 18).

DR. CLAIRE E. RUTLEDGE conducted training sessions for the Wasp Watcher Citizen-Scientist program in Glastonbury, Clinton, North Stonington, Bozrah and Scotland (10 participants) (July 1, 5, 6 & 8) and helped run the Connecticut Tree Protective Association Summer Meeting, Farmington, CT (738 adults, 40 youth) (July 21).

DR. VICTORIA L. SMITH participated in the annual summer meeting of CT Nursery and Landscape Association, held at Monrovia Nursery in Granby CT, with a display on the newly-enacted Pennsylvania Boxwood Blight Quarantine (approximately 200 participants) (July 20); and participated in a meeting of the Yale Biosafety Committee, held at 135 College Street, New Haven (20 participants) (July 21).

DR. KIMBERLY A. STONER presented a scientific poster, "Current Risk Assessments for Neonicotinoid Insecticides Do Not Adequately Address Risks to Bumble Bee Queens (*Bombus* spp.), at the International Pollinator Conference at Penn State University, State College, PA (July 17); and organized, facilitated, and took notes on a meeting of the CT Native Plant, Pollinator, and Wildlife Working Group, Windsor Valley Laboratory (9 attendees) (July 28).



Ms. Catherine Walters is a summer research assistant working with Dr. Francis Ferrandino in the Department of

ENVIRONMENTAL SCIENCES

DR. PHILIP ARMSTRONG gave the presentation “What’s the latest buzz about Zika virus” to the Business Council of Fairfield County (25 attendees) (July 28); was interviewed by the New Haven Register about monitoring mosquitoes for Zika virus (July 11); was interviewed by Fox 61 about the first detection of West Nile virus in mosquitoes (July 15); and was interviewed by the Stamford Advocate about the detection of West Nile virus in Stamford (July 18).



MS. MARIA CORREA started working as an Agricultural Research Technician with Dr. Douglas Brackney in the Department of Environmental Sciences in July, 2016. After completing her BS at Yale University, she worked as a laboratory assistant in Yale’s Department of Ecology and Evolutionary Biology, conducting research on the phylogeny and systematics of North American freshwater fishes. She will be working towards understanding the role of autophagy in flavivirus infection of mosquitoes. She can usually be found in the BSL-3 laboratory.

FORESTRY AND HORTICULTURE

DR. JEFFREY WARD met with John Anderson, Director Aton Forest, to discuss forest ecology and habitat management in Norfolk (July 5).

DR. ADRIANA ARANGO VELEZ spoke on “From west to east, south to north, the unwelcome guests Mountain pine beetle (MPB- *Dendroctonus ponderosae* Hopkins) and Southern pine beetle (SPB- *D. frontalis* Zimmermann). Are naïve conifers ready to defend?” at the IUFRO Conference in Sept-Îles in Quebec, Canada. (40 attendees) (July 11-15)

DR. ABIGAIL MAYNARD visited the West Haven farmer’s market and spoke with 4 growers about the New Crops program (July 14); visited the Stratford farmer’s market and spoke with 3 growers about the New Crops program (July 18); and

PLANT PATHOLOGY AND ECOLOGY

DR. DONALD E. AYLOR gave an invited talk on “Physical Aspects of Aerial Spore Dispersal” at the Annual Meeting of the American Phytopathological Society (APS) in Tampa, FL on July 31) (120 attended).

DR. WADE ELMER presented the invited presentation “Metal oxide nanoparticles for management of Verticillium wilt of eggplant and Fusarium wilt of watermelon” (88 attendees): and attended the Widely Prevalent Fungal Working Group and participated in the APS Academic Unit Leaders Forum at the Annual Meeting of the American Phytopathological Society (APS) in Tampa, FL (July 31-Aug 2).

DR. YONGHAO LI visited the Northeast Institute of Geography and Agroecology at the Chinese Academy of Sciences, Harbin, China and discussed soil-borne diseases with Dr. Yanli Xu and her researchers in the lab (July 5), attended the Connecticut Tree Protective Association Summer Meeting and assisted CAES Booth in Farmington, CT (July 21); and was interviewed by James Mosher at Crains Connecticut Newsletter about boxwood blight (July 25).

DR. LINDSAY TRIPLETT spoke on a panel to high school students from all 50 states and 92 countries about biology and agriculture careers at the Yale Young Global Scholars Program in Biological and Biomedical Sciences (220 youths) conducted a question and answer panel for a select group (70 youths) (July 16), presented a talk titled “Microbial manipulation of host primary metabolism using a type III secreted effector” at the 2016 Congress of the International Society of Molecular Plant-Microbe Interactions in Portland, OR. She also served as co-organizer and moderator of the session. (280 attended) (July 18); and organized an “APS Preview Seminar” for CAES staff and scientists four presentations by **DRS. LINDSAY TRIPLETT, QUAN ZENG, ROBERTO DE LA TORRE-ROCHE, and WADE ELMER** in Jones Auditorium (July 28),

DR. TEJA SHIDORE was awarded the Ko Shimamoto travel award to attend the 2016 Congress of the International Society of Molecular Plant-Microbe Interactions in Portland, OR where she presented a poster titled “Characterization of the functional duality of a bacterial type III secreted protein AvrRxo1 and its chaperone Arc1 as a toxin-antitoxin system” (July 17).

VALLEY LABORATORY

DR. RICHARD COWLES met with the Hartford Tree Commission on July 6 to discuss the economics of ash and emerald ash borer management, Hartford (8 attendees). He presented “Neonicotinoids and Pollinator Health” to the Connecticut Tree Protective Association at their summer meeting, Farmington (180 attendees). He provided a webinar presentation to the Second Annual Hemlock Woolly Adelgid Program Managers’ Meeting (physically held in Ithaca, NY) on “Insecticide Efficacy and Pollinator Impacts,” July 26 (50 participants).

DR. JAMES LAMONDIA participated in the Journal of Nematology Editorial Board meeting and presented a poster entitled ‘Evidence for suppression of *Meloidogyne hapla* by *Pasteuria* sp. in Connecticut’ at the joint meeting of the Society of Nematologists and the Organization of Nematologists of Tropical America held in Montreal, Quebec (July 17 to 22); was interviewed about the effects of drought on crops in Hartford County by Greg Ladky of the Hartford Courant (July 26); presented a poster about research titled ‘Susceptibility of *Buxus* accessions to the boxwood blight pathogen *Calonectria pseudonaviculata*’, and participated in the APS Division Forum Representatives meeting and the Nematology Committee meeting at the annual meeting of the American Phytopathological Society in Tampa Florida (July 30 to August 2).

Dr. James LaMondia, Dr. Jatinder Aulakh, Dr. DeWei Li, Ms. Rose Hiskes and Ms. Diane Riddle conducted a tour of the Valley Laboratory and spoke about research programs and services to an Environmental Monitoring Science class from Goodwin College (July 26, 10 people).

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DEPARTMENTAL RESEARCH UPDATES JULY 2016

Hamilton, J.A., W. El Kayal, A.T. Hart, D.E. Runcie, A. Arango-Velez, and J.E.K. Cooke. 2016. The joint influence of photoperiod and temperature during growth cessation and development of dormancy in White spruce (*Picea glauca*). *Tree Physiology*. doi:10.1093/treephys/tpw061

Abstract: Timely responses to environmental cues enable the synchronization of phenological life-history transitions essential for the health and survival of north-temperate and boreal tree species. While photoperiodic cues will remain persistent under climate change, temperature cues may vary, contributing to possible asynchrony in signals influencing developmental and physiological transitions essential to forest health. Understanding the relative contribution of photoperiod and temperature as determinants of the transition from active growth to dormancy is important for informing adaptive forest management decisions that consider future climates. Using a combination of photoperiod (long = 20 h or short = 8 h day lengths) and temperature (warm = 22°C/16°C and cool = 8°C/4°C day/night, respectively) treatments, we used microscopy, physiology and modeling to comprehensively examine hallmark traits of the growth-dormancy transition—including bud formation, growth cessation, cold hardiness and gas exchange—within two provenances of white spruce [*Picea glauca* (Moench) Voss] spanning a broad latitude in Alberta, Canada. Following exposure to experimental treatments, seedlings were transferred to favorable conditions, and the depth of dormancy was assessed by determining the timing and ability of spruce seedlings to resume growth. Short photoperiods promoted bud development and growth cessation, whereas longer photoperiods extended the growing season through the induction of lammas growth. In contrast, cool temperatures under both photoperiodic conditions delayed bud development. Photoperiod strongly predicted the development of cold hardiness, whereas temperature predicted photosynthetic rates associated with active growth. White spruce was capable of attaining endodormancy, but its release was environmentally determined. Dormancy depth varied substantially across experimental treatments suggesting that environmental cues experienced within one season could affect growth in the following season, which is particularly important for a determinate species such as white spruce. The joint influence of these environmental cues points toward the importance of including local constant photoperiod and shifting temperature cues into predictive models that consider how climate change may affect northern forests.

Ward, J.S. 2016 Twenty-five year response of non-crop trees to partial release during precommercial crop tree management. *Forest Ecology and Management*
<http://www.sciencedirect.com/science/article/pii/S0378112716302821>

Abstract: An underappreciated component of precommercial crop tree release (PCTR) is the inevitable partial release of non-crop trees. While the response of fully released crop trees is increasingly understood, few studies have examined the response of non-crop trees. The effects of precommercial crop tree release at canopy closure on upper canopy persistence, mortality, and diameter growth over 25-years were examined on seven study areas established in Connecticut in 1988. Each area had nine 8 m × 8 m plots for each of two treatments: PCTR and unmanaged controls. The equivalent of 156 crop trees per hectare were completely released by cutting all stems with adja-

cent crowns. This resulted in the inadvertent partial release on two or more sides of 480 upper canopy, non-crop trees per hectare. Diameters and crown classes of all stems (DBH > 2 cm) were measured annually. For those stems in the upper canopy at when treated, partial release increased the proportion of oaks, but not maples or birches, which persisted in the upper canopy. Partial release increased the proportion of intermediate oaks that ascended into the upper canopy and reduced mortality. Partial release increased 25-year diameter growth of oaks. However, releasing upper canopy, sapling oaks on only one side did not increase upper canopy persistence or diameter growth. PCTR increased the proportion of oaks among the largest 300 trees per hectare twenty-five years after treatment. Where predicted oak densities are below management goals, precommercial crop tree release should be considered as a tool to increase survival and growth of quality oak saplings.

Elmer, W. H. and White, J. 2016. Nanoparticles of CuO improves growth of eggplant and tomato in disease infested soils. *Royal Chemical Society Environmental Science: Nano*, DOI: 10.1039/C6EN00146G

Abstract: Nanoparticles (NP) have great potential in agriculture. For example, micronutrients have poor mobility in plants and poor availability in neutral soils, yet they play pivotal roles in root health. We investigated whether foliar sprays of micronutrient NP could affect plant health in disease infested soils. In the greenhouse, NP of AlO, CuO, FeO, MnO, NiO, and ZnO were sprayed on tomatoes and grown in soilless medium infested with the *Fusarium* wilt fungus. NP of CuO, MnO, or ZnO reduced disease estimates [Area-Under-the-Disease-Progress-Curve (AUDPC)] by 31%, 28%, or 28%, respectively, when compared to untreated controls. When NP of CuO, MnO, or ZnO, their bulked equivalents, or their sulfate salts were compared to untreated eggplants and held in the greenhouse in soilless medium infested with the *Verticillium* wilt fungus, NP of CuO increased fresh weights by 64%, reduced AUDPC values by 69%, and had 32% more Cu in the roots. These same amendments were sprayed onto the foliage of tomato and eggplant transplants and set in field plots in soil heavily infested with the *Verticillium* wilt fungus. Compared to untreated controls, yields of tomato were 33% or 31% greater with NP of CuO or the bulked MnO, respectively. NP of CuO or ZnSO₄ increased eggplant yields by 34% or 41% when compared to controls, respectively. In vitro studies found NP of CuO were not inhibitory to the *Fusarium* wilt fungus suggesting host defense was being manipulated.

Triplett, L.R. and J.E. Leach. Host mechanisms for resistance to TAL effectors: Thinking outside the UPT box. 2016. *Physiological and Molecular Plant Pathology* 95: 66-69.

Abstract: Transcriptional activator like (TAL) effectors are important virulence factors of several plant pathogenic species of *Xanthomonas*. Members of this secreted protein family may activate transcription of; susceptibility factors, favoring disease, or resistance genes, triggering immunity. Accordingly, most research in this area has focused on the responses of a few model varieties of plants to the transcriptional activities of TAL effectors. However, a few studies suggest that plants may have evolved a diversity of additional responses to TAL effectors that are not well understood. These could include resistance to the effects of the TAL-activated

susceptibility factors such as carbohydrate transporters, genomic multiplication of off-target effector binding sites, direct receptor recognition of the conserved TAL effector structure, or mutation of the host machinery required for TAL effector function. A better understanding of the diversity of plant responses to TAL effectors will be important for harnessing the potential of these proteins for agricultural applications.

Triplett, L.R., T. Shidore, J. Long, J. Miao, S. Wu, Q. Han, C. Zhou, H. Ishihara, J. Li, B. Zhao, and J.E. Leach. AvrRxo1 is a bifunctional type III secreted effector and toxin-antitoxin system component with homologs in diverse environmental contexts. 2016. PLOS ONE, <http://dx.doi.org/10.1371/journal.pone.0158856>.

Abstract: Toxin-antitoxin (TA) systems are ubiquitous bacterial systems that may function in genome maintenance and metabolic stress management, but are also thought to play a role in virulence by helping pathogens survive stress. We previously demonstrated that the *Xanthomonas oryzae* pv. *oryzicola* protein AvrRxo1 is a type III-secreted virulence factor that has structural similarities to the zeta family of TA toxins, and is toxic to plants and bacteria in the absence of its predicted chaperone Arc1. In this work, we confirm that AvrRxo1 and its binding partner Arc1 function as a TA system when expressed in *Escherichia coli*. Sequences of *avrRxo1* homologs were culled from published and newly generated phytopathogen genomes, revealing that *avrRxo1:arc1* modules are rare or frequently inactivated in some species and highly conserved in others. Cloning and functional analysis of *avrRxo1* from *Acidovorax avenae*, *A. citrulli*, *Burkholderia andropogonis*, *Xanthomonas translucens*, and *Xanthomonas euvesicatoria* showed that some AvrRxo1 homologs share the bacteriostatic and Rxo1-mediated cell death triggering activities of AvrRxo1 from *X. oryzae*. Additional distant putative homologs of *avrRxo1* and *arc1* were identified in genomic or metagenomic sequence of environmental bacteria with no known pathogenic role. One of these distant homologs was cloned from the filamentous soil bacterium *Cystobacter fuscus*. *avrRxo1* from *C. fuscus* caused watersoaking and triggered Rxo1-dependent cell collapse in *Nicotiana benthamiana*, but no growth suppression in *E. coli* was observed. This work confirms that a type III effector can function as a TA system toxin, and illustrates the potential of microbiome data to reveal new environmental origins or reservoirs of pathogen virulence factors.

Zhang, Yanyan, **Joseph J. Pignatello,*** and Shu Tao,* Bioaccessibility of Nitro- and Oxy-PAHs in Fuel Soot Assessed by an in vitro Digestive Model with Absorptive Sink; Environmental Pollution, (2016); doi:10.1016/j.envpol.2016.08.021

Abstract: Ingestion of soot present in soil or other environmental particles is expected to be an important route of exposure to nitro and oxygenated derivatives of polycyclic aromatic hydrocarbons (PAHs). We measured the apparent bioaccessibility (Bapp) of native concentrations of 1-nitropyrene (1N-PYR), 9-fluorenone (9FLO), anthracene-9,10-dione (ATQ), benzo[a]anthracene-7,12-dione (BaAQ), and benzo[*a*]anthrone (BZO) in a composite fuel soot sample using a previously-developed in vitro human gastrointestinal model that includes silicone sheet as a third-phase absorptive sink. Along with Bapp, we determined the 24-h sheet-digestive fluid partition coefficient (K_{s,24h}), the soot residue-fluid distribution ratio of the labile sorbed fraction after digestion (K_{r,lab}), and the maximum possible (limiting) bioaccessibil-

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ity, Blim. The Bapp of PAH derivatives was positively affected by the presence of the sheet due to mass-action removal of the sorbed compounds. In all cases Bapp increased with imposition of fed conditions. The enhancement of Bapp under fed conditions is due to increasingly favorable mass transfer of target compounds from soot to fluid (increasing bile acid concentration, or adding food lipids) or transfer from fluid to sheet (by raising small intestinal pH). Food lipids may also enhance Bapp by mobilizing contaminants from nonlabile to labile states of the soot. Compared to the parent PAH, the derivatives had larger $K_{r,lab}$, despite having lower partition coefficients to various hydrophobic reference phases including silicone sheet. The Blim of the derivatives under the default conditions of the model ranged from 65.5% to 34.4%, in the order, 1N-PYR > ATQ > 9FLO > BZO > BaAQ, with no significant correlation with hydrophobic parameters, nor consistent relationship with Blim of the parent PAH. Consistent with earlier experiments on a wider range of PAHs, the results suggest that a major determinant of bioaccessibility is the distribution of chemical between nonlabile and labile states in the original solid.

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JOURNAL ARTICLES APPROVED JULY 2016

Brackney, Douglas E. and Philip M. Armstrong. Transmission and evolution of tick-borne viruses. *Current Opinion in Virology*

Cheah, Carole A. S-J. HWA winter mortality in Connecticut & implications for management and control. *CAES Fact Sheet*

Mukherjee, Arnab, Joseph Hawthorne, Jason C. White, and Jason W. Kelsey. Nanoparticle Ag co-exposure reduces the accumulation of weathered persistent pesticides by earthworms. *Environmental Toxicology and Chemistry*

Pasquali, F., C. Agrimonti, Luca Pagano, A. Zappettini, M. Villani, M. Marmiroli, Jason C. White, and N. Marmiroli. Nucleo-mitochondrial interaction in yeast in response to cadmium sulfide quantum dots. *Nanotoxicology*

Zhao, Qing, Chuanxin Ma, Jason C. White, Om Parkash Dhankher, Xuejiao Zhang, Siyu Zhang, and Baoshan Xing. Quantitative evaluation of multi-wall carbon nanotube uptake by *Arabidopsis thaliana* (L.) in the presence of small polar aromatic organic molecules. *Environmental Science & Technology*



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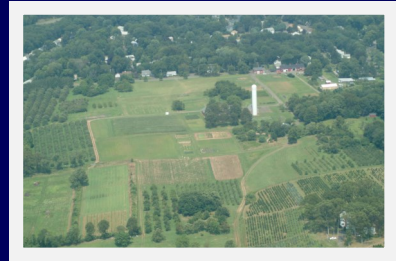
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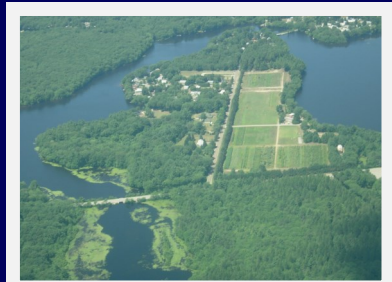
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Valley Laboratory, Windsor

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Volume 6 Issue 8
August 2016

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